Towards Generativity Epistemic Infrastructure: Standards, Protocols, and the Recording of Generative Trajectories

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Abstract

The proliferation of representations creates a practical difficulty for inquiry: a retained statement, an authentic source, an institutionally accepted classification, and a warranted account of reality can diverge. This paper develops an epistemic infrastructure response grounded in the Generative Relational research programme. The proposed object of standardization is the accountable recording, examination, presentation, contestation, and revision of generative trajectories, including their conditions, alternatives, contributions, and practical consequences. The argument distinguishes theoretical foundations, operational record roles, epistemic representation, evaluation, jurisprudence, governance, and technical implementation. It reconstructs a standards-development architecture and examines three experimental specifications for record graphs, coordinated transactions, and event-defined spacetime projections. A Git binding preserves accepted recording revisions, while explicit event relations define partial orders of represented occurrences. Predecessor-closed event selections determine the applicability of retained accounts and the resulting relational topology. The paper gives finite formal results for these constructions, analyzes failures involving conflicting chronology and uncertain scope, and follows a synthetic community inquiry through record creation, correction, and historical reconstruction. Source inspection, existing validation dossiers, and bounded re-executed software checks support engineering claims; institutional effectiveness and factual warrant require additional evidence. A comparison with established standards-development practices and provenance resources identifies potential interfaces without asserting equivalence or affiliation. The resulting contribution is an inspectable research and implementation architecture, accompanied by versioned documentary appendices, for developing standards that preserve the conditions of future recognition, reinterpretation, and practical continuation.

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Keywords: generativity; epistemic infrastructure; Generative Relational theory; provenance; standards development; record graphs; event partial orders; contestation; Git; institutional governance.

Publication and Evidence Statement

This research working draft presents the programme as it stands in the source corpus frozen for 30 September 2026. The associated governance and standards-track documents remain preparatory working drafts. GR-SPEC-120, GR-SPEC-121, and GR-SPEC-130 are experimental Specifications. Publication of the present paper carries no adoption decision and gives no institution a mandate to represent another constituency.

The main text distinguishes source interpretation, implemented behavior, finite mathematical results, synthetic demonstrations, and prospective evaluation. Documentary appendices reproduce earlier material under its original status. Their inclusion makes the argument inspectable; it does not reconfirm every external reference appearing in the historical documents. External works newly cited in the research text were checked online before drafting and are recorded in `refs/VERIFICATION_LEDGER.tsv`. Local manuscripts have a separate source classification and retain unresolved edition chronology.

The article layout follows the supplied *Knowledge-Capital Expansion in Modernity* template. The original template's documented TeX Gyre Termes fallback is used for compilation. Its earlier article content and licence notice are not transferred to this manuscript. Newly authored programme material follows the repository's MIT licence and contributor attribution; retained source notices and third-party rights keep their respective scope.

OpenAI's Codex assisted source examination, online reference verification, drafting, formal-example construction, and compilation. The author supplied the programme, philosophical orientation, implementation history, and task instructions. This version is prepared for the author's substantive review. The assistance and successful build do not establish independent scholarly review or the author's approval of every formulation.

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1 Symbolic Crisis and the Infrastructure of Inquiry

The organizing problem of generativity epistemic infrastructure is the relation between a represented situation and the practices through which that situation becomes recognizable, assessable, and actionable. The programme calls the contemporary instability of these relations a symbolic crisis. The term identifies a family of problems: abundant representations can coexist with weak access to their grounds; inherited categories can remain administratively effective after their descriptive adequacy changes; and apparently authoritative accounts can circulate more readily than the material needed to examine them. Chapter 1 of the supplied Generative Relational Economics manuscripts develops the related diagnosis of representational crisis in its treatment of symbolic abundance, classification, authenticity, and trust [8]. The present paper gives that diagnosis an operational interpretation.

The proposed response begins with a distinction among reality, manifestation, record, claim, assessment, and practical uptake. A social arrangement can exist before it acquires an official name. An observation can register only one aspect of that arrangement. A record can faithfully retain the observation while a later interpretation overstates its implications. An institution can then act on the interpretation. If the interpretation is corrected, the earlier action and its consequences can persist. Recording the final corrected statement alone would leave much of this trajectory unavailable for examination.

1.1 Generative trajectories as a recording object

A generative trajectory concerns changes in the conditions under which further distinctions, relations, capacities, and possibilities can develop. An output is one possible manifestation of that trajectory. A research project can produce a publication while also establishing a method, exhausting a community's willingness to cooperate, creating a reusable dataset, or closing an alternative line of inquiry. These effects can differ in timing, evidential support, and value for affected parties. A useful record therefore connects outputs with the processes and relations through which their significance is assessed.

The word generativity carries an explicit evaluative caution. Expanded capacity can support beneficial activity, coercion, or destructive action. Preserving a generative history supplies material for evaluation; it does not classify that history as good. The programme accordingly retains the perspective, boundary, horizon, and criteria of an evaluation. Competing assessments can remain separately identifiable when agreement is unavailable or when different constituencies ask different questions.

1.2 Research objective and contributions

The research objective is to determine a coherent boundary for standardization and to demonstrate selected technical mechanisms within that boundary. The paper contributes a multilayer architecture linking conceptual sources to recording requirements; a procedural account of standards development and publication authority; an experimental graph, transaction, and temporal protocol; a finite analysis of the semantics of event cuts and retained applicability; and a worked implementation account with explicit evidence limits. The documentary appendices preserve the sources from which the account can be reconstructed.

The central design commitment is warranted revisability. A record should support later examination of the grounds of a claim, the relations it describes, the alternatives retained or excluded, and the consequences of its use. This commitment does not imply exhaustive capture. Collection has costs, and some material requires restriction or disposal. The proposed infrastructure makes the boundary of a record and the consequences of that boundary examinable.

1.3 Scope of the present intervention

The implemented protocol is narrower than the programme's institutional ambitions. It supports private project workspaces, attributed records, independently identified Relations, attached material, atomic revisions, historical inspection, and event-defined topology. It does not supply a tribunal, an independently

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authenticated evidence service, a general theory of causal discovery, or a complete privacy regime. The standards-track drafts address broader obligations whose implementation can involve people, organizational procedures, and domain-specific judgment.

The two levels are evaluated separately. A successful software transaction can preserve an account without establishing its truth. A clear proposed review procedure can be drafted before a competent institution is available to operate it. The paper treats each as a contribution with a specified subject and an appropriate evidential burden. Sections 2–5 establish the interpretive and architectural basis; Sections 6–10 develop procedure and representation; and Sections 11–17 address use, implementation, evaluation, and institutional development.

2 Source Corpus and Research Method

The method combines interpretive reconstruction, specification analysis, finite formal reasoning, source inspection, and bounded software verification. Each method answers a different question. Manuscript interpretation establishes the conceptual distinctions the programme seeks to preserve. Specification analysis examines the commitments made by a representation or operation. Formal reasoning identifies consequences under stated assumptions. Executed checks examine selected implementation behavior. None of these methods alone measures public trust, institutional legitimacy, or the effectiveness of an educational or policy intervention.

2.1 Corpus boundaries and version control

The foundation corpus contains seven supplied PDFs: GRE Chapters 1, 4, and 5; two separately retained Chapter 3 files; and the two metamodel papers. The programme manifest assigns stable FM identifiers to these copies. The two Chapter 3 files have related but differing content. The unqualified filename contains a dedicated discussion of access to generative capacities and conditions, while the file marked complete first draft retains an earlier organization of the problem families [9, 10]. The filename alone supplies no verified supersession decision. The paper cites the particular source relevant to each argument and preserves both in the documentary corpus.

The operational corpus comprises the Programme Brief, publication taxonomy, governance drafts, standards-track drafts, experimental Specifications, architecture decisions, planning records, examples, and validation dossiers. The nine-document version 0.3 package contains 754 requirement identifiers. Its preceding version 0.2 supplied the fixed 753-identifier baseline for the recorded review cycle. The two totals refer to different editions and different tasks. A review inventory is also distinct from the number of fields a user must complete in an ordinary record.

The software corpus includes the common Python record protocol and Git store, the generalized web application, and the independently retained academia application. The learning handoff belongs to a separate companion inquiry. Shared motivation does not establish shared serialization or completed interoperability among these systems. The paper identifies interfaces requiring additional work rather than describing source proximity as protocol compatibility.

2.2 Interpretive trace and operational selection

An operational proposal is traced through five stages: the source passage, the distinction at stake, the recording need, the candidate implementation, and the evidence capable of discriminating success from failure. For example, the distinction between a relation and evidence of that relation leads to separately attributed claims and material roles. It does not determine whether a software implementation should use a table, a nested object, or an independently identified assertion. Those choices require an architectural argument and a testable use case.

The existing foundation traceability map performs this translation for motivation, epistemic warrant, revision, praxis, identity, temporal history, and loss. The current paper reconstructs that work while

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Table 1: Evidence classes and their interpretive boundaries.

Evidence class	Supports	Additional evidence required
Foundation interpretation	A documented conceptual distinction	Historical precedence, exhaustive theory, empirical generalization
Draft requirement	A proposed obligation and assessment subject	Adoption and operational capacity
Experimental Specification	A precise implementable contract	Independent implementation and broader conformance
Finite construction	A conditional mathematical result	Adequacy of the selected social interpretation
Automated check	Behavior in the executed cases	Untested inputs, security, usability, and institutional effectiveness
Synthetic demonstration	Expressibility and an inspectable workflow	Real-world accuracy and practical outcomes

preserving its provisional status. The six record roles and the event-cut model are operational selections. Their usefulness can be assessed even while the programme retains ontological suspension concerning ultimate constituents of reality.

2.3 Evidence classes and reporting rules

Table 1 summarizes the evidence classes used throughout the paper. A claim about execution names the tested artifact and scope. A claim about a synthetic example concerns the stipulated example. A proposed institutional arrangement is evaluated as a proposal until there is evidence of actual participation, authority, and performance.

External literature was selected for specific interfaces: standards-development procedure, provenance, canonical serialization, event ordering, accessibility, and open-science policy. Bibliographic records and claim support were checked before their insertion into the research text. The review is targeted, rather than systematic or exhaustive. The verification ledger records access limits, including cases where only an authoritative bibliographic record was available. Historical references inside the reproduced programme documents are retained as historical text; their reproduction is a different act from newly endorsing them.

2.4 Reproducibility and interpretive accountability

The paper includes editable section sources, an explicit build process, frozen figures, source hashes, executed-check output, and a documentary inventory. Appendix A explains the appendix volumes and their scope. Appendix D gives reproduction commands and the distinction between a source archive and a running-service backup. These materials enable readers to challenge the account at a concrete point: a mistaken source interpretation, an overbroad requirement, a failing operation, or an unsupported practical inference.

3 Generative Relational Foundations and Operational Translation

The foundational task is to preserve conceptual distinctions while selecting representations suitable for recording. The supplied manuscripts approach change, structure, constraint, and difference as a minimal analytical vocabulary. They also examine richer categories used to describe social facts. These levels have different purposes. A mathematical carrier and an action on that carrier support conditional reasoning; a retained Event account carries attribution, a target description, epistemic qualifications, and a historical place within an inquiry.

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3.1 Ontological suspension and mediated manifestation

GRE Chapter 4 distinguishes ontological, relational, and manifestational registers [11]. The registers organize questions concerning reality and access to it. They do not prescribe mutually exclusive bins into which a database can place objects. An administrative form, for example, can be a material object, a manifestation of an institutional practice, and an intervention that changes future relations. The representation chosen for one inquiry need not exhaust these roles.

This architecture places epistemic mediation within the field of inquiry. Observers encounter traces under material, methodological, and institutional conditions. A surviving trace can be informative partly because of its production path, and misleading when the conditions of its production are misunderstood. The same visible absence can result from non-occurrence, failure to observe, prohibited reporting, selective retention, or destruction. These possibilities motivate explicit coverage and missingness descriptions.

GRE Chapter 5 expresses reconstruction through an admissible compatibility set conditioned on manifestations, evidence, circumstances, and auxiliary assumptions [12]. The construction leaves the relevant kind of compatibility open. The present protocol does not implement a universal solver for that set. It seeks to preserve enough of the grounds and alternatives for an assessor to reconstruct a domain-appropriate argument.

3.2 Metamodel structure and enriched social descriptions

Part I of the metamodel uses a carrier, a mechanism semigroup, an action, and a congruence to analyze changes in retained distinctions [13]. A fixed carrier and fixed equivalence provide a bounded mathematical setting. They do not account by themselves for unanticipated new distinctions or new kinds of state. The interpretation of a collapse also requires care: a mathematical loss of distinguishability does not automatically establish social harm.

Part II develops Entity, Relation, Event, Attribute, State, and Process as selected analytical categories [14]. Its explicit scope allows overlap and leaves exhaustiveness open. An entity criterion concerns reidentification across appearances. Relation incidence identifies participants in contextual roles. An event requires an occurrence criterion, rather than merely a difference between endpoints. A state description has a declared sufficiency question, and a process preserves a history whose intermediate structure can matter even when final effects coincide.

The programme's operational role named Property remains terminologically distinct from the metamodel's Attribute until a scoped equivalence is justified. The present paper preserves that unresolved interface. It also avoids identifying a mechanism with a Process record or a formal state with a semantically articulated State account. A future formal semantics can map selected structures across these levels, but the mapping needs explicit assumptions and counterexamples.

3.3 Generativity, orientation, and practical continuation

The programme's generativity concern extends to the direction of inquiry and action. Conditions can make some questions salient, some collaborations possible, and some continuations difficult to sustain. Chapter 3 treats orientation through attention, curiosity, selection, institutions, and heterogeneous values [9]. A record concerned only with completed outputs can obscure these changes.

An operational account can preserve an enabling encounter, a condition that was maintained, a rejected alternative, a claimed contribution, and an unrealized possibility. Such records remain qualified accounts. A possibility described retrospectively may differ from an option actors could identify at the time. A contribution claim needs grounds connecting a relation to an effect within a declared horizon. A process that opened opportunities for one group may have constrained another. These distinctions guide record content and assessment without requiring a scalar generativity score.

Praxis adds consequences to the archive. Diagnosis, intervention, monitoring, revision, withdrawal, and repair can form iterative practical activity. The manuscripts leave room for different sequences and

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methods. Accordingly, the infrastructure supports links among these activities while preserving the authority and evidence associated with each. A recorded intention to repair a loss remains distinguishable from completed repair.

3.4 Translation obligations

Four obligations follow for the standards programme. First, a standardized record needs a declared purpose and boundary. Second, the information that makes an identity, relation, or temporal claim interpretable must remain associated with it. Third, a display needs to disclose the mediation introduced by selection, aggregation, and layout. Fourth, revision needs to preserve the difference between a change in the represented situation, a change in evidence or judgment, and a change in descriptive categories.

These are operational consequences argued from the sources. They remain open to revision where a domain case reveals excessive burden, missing distinctions, or a misleading interface. Their justification is stronger when a counterexample shows exactly what fails without them. A late-recorded early event, a corrected classification with continuing effects, and a relation with more than two participants supply such counterexamples in the later sections.

4 Interfaces with Standards Development and Provenance Resources

The external comparison identifies resources whose scope intersects the programme and specifies the boundary of each connection. The analysis concerns procedural and representational interfaces. It does not establish that the programme reproduces an existing standards body's authority or that its experimental schema implements a certified mapping.

4.1 Procedural models and publication authority

ISO identifies its Directives Part 1 with technical-work procedures and Part 2 with the structure and drafting of documents [16]. This separation offers a useful design principle: the process that authorizes a publication and the rules that make its clauses intelligible require distinct treatment. The programme adapts that separation through its own Charter and two Directives. Detailed numerical rules in the programme are project proposals, rather than assertions about current ISO voting rules.

IEEE describes a six-stage development lifecycle with organizational oversight [15]. The relevant lesson for the present proposal is that drafting, balloting, approval, and maintenance are distinguishable activities. A technically detailed document can remain a draft while participation and review capacity are being established. The programme therefore records publication status independently of implementation maturity.

UN-system instruments have differing functions. ITU-T Recommendations address technical operation and interworking [17]. UNESCO's Recommendation on Open Science addresses policy, infrastructure, participation, and monitoring [23]. The programme can learn from both while distinguishing a technical contract from a recommendatory institutional proposal. There is no single UN format whose visual reproduction supplies institutional standing.

4.2 Provenance and attributed generation

PROV-DM supplies an extensible model of entities, activities, agents, derivation, responsibility, and related provenance structures [21]. PROV-O expresses the model through an ontology suitable for RDF use [20]. These resources are relevant to the production and transformation of records. A prospective export might identify a retained record revision as an entity, a recording operation as an activity, and an accountable recording role as an agent. That mapping would concern the recording process. A represented social event would require a separate mapping decision.

The programme adds questions that a provenance link alone leaves open: the claim for which material is relevant, the grounds of its evidential role, competing interpretations, the practical uptake of a

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classification, and the consequences of correction. These questions are compatible with provenance modeling but require additional vocabulary and assessment. A future mapping needs round-trip fixtures for qualification, scope, identity, and lost information. Until such fixtures and independent implementations exist, the relation remains a proposed interface.

4.3 Canonical serialization and conditional publication

RFC 8785 defines a canonical JSON representation under specified constraints [22]. The experimental transaction binding uses that representation when computing a digest of the logical request and verified file metadata. The digest helps distinguish an identical retry from conflicting reuse of a transaction identifier. It supplies neither a signature nor an evidential verdict.

JSON Schema Draft 2020-12 provides the structural vocabulary used by the distributed schema [18]. Cross-record references, resulting-snapshot conditions, and supported module behavior also require semantic checks. Git's conditional reference update supports the publication step of the binding: an accepted branch is advanced only if its previous object identifier matches the expected value [7]. These mechanisms have a concrete engineering role while leaving authorization, institutional responsibility, and retention policy to other layers.

4.4 Event ordering and temporal interpretation

Lamport's account of distributed-system events distinguishes a partial order from total orders constructed for coordination [19]. The comparison is useful for the present design because a display sequence can add order that the source does not establish. The programme's event relations have a different evidential origin: users retain attributed assertions concerning represented occurrences. A communication-based happened-before relation is therefore not imported as a definition of social chronology.

The experimental model uses explicit precedence and predecessor-closed event selections. It does not interpret incomparable events as simultaneous, infer physical duration from graph rank, or execute event transformations to calculate social outcomes. These limits define a tractable topology projection and leave richer interval, causal, and scenario semantics for subsequent work.

4.5 Assessment of the comparison

The comparison locates reusable mechanisms and separates them from the programme's distinctive integration problem. The contribution is the coordinated treatment of epistemic grounds, generative trajectories, revision history, practical response, and publication governance in one inspectable programme. Establishing priority over the wider literature would require a broader review. The present claim is that this particular architecture and its experimental realization can be examined, reproduced, and criticized through the supplied artifacts.

5 Multilayer Architecture and Publication Portfolio

The architectural task is to assign each claim and responsibility to a level at which it can be meaningfully examined. The programme distinguishes theoretical foundations, an operational record ontology, epistemic representation, normative evaluation, jurisprudential status, institutional governance, political economy, and technical realization. The layers interact. Their distinction prevents a result at one layer from silently acquiring authority at another.

5.1 Layer responsibilities

A record that an event occurred concerns a target-level representation. An observer's report of that occurrence introduces source attribution and a method of access. An assessment that the event was unjust

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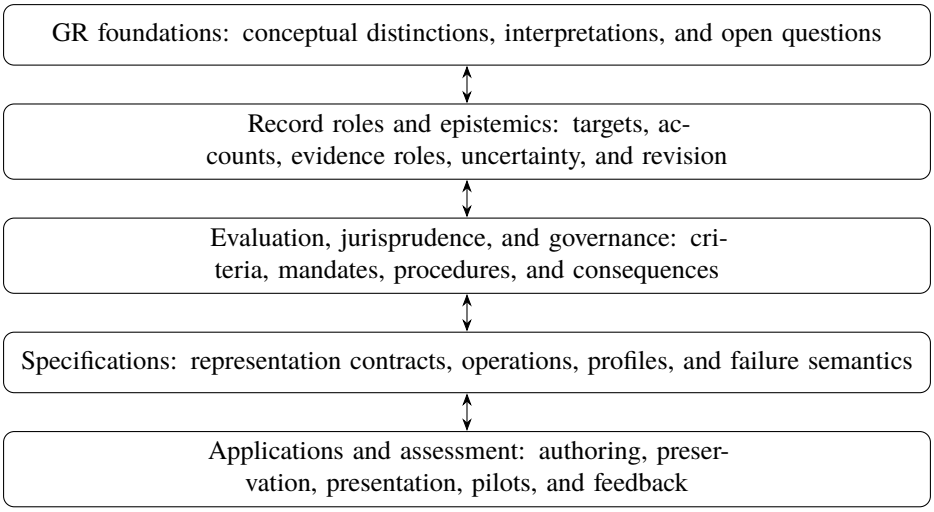

Figure 1: Interacting responsibilities in the programme. Arrows denote design feedback and interpretation, not logical entailment or delegated legal authority. Political-economic questions concerning access, ownership, cost, and participation apply across the arrangement.

applies an evaluative criterion. A claim that a legal duty was violated introduces a jurisdiction, authority, and procedural setting. A retention decision adds institutional responsibility. A JSON serialization supplies an implementation form. Each can be linked to the others while preserving its own grounds.

Figure 1 presents the architecture as connected responsibilities. The vertical arrangement is explanatory, rather than a hierarchy in which a technical layer proves an upper layer. Normative evaluation can question the purposes of collection, while implementation constraints can reveal that a proposed procedure is too costly or discloses more than its purpose warrants.

5.2 Standards-track projects and supporting Specifications

The portfolio begins with GR-100 vocabulary and GR-110 recording requirements. GR-200 concerns epistemic recording, while GR-210 concerns evidence, interpretation, contestation, and disposition. The technical and organizational complement includes information-model requirements, interchange, presentation, conformance, preservation, jurisprudential interfaces, procedural profiles, and institutional use. Some projects have substantive drafts; others remain work items or preliminary scope statements. Their identifiers preserve planning continuity without asserting equal maturity.

GR-SPEC-120 supplies the experimental record graph and module representation. GR-SPEC-130 specifies coordinated transactions and a Git binding. GR-SPEC-121 adds event precedence, temporal extent, and a declared spacetime projection. Their ordering in the portfolio reflects dependencies, rather than a claim that every underlying standard is already adopted. The development pattern begins with a normative problem, identifies a reusable infrastructure need, develops a Specification, tests it in a bounded pilot, and returns findings to the standards-track draft.

5.3 Publication classes and conformance subjects

A Standard is an edition adopted through the programme's operative procedure. A Specification can contain precise requirements while retaining experimental status. A Technical Report develops analysis that may remain exploratory. A manual guides practice. A policy proposal recommends institutional arrangements. A research paper argues for and examines the programme; it supplies no additional conformance authority merely by collecting the documents.

The subject of conformance also needs a declared boundary. A document package can retain the information required for an assessment. A recording practice can be assessed over an actual interval

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of activity. A review procedure can be assessed through the handling of cases. A software component can satisfy a specified operation contract. These subjects can be related without being substituted for one another. A parser cannot demonstrate that an affected person obtained meaningful review, and a completed review cannot establish that an export preserves every field.

5.4 Profiles and proportionality

Profiles are a candidate means of relating broad requirements to particular tasks. A research-notebook profile, a community inquiry profile, and an institutional review profile can share identity and revision mechanisms while differing in information sensitivity, evidential expectations, and participant roles. A useful profile identifies inherited obligations, conditional triggers, permitted simplifications, additional requirements, and the exact claim that an assessment supports.

Proportionality concerns retained distinctions as well as volume. A short attributed narrative can sometimes preserve uncertainty better than an extensive form with mandatory confidence scores. Conversely, a consequential institutional determination may require detailed grounds and a review route. The proposed test of adequacy is whether a record supports its declared questions while exposing material omissions, at a burden that participants and custodians can sustain. Selecting those questions remains a substantive institutional and ethical decision.

6 Governance of Standards Development

The governance layer specifies the conditions under which a draft can acquire programme authority. Its purpose is to make the development process itself inspectable: participation, objections, revisions, delegated powers, resource limits, and publication decisions become part of a retained trajectory. The current Charter and Directives are preparatory proposals. Their detailed form does not supply the actual authority or independent review capacity required for adoption [1].

6.1 Founding authority and representation

The proposed founding instrument identifies actual signatories, the resources and decisions over which they have authority, the exact governance editions accepted, their commitments, appointments, and effective conditions. It distinguishes control of a repository from a mandate to represent a profession, country, or community. This distinction matters because an infrastructure can become influential before its governance is broadly representative.

The Charter reserves consequential decisions such as governance amendment, committee mandates, formal work-item initiation, and Standard adoption. Operational duties can be delegated under an explicit scope. A delegation records who can perform an action, under which limits, with what reporting and succession arrangements. Merely naming a committee or assigning an acronym does not demonstrate that competent participants have accepted the responsibility.

6.2 Participation, consensus, and review

Participation needs an intelligible route into the process, accessible material, proportionate preparation costs, and a means of raising relevant objections. The programme's drafts distinguish consideration of concerns from numerical ballot success. A ballot can provide evidence for a decision while leaving substantive objections unresolved. Silence can arise from agreement, exclusion, lack of time, or inability to obtain the source material.

The proposed public-review record links each comment to its disposition, reason, affected text, and reply opportunity. Material changes receive further consideration under the applicable procedure. A neutral procedural reviewer needs actual separation from the contested decision and capacity to perform the task. If the function is unavailable, the limitation affects what the programme can claim about the review. Research and preparatory drafting can continue within their own authority.

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This structure is particularly important for a programme concerned with recognition. A process that records objections but systematically prevents them from affecting decisions would produce an impressive archive with weak practical accountability. Future assessment therefore needs evidence of consideration, response, and the consequences of accepted criticism. Comment counts and meeting attendance are insufficient proxies.

6.3 Work-item progression and maintenance

The proposed lifecycle distinguishes preliminary work, proposal, working draft, committee draft, public review, final approval, published Standard, and later review or withdrawal. Each progression has an accountable decision and a defined evidence requirement. A new work-item proposal states the problem, scope, affected interests, relation to existing work, anticipated deliverables, and capacity required. The publication class is selected according to the work's function and maturity.

Maintenance preserves the history of changed requirements. Editorial correction, substantive revision, interpretation, confirmation, and withdrawal have differing effects on users. A conforming implementation can depend on a dated edition; a later edition should not silently change the meaning of its earlier assessment. Withdrawal similarly changes the current status of a publication while leaving its historical use intelligible.

6.4 Ethics, contribution rights, and conflicts

The draft ethics and intellectual-property policy addresses contribution provenance, rights to circulate material, conflicts of interest, confidentiality, and protection of participants. Disclosure of a conflict supplies information for management; it does not by itself supply independent handling. A funding agreement can support infrastructure while also shaping priorities. The governance record therefore needs to expose relevant dependencies and the authority to change or terminate them.

Repository licensing and standards governance have separate functions. The project owner's MIT grant permits reuse of project-authored material within its stated scope. It does not adopt the Charter, authorize use of an external organization's name, or clear third-party material. An implementer can reuse the code while still needing to identify the profile and evidence supporting a particular conformance claim.

6.5 Governance as an object of pilot inquiry

The existing synthetic governance rehearsal exercises ballot arithmetic and procedural cases. Its 18 executed arithmetic cases are useful for checking a bounded rule calculation. They do not demonstrate that a real committee can recruit balanced participation or sustain neutral appeals. A future rehearsal should follow an actual proposal from notice through disposition, including a material objection and a revision, while measuring preparation effort, delays, accessibility, and unresolved interests.

The programme's own history is an appropriate first source for such examination. Changes from the initial outlines to detailed drafts, validation-driven corrections, and implementation-induced questions can be retained with their alternatives and reasons. This reflexive use avoids presenting governance as an external checklist imposed after technical development. It also exposes a difficult possibility: the proposed process may need simplification or additional resources before it can function as intended.

7 Record Graphs, Identity, and Modules

The experimental information model represents a project as a versioned collection of retained accounts. Its design goal is to permit inspectable relations among records while separating represented-target identity, record identity, recording ancestry, and layout. GR-SPEC-120 supplies the contract examined in this section [3].

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Table 2: Operational role emphases and discriminating boundary cases.

Role	Recording emphasis	Boundary requiring qualification
Entity	A subject identified across relevant appearances	Same label with disputed continuity
State	An account of conditions under a declared scope	Current accuracy with insufficient history for a later query
Event	An identified occurrence or qualified occurrence claim	Repeated acts with the same endpoint
Process	A temporally articulated course of activity	Similar output reached through different histories
Relation	Participants and contextual roles in a retained account	Partial, higher-order, or contested participation
Property	An attributed characteristic with interpretation	Unknown, inapplicable, or differently scaled values

7.1 Record roles and account qualification

A record has a stable identifier, title, content, primary presentation role, a nonempty set of applied roles, epistemic mode, modality, disposition, modules, and recording attribution. The six roles are Entity, State, Event, Process, Relation, and Property. Role sets can overlap. Their implementation does not turn the roles into an exhaustive metaphysical partition.

The qualification fields answer separate questions. An account can be reported rather than directly observed, concern an intended rather than realized activity, and be contested rather than unreviewed. These combinations are meaningful. An inferred possibility is not necessarily a failed observation, and a contested report is not automatically false. Descriptive grounds provide further method, source attribution, uncertainty, alternatives, conditions, and consequences. Empty text records an omission from that field, rather than substantive absence.

Table 2 gives the operational emphasis of each role and a boundary case. The table summarizes the programme; detailed admissibility and sufficiency remain subjects of the associated drafts.

7.2 Record identity and continuity judgments

A UUID identifies the retained representation within the profile's reference boundary. It does not prove that two appearances concern one continuing social entity. Continuity can depend on a legal rule, organizational practice, historical reconstruction, or a chosen analytical criterion. A merger, split, renamed institution, and unchanged name after replacement supply distinct cases. The record can preserve a continuity claim and its basis while keeping alternatives inspectable.

The initial reference boundary is one project snapshot. A reference resolves to a retained record in that snapshot. This restriction simplifies historical consistency and authorization. It also limits cross-project scholarship and federation. A future external-reference profile would need source version, availability, access, collision, and identity rules; copying a UUID alone would leave those questions unresolved.

7.3 Relations as independently identified accounts

A structured Relation is an ordinary record carrying a supported relation module. Each participant incidence has its own identifier, referenced record, descriptive role, scope, and orientation. The same participant can occupy multiple incidences, and a Relation can itself participate in another Relation. This incidence representation retains information that an unqualified binary edge could obscure.

For example, an arrangement can involve a residents' group, a stewardship team, and a garden, with different roles for permission, responsibility, and subject matter. A later account can qualify that arrangement or describe dependence on another relation. The relation's participant-completeness flag and

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limitation text are material: a visible three-node display can otherwise suggest that the account is complete when a participant is unknown or withheld.

The scope distinguishes reference to a record from reference to its represented target. A relation that challenges a description concerns the retained account. A relation describing cooperation concerns represented participants under the account's identification assumptions. Orientation specifies incidence direction for the projection; it does not assign causality. Neutral related-record links remain separate from typed structured relations.

7.4 Versioned modules and conservative extension

A module is a namespaced, versioned component with a required-support declaration. Supported modules include notes, files, relations, event order, and temporal extent. Unknown optional content is retained as opaque data. Unknown required content can prevent a mutation when its constraints cannot be evaluated. This distinction allows extension while avoiding a claim that an implementation has checked semantics it cannot interpret.

Modules are declarative. Their contents do not install executable code or provide arbitrary server paths. The profile bounds module size, record count, operations, file count, and binary size. These are implementation capacity decisions, not properties of GR theory. Increasing them requires new capacity evidence and does not change the conceptual role of a record.

7.5 Material descriptors and graph projections

A file descriptor identifies an acquisition or attachment account separately from its bytes. SHA-256 identifies the retained content; descriptor identity, name, custody attribution, and time supply additional context. Several descriptors can point to identical bytes without supplying independent corroboration. Replacement retains the descriptor while changing its content reference in a new revision. Detachment changes the current link and leaves historical retention subject to the storage binding.

The canonical incidence projection exposes retained records as selectable nodes and participant incidences as edges with their role, scope, orientation, and owning Relation. A historical projection is computed from one source revision. Current titles or modules cannot silently substitute for earlier content. Filtering and layout are additional transformations whose boundaries need disclosure. The graph can therefore support navigation and examination while leaving substantive truth and evidential weight to declared assessments.

8 Claims, Evidence Roles, and Revisable Judgment

The epistemic architecture addresses the grounds on which a retained representation can be used. GR-200 develops the information needed to examine claims, while GR-210 concerns practices of assessment and contestation. The experimental record envelope implements only a bounded part of this wider architecture. A field labeled evidence is a starting affordance; richer material, evidence-role, assessment, and dependency structures remain implementation work.

8.1 Claim boundaries and attributed content

An epistemic package declares its purpose, included claims, collection boundary, responsible role, descriptive regime, and access scope. A source stored in the package does not automatically make every sentence in that source an endorsed claim. The package distinguishes retaining a document, asserting that the document contains a statement, and adopting the statement as a substantive account. This prevents citation and storage from becoming unnoticed mechanisms of endorsement.

A claim reference identifies a formulation and version. It can be local to a narrative dossier and need not be a globally registered software object. Shared method or acquisition context can be referenced by several claims where its applicability is explicit. Exceptions remain associated with the affected claim.

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This approach supports proportionate recording without hiding material differences behind a package-wide declaration.

8.2 Evidence as a relation to a claim

A material item can support, challenge, qualify, or fail to discriminate among claims. Its role depends on the inferential target and the conditions of production and preservation. A meeting attendance sheet may support a claim that names were entered. It may provide weaker grounds for counting distinct people who actually participated. Duplicate entries, partial attendance, and retrospective completion can change its use.

An evidence-role assignment therefore identifies the material, claim version, assessor, relevance, limitations, and alternatives. Authenticity and custody can strengthen confidence in what was retained while leaving the substantive inference open. Several documents copied from one source do not become independent evidence because they have different filenames. A generated summary may preserve a useful interpretation while requiring a separate check of its dependence on the underlying material.

8.3 Uncertainty and missingness

Uncertainty can concern target identity, occurrence, measurement, ordering, attribution, scope, or the implications of an intervention. A single numerical confidence field can obscure these differences. Where a quantity is used, the record needs to identify what it measures and the assumptions supporting comparison. The architecture also allows qualitative qualifications when a probability would imply unsupported precision.

Missingness needs an account of the observation and preservation process. Unknown, not collected, withheld, lost, and inapplicable have different consequences. Negative evidence is especially sensitive to that process: absence of a complaint has different force when reporting was accessible, dangerous, or unrecorded. A package can retain a bounded negative-evidence argument, but an empty field supplies no such argument by itself.

8.4 Three dimensions of revision

The programme distinguishes changes in the target situation, changes in evidence or interpretation, and changes in the categories or methods used to describe the situation. The dimensions can coexist in one revision. A new observation can reveal a prior error while an intervention changes the target and a new classification changes the terms of assessment.

Keeping these dimensions visible supports two historical questions: what could reasonably be known at a prior stage, and what can now be said about that stage. The questions can have different answers. A later discovery need not establish that earlier actors ignored available evidence. Conversely, a correction does not erase the practical effects of an earlier classification. The record links revisions to prior formulations, grounds, affected dependencies, and consequential uses.

8.5 Contestation and practical uptake

Contestation requires more than a status flag. An affected actor needs an intelligible route to identify the challenged claim, submit relevant grounds, receive a response, and understand the disposition within the available procedure. The route can involve protected evidence and independent review rather than unrestricted publication. Recording restrictions needs to expose their effect on inspectability without disclosing the protected content.

Practical uptake deserves its own record. A classification can affect access, allocation, participation, or a future opportunity. A corrected description can therefore require a changed decision, notice to downstream users, or a separate remedy. The present architecture keeps the assertion, assessment, decision,

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execution, and verification of an action distinguishable. Their connection is essential to an infrastructure concerned with praxis as well as archives.

8.6 Generative attribution

A claim that an encounter or relation generated a later capacity needs a target effect, boundary, horizon, proposed contribution, and examination of alternatives. Temporal precedence is one possible component of that inquiry. It does not determine the contribution by itself. Likewise, a recorded unrealized alternative can help reconstruct selection without proving that the alternative was feasible.

The proposed standardization task is to preserve the information required to examine such attributions under appropriate methods. Historical, qualitative, experimental, computational, and formal inquiry can contribute different evidence. The infrastructure supports traceable disagreement about their interpretation. It does not make one method universally adequate for every generative claim.

9 Coordinated Transactions and the Git Recording Binding

The transaction layer preserves coordinated changes to records, modules, and material under a declared base revision. Its purpose is to prevent a graph or attachment account from becoming partly accepted when one of its dependent changes fails. GR-SPEC-130 defines the experimental contract, including publication, receipt recovery, historical reads, and export boundaries [5].

9.1 Transaction subject and validation sequence

A logical request contains a protocol identifier, transaction UUID, expected head, reason, change categories, and operations. The operation set covers record creation and update, module changes, attachment operations, and explicit legacy migration. The authenticated application supplies recording identity and time separately from source attribution entered in the account.

Validation examines the complete proposed result. Two records created in the same transaction can refer to each other if the final candidate is valid. Sequentially publishing each operation would create an unnecessary intermediate dangling reference and could leave a partial result. Conversely, repeated mutations of one guarded resource can be ambiguous. The profile rejects those cases rather than assigning implicit last-write-wins meaning to operation order.

The pure protocol package prepares a candidate and receipt without accessing a database, Git repository, or web framework. The application checks authorization and actual uploaded bytes. The Git adapter verifies storage closure, bounds resource use, constructs objects, and conditionally publishes one accepted revision. This separation exposes which component is responsible when a check fails.

9.2 Material closure and byte identity

An attachment request declares a part name, descriptor identity, owning record, filename, media type, length, and digest. The supplied part inventory must match the declared operations. Actual byte length and SHA-256 are checked before publication. The bytes written to storage are the same bounded bytes that were checked; validating a pathname and later rereading changed content would break this guarantee.

Each understood file descriptor in the candidate has a corresponding retained asset of the declared identity and size. The adapter refuses undeclared incoming material and incomplete understood closure. Filenames remain descriptive metadata, and media types do not authorize execution. Unsupported modules can limit what the implementation knows about dependencies; an export consequently cannot claim complete recovery of material whose module semantics remain opaque.

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9.3 Publication and conditional advancement

The initial binding uses one application-managed bare Git repository per project and one accepted branch. The tree retains a project manifest, record files, content-addressed assets, a protocol manifest, and transaction receipts. These project repositories differ from the four source-code repositories used to distribute the programme and its applications.

The adapter prepares affected trees and a candidate commit, then advances the accepted reference only if its current value equals the expected parent. The logical publication condition is given in Equation 1. Here H is the accepted head at the comparison point, h is the request's expected head, and c is the fully prepared candidate whose parent is h.

$$\text{publish}(H, h, c) = \begin{cases} c, & H = h \text{ and the candidate has passed the binding checks,} \\ H, & \text{otherwise.} \end{cases} \tag{1}$$

Equation 1 describes the accepted-reference transition. Failed preparation can leave unreachable Git objects, but ordinary reads do not treat those objects as accepted history. The binding checks reachability when resolving a requested revision, so a dangling candidate cannot be used as an accepted snapshot merely because its object identifier is known.

Git supports more general branching histories. The current application chooses a linear accepted branch with conflict reporting. A semantic merge of competing social accounts would require an explicit policy for identity, qualification, modules, evidence, and action dependencies. The existence of a Git merge operation supplies no such policy.

9.4 Receipts, retries, and uncertain responses

The request digest is computed from canonicalized logical transaction content and verified file-part metadata. Multipart framing and server-assigned recording time do not determine request identity. A committed receipt includes the original base, actor, reason, change categories, digest, changed-resource summaries, and validation scope. It is stored in the same accepted tree as the effects.

The receipt cannot contain the resulting commit identifier without introducing a self-reference into the content that determines that identifier. The response instead resolves the commit that introduced the receipt path and distinguishes it from the currently observed head. A retry with the same transaction identifier, actor, and logical digest returns the original result. Reusing an identifier for different content or another actor is a conflict.

Receipt lookup precedes rejection based solely on an old base. Otherwise, a client whose first response was lost could be told to reconcile a transaction that had already succeeded. After a publication race, the application checks for an identical committed request before treating the race as an unrelated conflict. A timeout remains an uncertain response until recovery establishes the outcome; it does not prove that no publication occurred.

The guarantee concerns accepted project effects within the binding. It does not promise exactly-once notifications, institutional action, or external file transfer. An administrator with repository access can rewrite or remove history. The current SHA-1 Git object format and SHA-256 asset digests do not provide independent identity authentication, external timestamps, or preservation against that administrator.

9.5 Historical reads and export scope

A read pins one accepted revision and obtains the manifest, selected records, labels, modules, and file descriptors from that snapshot. Historical views remain read-only in the interface. The application separately checks present authorization to inspect that historical content. An object digest or commit identifier is a locator, not a permission token.

Snapshot JSON exports record representations without file bytes or full history. A snapshot ZIP includes understood referenced material at the selected revision. A Git bundle preserves the accepted reachable history, including earlier replaced or detached material and receipts. None of these exports

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alone restores accounts, sessions, or application authorization configuration. The distinction between source preservation and service recovery is therefore part of the export contract.

10 Event Partial Orders and Relational Spacetime

The spacetime construction represents relational topology under an explicitly selected event boundary. Space denotes the organization of applicable accounts and their incidences. Time is supplied by retained precedence relations among Event records. Geographic coordinates can be described through appropriate State or Property accounts, but visual layout coordinates have no geographic interpretation by default. GR-SPEC-121 implements this bounded construction [4].

10.1 Recording revision and represented event order

Let S_h be a project snapshot at accepted recording revision h. Its Event-role records form a finite set E_h. Supported non-withdrawn event-order modules supply a set A_h of directed endpoint pairs. Order accounts retain independent identity, attribution, modality, disposition, and grounds. Two accounts can assert the same pair while remaining distinct sources.

The current projection includes contested and non-realized order accounts with visible qualifications. It does not choose a preferred historical scenario. Withdrawn order accounts remain inspectable but do not constrain the active ordering. A future scenario-selection profile could select a declared subset; silently removing inconvenient assertions would change the epistemic meaning of the current projection.

When A_h is acyclic, its transitive closure defines a strict partial order $\prec_h$. Equation 2 specifies that order. A path has positive length, so an event is never its own predecessor in a consistent account.

$$e \prec_h f \quad \Longleftrightarrow \quad \text{there is a positive-length directed path from } e \text{ to } f \text{ in } (E_h, A_h). \tag{2}$$

Equation 2 derives order only from explicit event-order assertions. Git ancestry, recording timestamps, UUID sorting, free-text occurrence descriptions, and display rank do not add constraints. An early event can be entered after a later one without contradiction.

10.2 Cuts and selected boundaries

For a user-selected set $U \subseteq E_h$, the projection includes the selected events and their known predecessors. Equation 3 defines this closure and its frontier.

$$D_h(U) = U \cup \{e \in E_h : \exists u \in U, e \prec_h u\}, \qquad F_h(U) = \max_{\prec_h} D_h(U). \tag{3}$$

The result in Equation 3 is a down-set, or predecessor-closed cut. Its frontier is the set of maximal included events. An explicit empty selection yields the empty cut. An omitted selection in the binding denotes the all-event cut. The distinction is exposed in the response so that a missing parameter does not silently mean a different historical boundary.

Proposition 10.1 (Minimal predecessor closure)**.** *For a finite acyclic event account, $D_h(U)$ is the unique least down-set containing U. The closure operation is extensive, monotone, and idempotent.*

Proof. Every member of U is included. If x precedes a member of $D_h(U)$, then x either precedes a member of U directly or does so by transitivity; hence x is included. Any down-set containing U contains these predecessors and therefore contains $D_h(U)$. This proves minimality and uniqueness. Inclusion of larger selected sets can only add reachable predecessors, which proves monotonicity. Since the result already contains its predecessors, closing it again adds nothing. □

Proposition 10.1 justifies the interface's automatic addition of known predecessors. It does not identify a physical instant. Two incomparable events can both belong to a cut or one can be included while the other is excluded. Neither choice asserts that they occurred simultaneously or independently.

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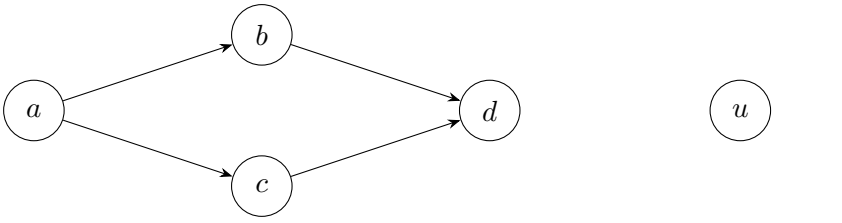

Figure 2: A synthetic event partial order. Arrows encode retained precedence accounts. Horizontal and vertical positions are layout choices with no duration or simultaneity semantics.

10.3 A branching example

Consider events a, b, c, d, u with asserted precedence $a \prec b$, $a \prec c$, $b \prec d$, and $c \prec d$. Event u has no asserted ordering. Selecting b yields $\{a, b\}$; selecting d yields $\{a, b, c, d\}$. The inclusion of c in the second cut follows from its asserted precedence to d, not from its display position.

Figure 2 depicts the example. Placing b and c on one visual level does not establish simultaneity. The same finite partial order permits linear extensions in which either event is first. Event u can occupy several places in an extension because the account supplies no relevant constraints. Appendix B gives additional cuts and contradictory cases.

10.4 Temporal applicability of retained accounts

A temporal-extent module describes a start, end, basis, and optional subject grouping. A boundary can reference an Event, be unknown, or be unbounded within the declared account scope. Absence of the module is a fourth condition, called unscoped. The distinctions are material: unbounded is an affirmative scope statement, while unknown is unresolved information.

Starts are inclusive and ends exclusive. When both bounds are events, supported strict start-before-end reachability is required for determinate interpretation. An equal, reversed, or incomparable pair is diagnosed as indeterminate; the extent itself does not add an ordering assertion. Unknown on either side remains indeterminate under this conservative profile, even where one known boundary would permit a narrower partial conclusion.

For a non-withdrawn account r with supported, determinate bounds, let s_r and t_r denote its start and end. The symbols $-\infty$ and $+\infty$ in Equation 4 are notation for the profile's scoped unbounded declarations, rather than claims of physical eternity.

$$\text{active}_h(r, D) = \big(s_r = -\infty \ \vee \ s_r \in D\big) \wedge \big(t_r = +\infty \ \vee \ t_r \notin D\big). \tag{4}$$

Equation 4 applies only after eligibility and uncertainty checks. The complete classification order is withdrawn, unsupported or unscoped, unusable order or invalid bounds, unknown bounds, not started, ended, and active. Unknown and unscoped accounts remain inspectable outside the default active topology. Their omission provides no evidence that their targets were absent.

10.5 Topology and trajectories

The topology at a cut retains active record nodes from the canonical incidence graph and only edges whose endpoints are active. A Relation node can remain active while one participant lacks determinate applicability. The projection then retains the Relation and reports partial incidence, identifying omitted participant entries. Removing the Relation entirely would conceal an active account; retaining every incidence would invent applicability for an uncertain participant.

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Subject trajectories group records through an explicit subject reference and stated continuity basis. They can display successive, overlapping, or competing State and Relation accounts. Grouping does not select one account as true, infer identity from a shared label, or calculate event effects. A transformation semantics would require additional operations, commutation assumptions, and evidence about how recorded events change targets.

Proposition 10.2 (Revision-pinned projection)**.** *For a fixed snapshot, supported projection version, and selected event set, a deterministic projection returns the same order, cut, and applicability classifications independently of the order in which the corresponding records were entered.*

Proof. The event relation is a function of retained order-module content in the fixed snapshot. The cut is a function of that relation and the selection. Applicability is a function of the resulting cut and retained extent modules. Recording sequence is absent from these inputs. Thus permutations of entry history that leave the snapshot inputs unchanged leave these results unchanged. □

Proposition 10.2 concerns the specified inputs. A different snapshot can contain corrected bounds, withdrawn orders, or changed qualifications and legitimately yield a different projection. The result also does not promise identical force-layout pixels under different display engines.

10.6 Contradictions and unsupported semantics

A cycle prevents the active order from defining the required strict partial order. The implementation retains the assertions, identifies involved events and order accounts, and returns null cuts and topology. It does not erase the conflict to construct a convenient timeline. Unsupported retained event-order versions likewise prevent a claim of complete temporal interpretation. An unsupported extent affects the corresponding account's applicability without necessarily invalidating an otherwise understood event order.

These behaviors make representational failure visible. A user can inspect the ordinary graph, review the grounds, and withdraw or revise a mistaken order in a new recording revision. The historical contradiction remains available. The combination of retained conflict and revision-pinned projection supports epistemic reconstruction while preserving the difference between correcting an account and changing the past.

11 Contestation, Institutional Action, and Practical Repair

The praxis interface connects revised judgment with consequences for participants and institutions. Its analytical object is the trajectory from a claim's use to any later challenge, disposition, and practical response. A recording infrastructure can preserve each stage without having the authority to decide the case or execute a remedy. The programme consequently distinguishes an information contract from an institutional mandate.

11.1 A complete contestation episode

A consequential challenge begins with an identified target: an account, assessment, classification, decision, or procedure. Intake records the grounds supplied, the submitter's relevant capacity, access needs, protection constraints, and the requested examination. Admissibility determines whether the declared procedure can hear the issue. Refusal to admit a case is a procedural outcome and need not settle its substantive merits.

Assignment identifies a competent reviewer and relevant conflicts. Notice and response make the material grounds of a prospective decision accessible within protection limits. The assessment distinguishes evidence, criteria, assumptions, unresolved alternatives, and the scope of authority. A disposition records the questions actually decided, reasons, qualifications, and routes for further review. Each stage can fail or remain incomplete, and the record preserves that status.

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The proposed procedure allows protected handling. A witness may need restricted access, an intermediary, or a permitted summary. The existence of such protection can limit what an external reader can assess. The released view should expose the resulting limitation without treating secrecy as proof of either credibility or misconduct. A credible review route requires actual arrangements appropriate to the case.

11.2 Correction and downstream dependence

An incorrect field can influence several later decisions. Correcting its present value is only one part of the response. The institution needs to identify affected uses, determine which remain within its control, notify relevant recipients, and record attempted and completed changes. Uncontrolled copies may persist. A correction account should therefore state the reach and limits of its propagation.

Consider a synthetic participation record that counts eighteen entries as eighteen distinct people. A later review finds sixteen distinct attendees. The revised record can preserve the original ledger, explain duplicate entries, change the current count, and identify reports that used the earlier number. Whether the difference affects a decision depends on that decision's criteria. A technical correction can be completed while a disputed allocation remains unresolved.

11.3 Action authority and verification

An action plan distinguishes proposed, authorized, assigned, initiated, completed, verified, failed, and abandoned activity where those differences matter. A reviewer can recommend restoring access without controlling the system that grants it. The record should identify the responsible recipient and the evidence needed to establish execution. A message announcing a remedy is not the same evidence as successful restored access.

Temporal urgency adds another dimension. An institution may take a limited protective action before full examination. The record needs a purpose, authority, duration or review point, notice limits, expected consequences, and later review. The provisional action does not automatically establish a final finding. The infrastructure can help expose these relationships, but the legitimacy of the action remains a contextual legal and normative question.

11.4 Reopening and changed conditions

A case can reopen because of new evidence, an earlier error, changed target conditions, revised categories, procedural defect, or unimplemented action. The grounds can affect the past assessment, current action, or both. A later improvement in conditions does not prove that an earlier report was mistaken, just as a later failure does not alone prove that an earlier decision ignored available evidence.

Closure records which issues are disposed, which actions remain pending, who owns follow-up, and what can trigger reconsideration. Administrative closure and epistemic agreement remain distinguishable. An institution that closes a queue entry while leaving an action unperformed has changed the workflow state; it has not thereby restored the lost opportunity.

11.5 Jurisprudential interfaces

The jurisprudential work items concern the relation between records and rights, duties, authority, jurisdiction, admissibility, and procedure. The paper offers an information architecture for expressing those claims, rather than a legal opinion about a particular jurisdiction. A legally consequential profile would need qualified review of its applicable sources, institutional mandate, procedural safeguards, and conflicts among obligations.

Technical standardization can improve the clarity of an authority claim by requiring a source and scope. It cannot create the claimed authority. The same applies to rights labels and consent fields. A database can record that consent was asserted; whether the underlying agreement is valid and sufficient

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depends on circumstances beyond the schema. The programme keeps this distinction visible through separate publication classes and domain-specific assessment.

12 Preservation, Protection, and Access

The preservation problem concerns what future inquiry can recover and under which conditions. The protection problem concerns the effects of collecting, retaining, and disclosing that material. These purposes can support or constrain one another. The programme therefore treats retention and access as governed activities rather than automatic consequences of a storage mechanism.

12.1 Capture boundaries and proportionality

A project first needs a reason to collect a class of material. That reason identifies the questions the material is expected to support, relevant participants, known sensitivities, and possible substitutes. Complete capture is often unavailable and can be undesirable. A useful record can describe a protected source or an absence without retaining the sensitive content itself, provided that the resulting evidential limits remain clear.

Collection choices affect recognition. A system that privileges easily quantified events may make informal care or excluded testimony less visible. A requirement to produce extensive documentation can impose disproportionate costs on people with limited access to tools or institutional support. Evaluation should therefore examine who can contribute, who can challenge a record, and whose activity becomes difficult to represent under the selected categories.

12.2 Preservation and released views

The retained package and a released view have different boundaries. A public display may omit identities, detailed locations, or sensitive testimony. It should state its purpose, source revision, selection rule, and material limitations. The audience needs enough information to understand what the view establishes without assuming access to a complete archive.

Redaction, normalization, transcription, and summarization are transformations. A transformation record identifies input and output versions, operation, responsible role, and known effects on interpretation. A redacted document can remain useful while leaving a particular question unassessable. A summary can preserve a decision's conclusion while losing its qualifications. The infrastructure should make these differences available at the point of use.

12.3 Retention and disposal in a Git binding

The current Git binding retains replaced and detached assets in accepted history. This supports recovery but creates a specific limitation for sensitive information: removing a current link is not historical erasure. Copies, bundles, backups, and previously authorized downloads can extend retention beyond the live repository. A deployment needs a retention arrangement appropriate to these facts before accepting protected material.

Selective erasure would require a separate design. Possible directions include segregated protected storage, encrypted material with governed key destruction, retained tombstones, or controlled history rewriting with a correction record. Each changes the preservation and verification story. Key destruction does not remove every copy of plaintext, and history rewriting changes object identifiers and the evidence available to prior references. The present edition implements none of these as a general compliance solution.

The appropriate engineering response is explicit capability disclosure and proportionate use. Synthetic demonstrations and low-sensitivity private research records fit a different risk profile from consequential institutional dossiers. A successful attachment test should not be used to justify expansion to a more sensitive domain without a protection design and qualified review.

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12.4 Authorization, custody, and operational continuity

Project access is enforced by the application, including historical content and file delivery. A retained digest proves a byte-identity comparison within its method; it does not authenticate the actor who supplied the material. A Git bundle preserves objects but omits account and authorization state. A service backup therefore needs additional arrangements, and restoring it requires control over credentials, ownership, and access rules.

Custody extends over time. A maintainer can leave, hosting can end, and a dependency can become unsupported. The institution needs to identify a successor or communicate the limits of continued service. Long-term preservation also requires format inspection, integrity checks, migration decisions, and accessible descriptions of what has changed. Source availability helps, but it does not by itself fund or perform these tasks.

12.5 Threats arising from epistemic use

The main threats include deliberate falsification, mistaken interpretation, misleading presentation, unauthorized disclosure, coercive documentation, and overreliance on apparent validation. Their countermeasures differ. A digest mismatch calls for an integrity response. A well-preserved false claim calls for substantive examination. A complete graph with a misleading legend calls for presentation correction. A person unable to contest a classification needs a usable institutional route.

Threat modeling should therefore begin with concrete actors, resources, actions, and consequences. The paper's engineering checks cover selected operations and failure paths. They do not certify the system against a general adversary or establish that the social costs of recording are acceptable. Those remain deployment-specific evidence obligations.

13 Application Architecture and Domain Interfaces

The implementation architecture separates reusable semantics from application hosting. Common packages implement record preparation, validation, projection, and Git storage. Domain applications provide entry points, user interaction, authorization, and domain-specific interpretation. The repository hierarchy makes the separation visible while allowing coordinated development.

13.1 Source repositories and runtime repositories

The programme root contains the applicative infrastructure as a submodule. The infrastructure repository contains the generalized and academia applications as separate submodules and retains common tools and packages. These four repositories distribute software and documentation. A generalized application's runtime separately manages one bare Git repository for each user project. The distinction is important for both backup and publication: publishing source commits does not publish private project records.

The generalized application supports registration, login, project creation, record authoring, graph inspection, modules, attachments, history, and spacetime views. Its application database manages service-level identities and sessions, while project repositories retain record revisions and material. The storage adapter receives an authenticated actor from the application; it does not discover identity by interpreting a Git author string as independent evidence.

13.2 Common semantic and storage boundaries

The record protocol package validates the final candidate and produces projections from supplied snapshots. Its absence of framework and repository dependencies permits direct testing of semantic behavior. The Git store supplies object construction, bounded reading, accepted-history reachability, material closure, receipt lookup, and conditional publication. The HTTP binding adds transport parsing, file verification, project access, and protection against unauthorized state changes.

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Limits belong to their layers. A protocol transaction can have a broader internal JSON bound than the HTTP transport accepts. A storage snapshot can impose a tighter aggregate bound than the pure package. An error should identify the applicable constraint rather than truncate input to make it fit. The capabilities response documents supported versions and limits so that clients can distinguish unavailable features from invalid data.

13.3 Authoring and presentation

The graph interface makes records selectable and Relations inspectable. A user can create a record, connect participants, and examine associated notes or files. Modules organize material around an account without treating every module as a new ultimate ontology class. A record's primary role can guide presentation while its applied role set preserves overlap.

The spacetime interface adds event-order inspection, event-cut selection, temporal-extent editing, applicability classifications, and subject trajectories. Selecting a cut is a read operation. It changes the presentation of a pinned snapshot and does not create a recording revision. Editing an extent or precedence account is a transaction and retains the usual reason, qualifications, and history.

Visual layout requires particular care. A grid can avoid overlap without adding semantics. A force layout can improve navigation while suggesting closeness that the data does not assert. The implementation's presentation contract therefore separates coordinates from target properties, and the worked gallery explains its filtering and local layout choices. Accessible tabular and textual routes remain important for interpreting incidences and temporal qualifications.

13.4 Academia and learning as distinct domain systems

The academia application was migrated into the infrastructure hierarchy with its native protocol and provenance retained. That migration is an organizational change, not a completed semantic conversion to the generalized protocol. An adapter would need to examine signed content, record identity, relation kinds, domain modules, files, authority claims, and unmapped fields. A shared library becomes evidence of interoperability only when independently implemented exchange cases succeed under a specified mapping.

The learning prototype described in the companion paper is a further distinct system. It uses GMD source in an authenticated hosted notebook, SQLite transactions, stable semantic references, and source-derived edges. Its entity kinds such as question, method, and formula are domain authoring categories. They are not a replacement for the generalized six-role model. Its explicit-date timeline also differs from the event-cut topology developed here.

The common research problem concerns retained commitments and derived views. A future cross-domain interface can map a learning document revision into a record package while preserving source occurrences, independent question identity, and review provenance. The mapping needs to expose uncertainty and loss. Presenting the two applications side by side does not establish that such a mapping has already been implemented.

14 Synthetic Demonstration of a Generative Trajectory

River Commons is a synthetic inquiry into the shared care of a garden. It demonstrates an encounter that opens an opportunity, a provisional arrangement, changing accounts of access and responsibility, a later review, and correction of a mistaken chronology. Every person, institution, observation, and material item is invented. The demonstration tests expressibility and inspectable behavior rather than facts about a real community [2].

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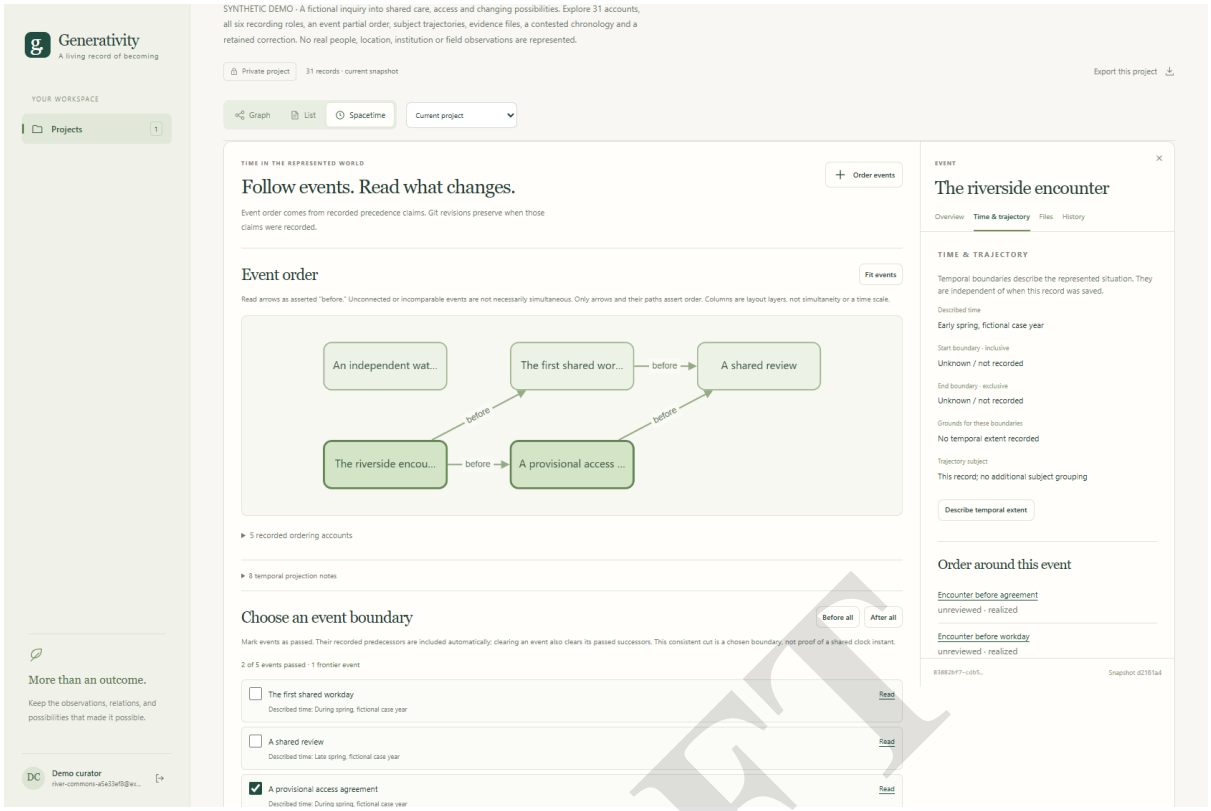

Figure 3: River Commons event-order view from the running generalized application. The later review was recorded first. Explicit precedence supplies the branching structure; layout and recording sequence do not supply physical time. The screenshot uses synthetic data.

14.1 Scenario inventory and recording sequence

The final project has 31 records: four primary Entity accounts, five States, five Events, one Process, twelve Relations, and four Properties. The Relations include seven substantive relationship accounts and five precedence accounts. Four precedence accounts remain active; a fifth is withdrawn after producing a cycle. Six fictional files supply encounter notes, an access memorandum, water observations, a review summary, an attendance ledger, and chronology reconciliation.

The sequence deliberately begins by recording the later review. Earlier encounter, agreement, and workday events are added retrospectively. Scoped States and Relations are then recorded, followed by a contradictory precedence account and its correction. The chronology correction withdraws the claim that the review preceded the encounter. A separate correction changes eighteen attendance entries to sixteen distinct attendees. These revisions concern the account of the stipulated history.

14.2 Event order and incomparable branches

The encounter precedes both the access agreement and the first shared workday. Both precede the review. The agreement and workday have no asserted mutual order. An independent water observation is unordered relative to the four-event structure. Figure 3 shows the actual event-order interface. The display can place events into columns while leaving their incomparability explicit.

Selecting the agreement includes the encounter as a predecessor, giving a two-event cut. Selecting the review includes both branches and the encounter, giving a four-event cut. The independent observation remains outside these selections. An all-event cut would include it without establishing a new relation to the other events. This difference makes the meaning of selection visible to the reader.

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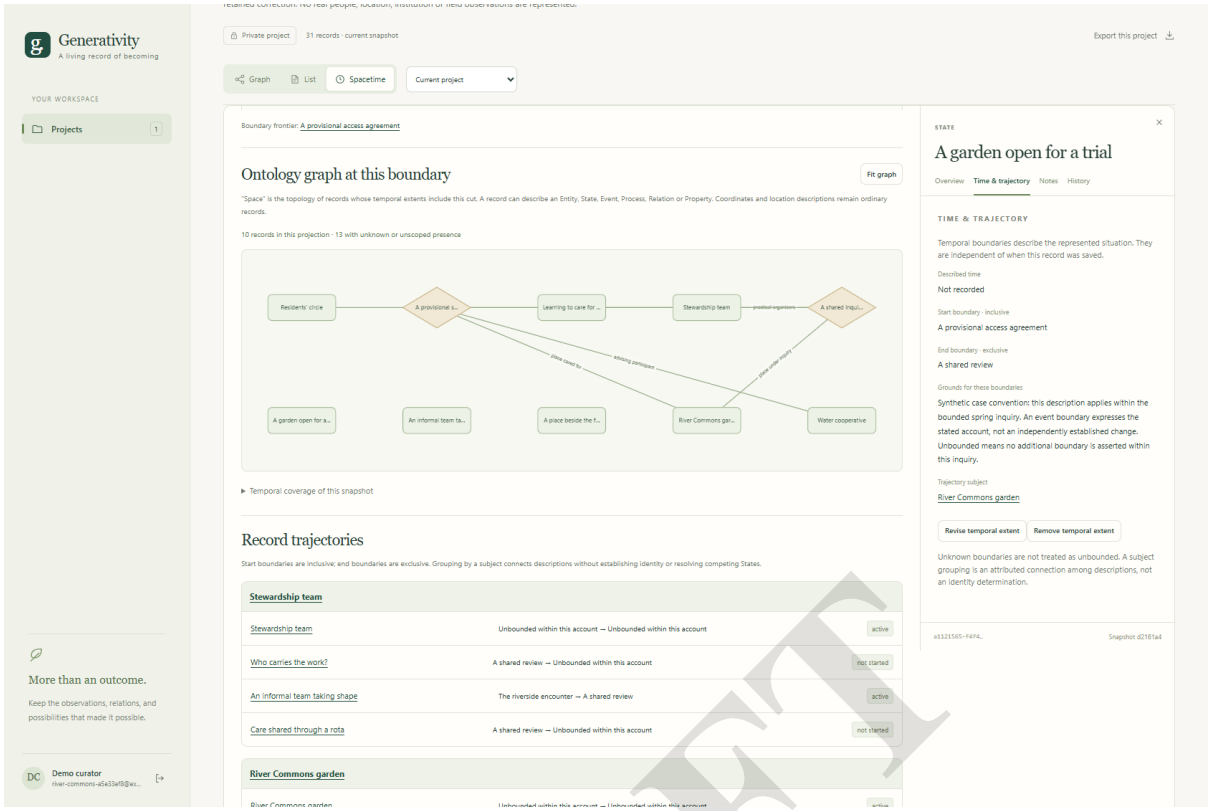

Figure 4: Topology after the access agreement: the encounter and agreement are included, and the trial-access State is selected. The workday is not a known predecessor of the agreement. Unknown and unscoped accounts remain separately inspectable.

14.3 Topology at two event boundaries

The two cuts are projected from the same current recording revision. At the agreement cut, ten records are active in the topology, including trial access and a provisional stewardship arrangement. At the review cut, thirteen records are active, including revised access, a rotating-care State, and renewed stewardship. Figure 4 and Figure 5 preserve the actual boundary labels and selected accounts.

The example also retains indeterminate water applicability and an unscoped proposed capacity. Their separation prevents a complete-looking graph from inventing a definite period for uncertain claims. A geographic description appears as a contextual Property; it does not determine the graph's coordinates. The garden's successive State accounts and the stewardship team's accounts are grouped through supplied subject references with explicit scope.

14.4 Relation identity and preserved disagreement

The provisional stewardship arrangement has its own account and three participant roles. A higher-order relation qualifies an account of access, showing that Relations can themselves be objects of inquiry. A disputed workload Property remains visible beside the accounts of improved coordination. The example therefore permits an attributed gain and an unresolved concern to coexist without forcing a single score.

The historical revision containing the mistaken chronology returns a cycle diagnostic and withholds a consistent cut. The current revision retains the withdrawn order account and uses the remaining active assertions. A reader can compare the grounds and consequences of the correction. Preserving the contradiction is useful precisely because a clean current view alone would conceal the route through which the account became usable.

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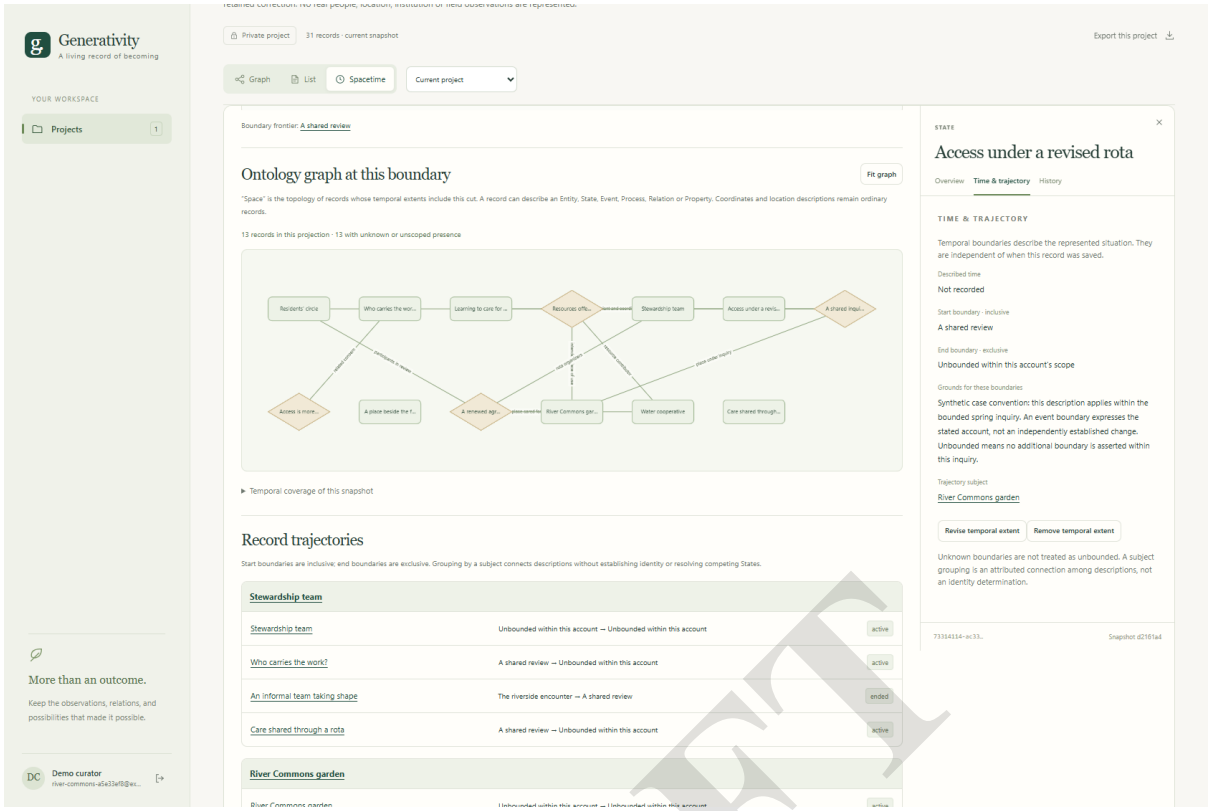

Figure 5: Topology after the review, at the same Git revision as Figure 4. Both branches are included. Revised access and renewed arrangements apply according to retained extents. The difference is a projection of applicability accounts, not an inferred causal simulation.

14.5 Interpretive reach of the demonstration

The demonstration establishes that the implemented representation can express this stipulated story, retain its material, and distinguish its temporal questions. It supplies no evidence that the fictional arrangement was effective, just, or legally valid. It also does not establish that users unfamiliar with the design correctly interpret cuts, partial incidences, or subject groupings. Those are prospective comprehension tasks for evaluation.

15 Verification Results and Evaluation Boundaries

The evaluation separates documentary checks, finite constructions, executable software behavior, and future institutional assessment. This separation permits useful results to be reported without treating one evidence class as a substitute for another. The current checks support a reproducible development state and a bounded implementation account.

15.1 Documentary and synthetic assessment

The publication checker passed for the nine version 0.3 documents. It found 754 unique requirement identifiers and checked source metadata, references, archive hashes, build freshness, and extracted PDF coverage. The documents total 226 pages. These checks establish consistency properties of the publication package. They do not perform a fresh substantive judgment on every requirement or certify accessibility.

The fixed-baseline validation checker passed for 753 version 0.2 identifiers across 116 review groups. The P1 assessment has 208 rows: 54 component rows, of which 53 are fulfilled and one not assessed, and

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154 whole-requirement rows, of which 152 are not assessed and two not applicable. The row classes are distinct. A fulfilled component does not make its whole requirement fulfilled. The 18 ballot-arithmetic cases matched their expected results [6].

The interpretation of these numbers is bounded. Review coverage means that an identifier was associated with a review group and recorded disposition. It does not imply independent institutional validation. The synthetic case can reveal a missing field or ambiguous assessment boundary, while the availability of actual reviewers, affected participation, and remedy capacity remains unassessed.

15.2 Re-executed common-package checks

For this paper, the common record-protocol and real-Git storage suites were executed in the existing Windows development environment. All 146 tests passed in the recorded run. The raw output and command are retained in the evidence directory. The scope includes protocol and temporal behavior, transaction preparation, storage operations, and their tested failures. It excludes a fresh application browser run and any real institutional procedure.

The existing spacetime review separately reports 178 non-browser tests and seven browser tests across focused runs, for 185 passing tests in that review cycle. These totals overlap with common-package cases and must not be added to the new 146 as independent coverage. The review includes reverse recording order, incomparable events, predecessor closure, cycles, withdrawn orders, uncertain extents, historical labels, authorization checks, and a topology-overlap correction.

The historical review also records a bounded 1,000-record, 500-event chain and agreement with an independent reachability oracle on 500 deterministic generated graphs. These checks support the implemented traversal and cycle handling in their tested domains. They are not throughput measurements or evidence of performance at arbitrary scale.

15.3 Counterexamples as assessment instruments

Counterexamples are valuable because they expose the consequence of a collapsed distinction. If two independently identified occurrences have the same effect, an endpoint-only history loses occurrence count. If a claim's title changes after an institutional decision, resolving the old view against today's title misrepresents what was displayed. If a temporal extent adds an order merely because both bounds exist, it converts uncertainty into asserted chronology. If a file is detached and presented as erased, the interface misstates retention.

Appendix C organizes these cases by target, expected behavior, and evidence boundary. The schedule can guide independent implementations. It also distinguishes a deterministic invariant from an interpretation requiring human assessment. Correctly retaining an uncertainty field is a software property; whether its wording adequately communicates the uncertainty is a different question.

15.4 Burden, comprehension, and institutional performance

A prospective observed pilot should measure setup, capture, assessment, contestation, protection, revision, participation, and maintenance effort. Time is only one dimension. The record should also identify assistance, interruption, omitted information, abandoned tasks, and reasons participants decline a proposed structure. A shorter record can be more usable while omitting a crucial distinction; a longer record can be precise but practically unsustainable.

Comprehension tasks should ask readers to distinguish a record from its target, a digest from factual warrant, a precedence account from causation, and a cut from simultaneity. Tasks should include plausible misleading cases. A participant who correctly reports that a question is unresolved can outperform one who produces a confident but unsupported ordering.

Institutional assessment requires actual authority, participation, competent review, and practical follow-up. The most relevant outcomes include whether affected people can contest a consequential classification, whether an accepted correction reaches dependent uses, and whether a promised repair

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occurs. These outcomes cannot be inferred from source code or clause counts. The present paper supplies a design and evidence basis for such studies while preserving their status as future work.

16 Public Policy and Institutional Development Options

The policy task is to identify feasible institutional settings for testing and maintaining the infrastructure. Technical interoperability, public legitimacy, and sustainable capacity have different requirements. The options below are proposals addressed to research institutions, civil-society organizations, public-interest infrastructure operators, and potentially relevant international organizations. No participation or endorsement is presumed.

16.1 Research and archival pilot

A first option is a bounded research or archival pilot in which a participating institution retains a decision or inquiry trajectory under a declared recording profile. The pilot can use low-sensitivity material and a limited question, such as reconstructing why a method was revised. Its advantages are manageable scope and a concrete archive. Its risks include designer dependence and selection of unusually cooperative cases.

The pilot agreement would identify custodianship, rights, access, review roles, withdrawal conditions, and evaluation questions. Evidence would include both successful reconstruction and failures. A useful failure might show that a required distinction is too costly to capture or that a source cannot be disclosed sufficiently for the intended assessment. Such findings should inform the profile rather than be hidden as implementation inconvenience.

16.2 Participatory institutional review

A second option concerns a real procedure whose classifications affect participants. The infrastructure could support a challenge, reasoned response, correction, and follow-up. This option tests praxis more directly but requires stronger safeguards and an actual authority able to change decisions. The prototype's private-project authorization model would not by itself be adequate for this role.

The design would need differentiated access, representation and assistance, conflicts handling, declared deadlines, and independent review capacity. Evaluation would examine whose concerns enter the record, which influence a decision, and which remain excluded. Participation should include the ability to challenge the categories and recording burden, not only to fill fields chosen by system designers.

16.3 Open-science capacity building

A third option aligns with the policy concern for open infrastructures and inclusive participation articulated in UNESCO's Recommendation on Open Science [23]. A programme of training, example dossiers, translation, and independent prototype development could examine whether the representations travel across disciplines and resource conditions. This is an institutional option, not a claim that the Recommendation mandates the present protocol.

Capacity building would need funding for maintenance and meaningful participation. Releasing code can reduce one barrier while leaving language, hosting, expertise, and time costs intact. A programme should therefore evaluate who can operate the infrastructure, revise its categories, export material, and leave the service without losing essential context.

16.4 Technical liaison and interoperability study

A fourth option is a narrow technical study with implementers of provenance, archives, and domain record systems. The study would define a small set of mapping questions and independent exchange fixtures. Identity, qualification, event order, evidence-role context, and protected omissions are suitable targets. A

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failed round trip would be reported as a concrete loss, rather than repaired by silently inventing missing information.

The institutional route could involve informal research collaboration before formal liaison. The programme's own authority and resources should be established before commitments are made in its name. Standards adoption would follow the selected body's procedure and a recorded decision. A successful technical study would supply evidence for that process, not replace it.

16.5 Political economy of the infrastructure

Infrastructure affects the distribution of epistemic work. Someone funds storage, curates categories, maintains validators, answers challenges, and controls presentation defaults. These activities can produce public value while concentrating practical authority. A sustainability plan should disclose costs, dependencies, governance rights, exit routes, and the consequences of loss of support.

The design also needs to resist metric substitution. Counts of records, links, accepted suggestions, or nominally complete fields can become incentives that displace inquiry. A programme concerned with generativity should evaluate the future capacities and constraints associated with its use, including the possibility that documentation demands crowd out participation or experimentation. The appropriate indicators remain domain-specific and open to challenge.

17 Research Agenda and Development Priorities

The next development stage concerns the gap between an inspectable prototype and a sustainable, independently assessable infrastructure. The priorities below follow from the current limits and preserve the standards-first development pattern: a practical or normative need should motivate each new technical mechanism.

17.1 Epistemic model enrichment

The first priority is a more explicit representation of claims, material items, evidence-role assignments, assessments, and dependencies. The existing descriptive fields are useful for small accounts but make certain queries difficult. An assessor may need to distinguish two claims using the same material in different roles or determine which institutional actions depended on a superseded assessment. A model proposal should compare separate objects, qualified assertions, and hybrid structures using the same cases.

Richer structure can increase burden. The evaluation should therefore include reusable shared context, narrative locators, and selective structuring. A technically elegant schema that requires users to repeat a method statement for every sentence would weaken the practical objective. The criterion is recoverability of relevant distinctions under a declared task, rather than maximum decomposition.

17.2 Temporal and scenario semantics

The current event-cut model treats Event records as operational boundary markers. Extended events, overlap, duration uncertainty, and separate onset and completion need further semantics. Competing chronologies also require explicit scenario selection, with recorded inclusion rules and consequences. Such selection should preserve excluded accounts and avoid presenting the preferred scenario as the only possible history.

A future event-effect model would need to distinguish applicability from transformation. If different linear extensions of a partial order produce different results, the model must retain that difference or justify commutation assumptions. The current projection avoids this unresolved task by evaluating retained extents. Formal research can develop the stronger model in a Technical Report before it constrains an implementation profile.

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17.3 Identity, migration, and cross-domain mappings

Cross-project identity and domain mappings need tests involving disputed continuity, split and merger, reused labels, signed material, and unknown modules. The academia application's native protocol and the hosted learning profile provide useful contrasting cases. Their different persistence and authority boundaries should be preserved in the mapping argument.

Migration also needs an explicit account of lost information. A new classification can divide an older category into several cases that the retained evidence cannot distinguish. A migration can preserve the old category and mark the new assignment unknown. It cannot reconstruct omitted distinctions by changing field names. Reverse mappings and round-trip fixtures are therefore essential evidence.

17.4 Independent assessment and governance readiness

Independent implementation would test whether the Specifications are sufficiently precise beyond their authoring codebase. Independent procedural review would test a different claim: whether participation, objections, decisions, and maintenance can be handled under the proposed governance. Both require people and resources outside the current drafting process.

The programme should select a small number of discriminating pilots, publish their task definitions and scope, and retain negative findings. Priority should go to cases involving a consequential correction, an uncertain chronology, a protected source, and an unresolved practical response. These cases exercise the integration problem more directly than adding many easy records.

17.5 Accessibility and interpretive usability

Presentation research should examine keyboard operation, assistive technologies, multilingual input, meaningful text alternatives, and the comprehension of graph and temporal views. WCAG 2.2 provides a relevant external reference for web accessibility assessment [24]; current screenshots and scripted browser tests do not establish conformance. The research question also extends beyond interface access to interpretive access: a technically reachable control can still communicate the wrong epistemic meaning.

The intended development outcome is a smaller set of claims supported by stronger evidence. Additional pages, fields, and test counts are useful only where they address a substantive failure or unresolved question. Comprehensive development therefore includes decisions to defer a mechanism, narrow a profile, or revise a requirement when the available evidence warrants that choice.

18 Concluding Account of the Proposed Infrastructure

Generativity epistemic infrastructure concerns the conditions under which people can recover, examine, challenge, and continue a trajectory of inquiry and action. The proposed standards programme gives that concern a layered form. Conceptual sources guide the distinctions, working drafts specify proposed obligations, experimental Specifications define bounded mechanisms, and applications expose those mechanisms to practical use.

The record graph retains independently identified accounts and Relations. The transaction protocol preserves coordinated revisions and recovers uncertain publication outcomes through receipts. The spacetime projection uses explicit event precedence and predecessor-closed cuts to display the applicability of accounts and their relational topology at one recording revision. These mechanisms support historical reconstruction while leaving factual warrant, causal attribution, legal authority, and normative evaluation open to their appropriate forms of examination.

The evidence supports a coherent preparatory corpus, conditional formal results, a functioning bounded implementation, and a reproducible synthetic demonstration. It also identifies material gaps: richer epistemic objects, independent interoperability, governed protection, participant comprehension, sustainable burden, and actual institutional capacity. The documentary appendices make both the developed material and its limitations available for review. The programme can advance through that review

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without converting the current prototype into a premature claim of settled standards or comprehensive social knowledge.

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A Documentary Corpus and Edition Guide

The documentary appendices preserve the programme's development material as a separately indexed corpus accompanying the research paper. The complete reading edition places the paper first and appends the documentary volumes. A shorter main-paper PDF remains available for ordinary reading. The source inventory records original paths and hashes; the reproduced documents retain their publication-class declarations, and the volume indexes record page locations.

The current-drafts volume reproduces the nine compiled governance and standards-track documents, followed by the current Markdown corpus: the Programme Brief, architecture and planning records, additional standards-track drafts, experimental Specifications, manuals, Technical Reports, policy outlines, templates, examples, and review material. Application documentation is included under a separate group. Placeholders retain their status as placeholders. Including a project README does not turn its roadmap into a delivered feature list.

The foundation volume preserves all seven supplied manuscripts, including both Chapter 3 variants. Their original pagination, titles, notices, and edition ambiguity remain visible. The historical volume preserves earlier publication editions and their associated descriptive material. These reproductions support recovery of conceptual and procedural development. The research text's source hierarchy and claim limits continue to apply.

The source archive includes machine-readable schemas, review matrices, fixtures, and source versions of the reproduced documents where present. Executable application code remains separately versioned; the inventory records its repository reference and includes documentary interfaces rather than treating the entire dependency tree as a paper appendix. Runtime databases, credentials, private project repositories, caches, and development environments are excluded.

The corpus has a defined freeze boundary. Later modifications to the live repository do not silently change the appendix edition. A reader can compare the retained source hash with a later revision and identify the difference. The assembly report distinguishes the original page numbers inside reproduced PDFs from their positions in the combined reading edition.

The distinction between reproduction and endorsement is especially important for external references and notices. Historical documents may contain earlier formulations, licence notices, unverified references, or superseded proposals. They remain part of the preserved record. New scholarly claims in the present main text use the separately prepared verification ledger and do not inherit verification merely from appearing in a reproduced document.

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B Finite Event-Cut and Applicability Examples

The examples in this appendix make the operational temporal choices explicit. They use stipulated event accounts and supply no empirical chronology. Their purpose is to help an independent reader reproduce the consequences of the definitions in Section 10.

B.1 Complete cut inventory for a branching account

For the four-event diamond with $a \prec b$, $a \prec c$, $b \prec d$, and $c \prec d$, the down-sets are exactly $\varnothing$, $\{a\}$, $\{a, b\}$, $\{a, c\}$, $\{a, b, c\}$, and $\{a, b, c, d\}$. Adding an incomparable event u gives two variants of each cut: one excluding u and one including it. The resulting twelve cuts distinguish possible selected boundaries without assigning dates or probability weights.

Table 3 gives representative selections and their closures. Selecting all frontier members can recover the same cut as selecting every included event, which explains why the frontier is a useful display summary.

Table 3: Selections, closures, and frontiers in the five-event example.

Requested selection	Included cut	Frontier
$\varnothing$	$\varnothing$	$\varnothing$
$\{b\}$	$\{a, b\}$	$\{b\}$
$\{c, u\}$	$\{a, c, u\}$	$\{c, u\}$
$\{b, c\}$	$\{a, b, c\}$	$\{b, c\}$
$\{d\}$	$\{a, b, c, d\}$	$\{d\}$
$\{d, u\}$	$\{a, b, c, d, u\}$	$\{d, u\}$

B.2 Presence under specified and uncertain bounds

An account with start b and end d is not started at $\{a\}$, active at $\{a, b\}$, and ended at $\{a, b, c, d\}$. An account with start unbounded and end b is active at the empty cut and ended after b is included, within the declared account scope. An account with an unknown end remains indeterminate in the current profile even after its known start is included. An absent extent remains unscoped.

An account bounded by b and c is indeterminate because those events are incomparable. The user can retain that claim and its grounds, but the extent does not establish $b \prec c$. A separate precedence account would be needed to add that constraint. If the added account is later withdrawn, the temporal interpretation can change in a later recording revision while the earlier view remains available.

B.3 Cycle retention and account withdrawal

Adding $d \prec a$ to the diamond creates a cycle. The active order is then unusable for the cut construction, and the projection returns diagnostics with null cut and topology. Withdrawing the $d \prec a$ account restores the diamond if the remaining assertions are supported and acyclic. The withdrawal changes the active constraint set; it does not delete the earlier assertion from recording history.

Duplicate assertions of $a \prec b$ retain separate account identities but supply the same reachability constraint. Withdrawing one duplicate leaves the constraint active if another qualifying account remains. This case demonstrates why the implementation needs both an order-account inventory and an aggregated adjacency structure.

B.4 State trajectories and partial incidence

Suppose a garden State ends at b and a trial State starts at b and ends at d. Inclusive starts and exclusive ends permit a clear boundary transition at a cut containing b. The profile nevertheless allows other competing States with overlapping extents. It supplies no uniqueness axiom selecting a single true State of the garden.

Suppose a Relation is active at the trial cut while a participant is unscoped. The Relation node remains visible, the uncertain participant incidence is omitted from the active topology, and a partial-relation diagnostic identifies that omission. The ordinary record graph can still display the complete retained account. The two views answer different questions and should be named accordingly.

C Prospective Assessment Schedule

The schedule in Table 4 translates central distinctions into discriminating cases. It is informative research guidance, rather than a newly adopted conformance profile. An assessment identifies the edition, subject, evidence, applicability rationale, result, and limitations for each selected case.

An evaluator should retain failed and unassessed cases. Not applicable requires an absent trigger under the declared profile, rather than an unavailable person or missing evidence for an activity that was required. Whole-practice results also need a declared observation interval and responsible assessor. The result of a component check remains associated with that component.

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Table 4: Discriminating cases for implementation and practice assessment.

Subject	Case and expected distinction	Evidence boundary
Identity	Rename a record while retaining stable references; compare a disputed target continuity claim	Identifier preservation does not prove target identity
Relations	Retain a three-party account, repeated roles, and a Relation participant	Incidence preservation does not verify the relation
Transactions	Create mutually referring records; reject the whole candidate on a failed dependent operation	Accepted atomic effects within one binding
Retries	Lose a response, repeat the same request, then reuse its ID with changed content	Receipt recovery and conflict distinction
History	Rename and revise current accounts while viewing an earlier revision	Earlier labels, modules, and bytes remain pinned
Time	Record the later event first; add an early predecessor retrospectively	Explicit precedence differs from recording order
Uncertainty	Compare unknown, unbounded, and missing extents	Omission from active topology is not absence
Conflict	Retain a chronology cycle and later withdraw an order account	Historical contradiction remains inspectable
Material	Replace and detach a file, then inspect full history	Current removal differs from historical erasure
Epistemics	Use the same authentic material for two different claims	Evidence roles and their grounds remain separate
Praxis	Correct a classification while a dependent action remains pending	Documentary correction differs from completed repair
Participation	Challenge a category through an accessible review route	Presence of a form does not establish meaningful consideration

For a future real pilot, the evidence package should include task instructions, participant roles and consent arrangements, material-access conditions, observation conventions, interpretive rubrics, and a plan for reporting adverse outcomes. Any numerical threshold should be chosen for a stated purpose before interpreting the result. Graph density, record count, and total clause coverage can describe the artifact, but they are not measures of factual warrant, justice, or generative benefit.

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D Reproduction and Artifact Boundaries

The paper directory contains section-level LaTeX sources, figures, references, a verification ledger, and executed-check output. The accompanying tools compile the main papers and assemble documentary volumes. The build uses XeLaTeX, BibTeX, latexmk, Python, Pandoc for Markdown reproductions, and pypdf for assembly and inspection. Compilation has no need for a remote AI provider.

From the programme root, the common-package check can be repeated with the generalized development interpreter and the two common test directories. The exact argument list is retained in `evidence/common-tests.json`. The observed run reported 146 passing cases. The document checks are `tools/check_publications.py` and `tools/check_validation_package.py`; their scope remains as described in Section 15.

The River Commons seeder and gallery capture script remain in the generalized application repository. They create a separate synthetic account and preserve a local recovery manifest outside source control. Reproduction should use isolated runtime storage and the documented local server. The published figures are retained captures with known synthetic fixtures, not newly generated illustrations of an unimplemented interface.

The documentary source archive preserves selected project files and their original relative paths. Its

manifest records hashes and scope. It excludes private runtime state and third-party dependency installations. The source-code repository references and the learning handoff hash identify separate implementation evidence. A compiled PDF or a snapshot archive does not restore the complete running service.

The final validation report checks compilation, unresolved references, labels and citations, displayed-equation discipline, source/PDF page counts, and the assembly inventory. Visual inspection samples the title, dense tables, formal material, screenshots, bibliography, and appendix transitions. These checks support a readable research artifact while leaving comprehensive PDF accessibility assessment and substantive author review explicit.

DRAFT

GENERATIVITY STANDARDS PROGRAM

Programme Charter

Governance Working Draft

Version 0.3 2026-09-22

Standards Programme Charter

WORKING DRAFT FOR REVIEW

This document contains proposed provisions for technical and institutional review. It is not an adopted Standard or an operative governance instrument. Its scope, application conditions and publication status are specified in the text.

Prepared by the Generativity Standards Program. Reference to external publications does not imply endorsement by ISO, IEC, IEEE or any United Nations body.

Foreword

Version 0.3 records the bounded substantive review of the archived 0.2 package. Its requirement text is retained in this coordinated edition; updated references identify the companion 0.3 drafts. The review matrix, synthetic assessments and unresolved readiness questions are documented in `docs/reviews/validation_0.2/README.md`. These activities do not constitute adoption or an independent institutional assessment.

This document establishes proposed governance requirements for the Generativity Standards Program. It is a Governance Working Draft prepared for review, not an adopted Charter or technical Standard. Its authority depends on the founding procedure specified herein. The foundation manuscripts supply conceptual source authority; they do not constitute a governance adoption instrument.

Responsible editor: `UNASSIGNED`. Canonical source: `governance/standards_programme_charter.tex`. Intended readers are founding participants, administrators, reviewers, contributors, and affected people. Version 0.2 develops authority, participation, resources, oversight, transition, and assessment while retaining the requirement identifiers and obligations introduced in version 0.1.

This document is part of a coordinated draft governance package. Numerical development periods and ballot rules are specified in Directives Part 1. This Charter establishes the powers and accountability within which those rules operate.

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Introduction

The programme responds to instability in the connections among representations, their referents, institutional classifications, and practical trust. Its purpose is to support warranted recognition, reasoned contestation, revision of judgment and action, and preservation of consequential generative trajectories. This includes the conditions under which people can produce evidence, inspect grounds, and influence practices that affect their future possibilities.

The programme's own decisions can shape which accounts are recognized and which infrastructures become authoritative. Governance therefore forms part of the programme's substantive task. Open documents alone do not demonstrate accessible participation; a recorded vote does not establish truth; and a maintained history does not by itself repair the consequences of a mistaken decision. The requirements below assign functions, make their exercise inspectable, and provide routes to correction within the programme's actual authority.

The initial model uses individual contributions and explicitly delegated functions. It permits a small organization without presuming that named committees, independent reviewers, funding, or institutional mandates already exist. A transition to another participation model remains subject to recorded amendment.

1 Scope

1.1 Subject and application

This Charter specifies requirements for the programme's founding, mission, publication authority, participation, appointments, decision accountability, resources, records, external relations, and institutional continuity. The assessed subject is the programme's governance arrangement and its exercise during a declared review period. A work item or publication can supply evidence of that exercise without itself constituting governance adoption.

1.2 Boundaries

The portfolio includes recording, preservation, exchange, presentation, assessment, contestation, revision, and accountable institutional use of generativity-related records. The Charter does not settle a complete metaphysics or create authority over external legal decisions. Its requirements concern decisions and resources within the recorded programme mandate.

2 Normative references

2.1 Coordinated draft dependencies

The following documents contain provisions needed to apply identified requirements of this Charter. The cited editions are Governance Working Drafts, version 0.3. Their listing establishes a draft dependency only. The founding instrument fixes the exact coordinated editions accepted for operation.

Directives Part 1 — Procedures for Development and Maintenance. `governance/directives_part_1.tex`. Provides development stages, review periods, dispositions, ballots, appeals, emergency action, and maintenance procedure.

Directives Part 2 — Structure and Drafting Rules. `governance/directives_part_2.tex`. Provides publication classification, provision structure, traceability, and production requirements.

GR/TC 1 Charter — Generativity Records and Infrastructure. `governance/technical_committee_charter.tex`. Defines committee scope, technical coordination, review, and pilot responsibilities.

Ethics, Conflict-of-Interest, and Contribution Rights Policy. `governance/ethics_ip_policy.tex`. Provides conduct, conflict, impact, contribution, and rights-handling requirements.

2.2 Use of references

CH-042 The founding or amending authority shall identify the exact coordinated governance editions, resolve conflicting provisions, and record the resulting allocation of authority before dependent decisions proceed. A later draft of a referenced document shall not replace the operative edition automatically.

External sources listed in the bibliography are informative. Their citation neither incorporates their procedures wholesale nor grants their institutional authority.

3 Terms and definitions

3.1 Programme authority

A person or constituted body with an expressly recorded mandate to decide specified programme matters. The term identifies the scope of decision power; it does not imply governmental authority or legal

personality.

3.2 Founding instrument

The record of actual signatories, capacities, express commitments, accepted governance editions, effective conditions, appointments, and limits by which the programme adopts its initial governance.

3.3 Delegation

A bounded assignment of a function by an authority entitled to assign it, together with responsibility, limits, duration or review point, and reporting obligations.

3.4 Affected interest

A person, group, practice, or condition materially affected by a proposed programme activity. An identified affected interest does not imply that a particular participant represents it.

3.5 Decision eligibility

Recorded authority to participate in a particular formal decision under announced criteria. It is distinct from the opportunity to contribute or comment.

3.6 Material governance change

A change affecting authority, decision eligibility, participation rights, appeal independence, publication powers, essential resources, or the ability to maintain operative obligations.

3.7 Reserved decision

A decision retained by the programme decision authority rather than assigned to an editor or administrator. Its classification concerns programme accountability and does not establish a legal classification.

3.8 Governance evidence

Records or observed actions supporting an assessment of a governance requirement, identified by version, custodian, access conditions, and relevant limitations.

4 Mission and programme commitments

4.1 Mission application

CH-006 Programme publications shall distinguish metamodel, record ontology, epistemic representation, normative assessment, jurisprudential status, institutional governance, political economy, and technical implementation wherever a requirement or claim depends on more than one of these layers.

CH-007 The programme shall preserve the distinction between theoretical GR concepts and scoped operational requirements. Intentional narrowing, operationalization, or departure shall identify its foundation sources, alternatives, rationale, and recorded architectural decision.

CH-008 Programme publications and public claims shall not present technical conformance, authentic provenance, a programme decision, or a recorded institutional finding as sufficient proof of factual truth, ethical legitimacy, legal validity, or international endorsement.

CH-009 The programme shall identify jurisdictional and institutional authority separately whenever a proposal concerns legal duties, rights, admissibility, liability, or public power. Unresolved applicability shall remain explicit.

CH-003 Each proposed programme work item shall identify the recognition or practical problem it addresses, its intended beneficiaries and affected interests, its anticipated contribution to the mission, and the evidence by which that contribution will be evaluated.

CH-004 Programme evaluations shall distinguish demonstrated improvements in recording, interpretation, contestation, or practical response from broader claims about restored trust, justice, or future generative capacity. A broader claim shall identify its evidence and limitations.

CH-005 The programme shall examine its own classification, recording, decision, and publication practices as potential sources of exclusion, dependency, and concentrated authority. Findings and corrective decisions shall enter the programme's maintained issue record.

CH-043 The programme decision authority shall maintain a current statement of objectives that links active work to the mission, identifies the practical capacities being developed, and distinguishes intended benefits from effects supported by evaluation. Each annual review shall examine whether the active portfolio still addresses those objectives.

4.2 Selection and review of work

CH-044 When prioritizing work, the programme decision authority shall record the relative need, affected interests, alternatives to new standardization, resource demands, dependencies, and consequences of delay. A priority based on available funding shall identify the resulting coverage gaps and influence conditions.

CH-045 Where evidence shows that a programme activity materially undermines participation, inspectability, contestation, or future access, the responsible authority shall examine revision, narrowing, suspension, or closure and record the chosen response and follow-up evidence. Publication volume shall not alone justify continuation.

5 Publication authority

5.1 Classes and approval boundaries

CH-010 Each publication shall declare its class, maturity, version, responsible editor, and decision authority. Specifications, adopted Standards, policy proposals, governance documents, Technical Reports, and manuals shall retain their distinct authority.

CH-011 The programme shall reserve the designation adopted Standard for an edition approved under its operative development procedure. A draft, schema, prototype, protocol, or technically normative Specification shall not acquire that designation through technical completion alone.

CH-012 Standards-track work shall begin with a stated normative problem, scope, terminology, intended requirements, conformance subjects, and relevant constraints. A dependent Specification work item shall identify the reusable technical need that motivates it. Draft requirements and Specifications may co-evolve through pilots and review.

CH-013 A policy proposal shall identify its intended institution or class of institutions, mandate assumptions, institutional alternatives, expected effects, safeguards, and evaluation approach. Its recommendations shall not amend technical conformance requirements outside the standards-development procedure.

CH-014 Formal work-item approval shall depend on the governance launch conditions in this Charter and Directives Part 1. Preliminary source research, draft preparation, synthetic examples, and technical exploration shall retain their preliminary status while those conditions remain unmet.

5.2 Reserved and delegated powers

CH-046 The programme decision authority shall reserve approval of governance amendments, creation or material alteration of committee mandates, formal work-item initiation, Standard adoption, substantive publication maintenance, and agreements creating programme commitments. A delegation of an operational step shall not transfer a reserved decision unless the operative founding or governance instrument expressly permits it.

CH-047 An editor or repository administrator shall exercise only recorded editorial or custodial powers. Technical ability to merge, publish, assign identifiers, change access, or remove material shall not substitute for authorization of a substantive decision.

CH-048 Before an authorized release, the release owner shall verify the applicable adoption or publication decision and the exact artifact set. If the intended public statement exceeds the recorded decision, the statement shall be corrected or referred for a new decision before release.

6 Participation and consideration

6.1 Entry and access

CH-015 The programme shall provide a documented route for interested individuals to contribute proposals and comments and to receive reasoned dispositions. Employment, institutional sponsorship, a proprietary tool account, payment, or travel shall not be a prerequisite for submitting a relevant comment.

CH-016 The participant register shall distinguish participation in an individual capacity from authorized institutional representation. It shall record relevant affiliations, interests, assigned roles, and any limits on a representation mandate, subject to justified protection of sensitive information.

CH-017 For each work item, the coordinator shall identify affected interests, reviewer competence needed, known participation gaps, outreach undertaken, and feasible measures for language, disability, time-zone, connectivity, and resource barriers. Unfilled gaps shall remain visible in progression decisions.

CH-018 The programme shall provide an asynchronous contribution route and a human-readable account of proposed substantive changes. A contribution requiring assistance with format shall be assessed for its substance after proportionate assistance or an accessible alternative has been offered.

CH-049 The coordinator shall publish the purpose and actual availability of each contribution route, the information needed to handle a submission, access and attribution choices, and the process for obtaining assistance. Failed contact, inaccessible material, or unmet accommodation shall be recorded and referred to the responsible review chair.

6.2 Consideration and protection

CH-019 Funding, institutional affiliation, authorship volume, technical access, or control of repository credentials shall not by itself confer decision rights or priority in comment disposition. The decision authority shall assess whether concentrated interests or unpaid-work burdens materially limit fair consideration.

CH-020 Any restriction on participation shall state the conduct or process reason, its scope, duration or review trigger, responsible decision maker, and available challenge route. Restrictions shall not be

imposed solely because a participant disputes a proposal or authoritative interpretation.

CH-050 Before closing a review, the review chair shall examine recorded access failures and participation gaps, determine their materiality to the decision, and document extension, targeted outreach, alternative access, narrowed claims, or deferral as appropriate. The absence of a complaint shall not alone establish adequate access.

CH-051 When an affected person cannot participate through the published format, the coordinator shall offer a feasible alternative or explain the resource limitation and a route to review it. An assisted submission shall preserve the contributor's intended meaning and identify substantive interpretation by the assisting person.

CH-052 The programme shall distinguish endorsement, consultation, contribution, representation, and assent in public accounts. A participant's name, affiliation, or contribution shall not be used as evidence of support for a decision without an established basis for that attribution.

6.3 Decision eligibility

CH-039 Before constituting a decision roster, the programme decision authority shall publish the proposed decision scope, nominations route, closing date, competence or affected-perspective criteria, expected review commitment, and conflict rules. Eligible individuals shall have an accepted bounded role, disclosed relevant interests, agreed applicable conduct terms, and a recorded capacity for the particular decision. Institutional representation shall require an identified mandate.

CH-040 Selection to or exclusion from a decision roster shall have recorded reasons against the announced criteria and an available procedural challenge. The authority shall assess concentrated interests and missing perspectives before fixing the roster. A roster shall not change during a ballot except through the correction and restart rules of Directives Part 1.

CH-053 A change in an eligible person's affiliation, capacity, or material interest shall be assessed before their next affected decision. The coordinator shall record whether the accepted role remains valid, requires a new mandate, or requires recusal or replacement under the operative procedure.

Eligibility establishes a bounded role. It does not give priority to a participant's factual assertion or make institutional status a substitute for reasons and evidence.

7 Organization and accountable appointments

7.1 Required functions

The minimum functional arrangement comprises founding authority, programme decision authority, coordinator and records custodian, committee convenor, editors or work-item leads, independent procedural review, ethics contact and alternate, rights review, release ownership, and maintenance ownership. All actual appointments are `UNASSIGNED` unless separately recorded.

The programme decision authority corresponds to the governance authority in Directives Part 1. The coordinator and records custodian performs the Secretariat function. The neutral procedural reviewer performs the independent appeal-review function. A review chair is assigned to a particular review. Functions can be combined where competence, capacity, and conflict controls permit.

CH-021 An appointment shall identify the person, appointing authority, accepted mandate, decision limits, relevant interests, start date, term or review date, alternate or vacancy arrangement, and removal or replacement procedure. An office shall not be treated as staffed until acceptance is recorded.

CH-022 The programme decision authority shall publish reasons for appointments, renewals, and

removals at a level compatible with necessary protection. A challenged appointment or removal shall have access to neutral procedural review under Directives Part 1.

CH-023 Where one person holds multiple functions, each decision record shall identify the capacity exercised and any resulting conflict. A person shall not conduct the neutral review of their own challenged decision.

CH-024 The programme shall not delegate a decision to an automated system. AI-assisted drafting, summarization, analysis, or validation shall retain an accountable human role responsible for checking the resulting material and recording consequential use.

CH-025 The programme shall not exercise a delegated function while its required responsible role is vacant or recused without an authorized substitute. Unaffected preliminary work may continue with its status declared.

7.2 Acceptance, performance, and replacement

CH-041 An appointment renewal or proposed removal shall receive a recorded grounds statement and an opportunity for the affected person and relevant participants to respond before a final decision. A non-conflicted authority shall decide the matter within its mandate and provide access to neutral procedural review. Urgent temporary protective measures shall follow the ethics policy and emergency procedure, with a stated review point.

CH-054 Before granting operational access for an appointed role, the appointing authority shall confirm the holder's accepted mandate, relevant competence or induction needs, conflict assessment, and knowledge of escalation and protection duties. Credentials shall be limited to the tasks actually assigned.

CH-055 Each role holder shall report inability to perform a material assigned duty, loss of required access, or a conflict preventing performance to the appointing authority. The authority shall assign an authorized substitute, narrow the activity, or defer dependent decisions and record the response.

CH-056 A role handover shall identify pending decisions, deadlines, records and access responsibilities, conflicts, accepted commitments, and unresolved risks. The outgoing and incoming custodians shall verify transferred access and the disposition of credentials; absence of an outgoing holder shall be recorded with recovery actions.

CH-057 Role performance review shall consider completion and quality of assigned duties, handling of objections, protection of records, influence concerns, and resource limits. An adverse assessment shall identify evidence and permit a response before a final appointment action, subject to time-limited protective measures.

8 Founding and decision accountability

8.1 Founding review and express adoption

CH-001 The programme shall identify this document as a Governance Working Draft until a founding adoption record identifies the adopting persons, their actual authority over programme resources and publications, the edition adopted, its effective date, and the scope of that authority.

CH-002 An adoption record shall distinguish the programme's own publication authority from any claim to represent a profession, institution, community, jurisdiction, or international constituency. Each representation claim shall identify its actual mandate and limits.

CH-036 Before founding adoption, the prospective founding signatories shall identify their actual capacities and proposed commitments, publish the exact governance package within cleared rights, identify

proposed appointments and decision-eligibility criteria, and announce a founding review that applies the public-review, comment-disposition, reply, and material-change periods in draft Directives Part 1 as explicit conditions of that founding process.

CH-037 The founding signatories shall execute an adoption instrument only after review dispositions, a governance rehearsal, accepted minimum appointments, and independent assessment of the founding process are recorded. The instrument shall identify each signatory's express agreement, scope of commitment, dissent, outstanding limits, and the exact texts adopted. A person or institution shall not be bound or represented by a signature that lacks actual authority.

CH-038 The founding instrument shall identify the first programme decision authority, its delegated limits, appointment and succession route, and review date. Founding adoption shall not itself approve GR/NWIP-001 or any technical Standard. Subsequent formal adoption and maintenance decisions shall use the applicable ballot and review rules of operative Directives Part 1, distinguishing substantive maintenance from editorial correction and confirmation.

CH-058 The founding review notice shall distinguish the proposed founding signatories from reviewers and commenters, identify the actual resources or functions they can commit, and explain how additional participation or an objection to authority will be considered. A claimed mandate disputed during review shall receive a reasoned disposition before reliance on that mandate.

CH-059 Execution of the founding instrument shall identify the exact agreement accepted by each signatory, any reservation and its agreed effect, verification of assent, and satisfaction of effective conditions. An unsigned field, synthetic signature, or recorded invitation shall not be treated as assent.

8.2 Readiness and decision evidence

CH-026 Each consequential progression, adoption, mandate, or appointment decision shall identify the operative procedure, authority, evidence considered, interests and recusals, alternatives, material objections, reasons, consequences, and review route.

CH-027 A claim of consensus shall include evidence that relevant concerns were considered and that remaining substantial objections received reasoned treatment. Silence, elapsed time, a vote total, or lack of a funded alternative shall not alone establish consensus.

CH-028 Before formal work-item initiation, the governance launch record shall identify the adopted Charter and Directives, committee mandate, ethics and contribution arrangements, public-review route, maintenance and records arrangements, accepted appointments, and an available neutral procedural review route. It shall include the results and dispositions of a governance rehearsal.

CH-029 If neutral review is unavailable for a consequential contested decision, the programme shall defer that disputed progression or adoption decision and record the capacity gap. The programme shall continue research and drafting that do not depend on the contested authority.

CH-060 The governance launch assessment shall classify each required capacity as available and evidenced, limited with a stated consequence, or unavailable. A rehearsal result shall be recorded separately from actual staffing, public review, permissions, and independent-review availability. Unmet mandatory launch conditions shall prevent formal work-item initiation.

CH-061 For a decision involving multiple functions, the decision record shall identify who prepared the evidence, who reviewed it, who decided, and who implements the result. Combined capacities shall be explicit, and the record shall identify which findings depend on independent consideration.

8.3 Amendment and interpretation

CH-030 An amendment to governance shall follow the change and review procedure in Directives Part 1, state its effective date and transition arrangements, and preserve the prior edition. A procedure shall not be changed retrospectively solely to validate a disputed decision.

CH-062 A request to interpret an operative governance provision shall identify the text, affected decision, competing readings, and practical consequences. The governance authority shall publish a reasoned interpretation within its mandate; an interpretation changing authority, eligibility, obligations, or minimum safeguards shall use the amendment procedure rather than operate as an editorial clarification.

CH-063 A governance amendment shall assess pending proceedings and identify the edition governing each transition. A pending participant's opportunity for reply or procedural review shall not be removed by an undisclosed change of rule.

9 Resources and infrastructure

9.1 Funding and expenditure authority

CH-031 The programme shall maintain an inspectable record of material funding, in-kind support, decision-related conditions, and control of essential infrastructure. Restricted details shall have a stated reason for restriction and an accountable reviewer.

CH-032 A funding or hosting arrangement shall not authorize a sponsor to suppress relevant criticism, require adoption of its preferred technical solution, or bypass review. Material changes in support shall trigger a capacity and continuity assessment.

CH-064 Before accepting material support or expenditure commitments, the authorized holder shall record the purpose, amount or nature of support, actual committing authority, conditions, expected benefit, duration, and effect on independence and continuity. A contribution shall not create an undisclosed priority or publication veto.

CH-065 The programme decision authority shall compare planned obligations with available financial, human, technical, and accessibility resources before authorizing an activity. An unfunded essential safeguard or maintenance duty shall be resolved by resourcing, scope reduction, or deferral rather than recorded as an assumed future capacity.

9.2 Custody and continuity

CH-066 The coordinator shall maintain an inventory of essential repositories, identifiers, contact routes, publication locations, build resources, and protected record stores, with accountable custodians, actual access, recovery arrangements, and dependencies on external providers. Sensitive recovery information shall be protected.

CH-067 The responsible custodian shall periodically exercise recovery of essential publication and decision records and record the recovered version, access limitations, failures, and corrective action. The review interval and extent shall reflect identified continuity risks and shall be included in the governance records schedule.

CH-068 Before a change of hosting or custody, the governance authority shall record preservation of identifiers, versions, access restrictions, permissions, and continuity of comment and review routes. Unrecoverable losses shall be disclosed with their effect on pending decisions and publication claims.

10 Records and external relations

10.1 Inspectable institutional history

CH-033 The records custodian shall maintain access to publication status, version history, work scopes, decision reasons, comment dispositions, and correction notices. Protection or deletion of underlying sensitive records shall retain a non-sensitive account of the action and its authority where permitted.

CH-069 The records custodian shall distinguish operative decisions from proposals, superseded decisions, implementation reports, and unresolved questions. Corrections shall link the changed account to the reason and authority, preserving prior material subject to the applicable protection and retention decision.

CH-070 Where a public account omits protected material, the custodian shall record the basis and scope of restriction and the availability of authorized review. The public account shall disclose its limitation without revealing protected existence, identity, or content where that disclosure would defeat protection.

10.2 Liaison, public statements, and agreements

CH-034 An external liaison, pilot, endorsement, submission, or agreement shall identify who is authorized to act, its purpose and limits, and any external institution's actual assent. Participation in the programme shall not be represented as institutional endorsement.

CH-071 An external agreement proposal shall identify the counterparty's actual mandate, authorized programme signatory, commitments and costs, control of resulting material, publication rights, protection duties, review and termination arrangements, and effects on programme independence. Unresolved authority or rights material to the agreement shall prevent execution of the affected commitment.

CH-072 An authorized spokesperson shall distinguish the programme's adopted position from personal analysis, a committee draft, or a policy option. An inaccurate public claim of adoption, affiliation, or representation shall receive a recorded correction through the same relevant communication route where feasible.

11 Oversight, transition, and closure

11.1 Programme review

CH-035 The programme decision authority shall review mission performance, participation gaps, concentrated influence, conflicts, unresolved appeals, review capacity, and maintenance resources at least annually with the programme account required by Directives Part 1 and after a material institutional change. The review shall record remedial actions, owners, and follow-up.

CH-073 The annual governance review shall identify open corrective actions, repeated procedural failures, unresolved capacity gaps, resource concentration, overdue maintenance, and the practical effects of earlier remedies. The authority shall assign owners, review points, and escalation conditions for actions it retains.

CH-074 A material governance failure shall receive an assessment of affected decisions and publications. The governance authority shall record whether renewed participation, independent review, correction, repetition of a stage, or suspension is required; correcting the administrative record shall not alone validate the original decision.

11.2 Transition and orderly closure

CH-075 A transition to institutional or hybrid participation shall identify representation mandates, decision eligibility, related-entity influence, existing participant treatment, resource needs, and appeal independence, and shall undergo Charter amendment before the new model governs decisions.

CH-076 A proposal to suspend or close programme operations shall identify the reason, actual deciding authority, current commitments, pending reviews and complaints, custodial destination of publications and protected records, rights limits, and feasible maintenance or withdrawal arrangements. The transition shall be reviewed under Directives Part 1 before permanent disposition.

CH-077 A closure or suspension notice shall state which activities stop, which publication statuses remain operative or change, the custodian and available contact route, and unresolved matters. It shall not represent loss of operational capacity as erasure of historical decisions or as retroactive cancellation of external uses.

12 Assessment

12.1 Subject, evidence, and findings

CH-078 A governance assessment shall identify the operative or experimentally assessed edition, review period, scope, assessor, interests, and evidence for each applicable Charter requirement. Results shall distinguish fulfilled, not fulfilled, not assessed, and not applicable, with reasons and corrective actions.

CH-079 An assessor shall examine actual records and demonstrated routes relevant to the claim, including appointments, decision authority, access, recusal, independent review, resources, and continuity. A blank template, announced intention, or unperformed rehearsal shall not be accepted as evidence of completed performance.

12.2 Response and follow-up

CH-080 The programme decision authority shall respond to material assessment findings with an action, owner, due or review date, and consequence for dependent decisions. A finding shall be closed only with recorded evidence of the action or a reasoned change of scope, while preserving any unresolved historical effect.

Annex A

(normative)

Minimum governance evidence records

A.1 Common record elements

CH-081 Each governance evidence record shall include a stable identifier, record type, responsible actor, relevant date or interval, applicable governance edition, subject and version, evidence location or access limitation, status, related records, and correction history. Unknown information shall be explicitly identified rather than supplied by inference without attribution.

A.2 Authority and appointment record

The authority and appointment record contains: actual person or body; source and scope of power; accepted capacity; reserved and delegated decisions; start and end or review conditions; interests and management; substitute or vacancy route; contact; and evidence of assent. Where public and protected versions differ, their relationship is identified through the access record.

CH-082 The appointing authority shall maintain the authority and appointment elements in this annex for each operative role and shall update the record when its holder, scope, interests, acceptance, or effective status changes.

A.3 Decision and review record

The decision record contains: question; authority; input editions; evidence and alternatives; participating capacities; conflicts and recusals; material objections and replies; procedure and any ballot reference; reasons; result; conditions; implementation owner; notice; and review route. The review record adds findings, limitations, corrective actions, follow-up dates, and verified completion.

CH-083 The responsible decision maker shall ensure that a consequential decision has the decision and review elements in this annex before it is relied on for progression. Where evidence is restricted, authorized review access and a safe public account shall be identified.

A.4 Continuity and transition record

The continuity record identifies essential resources, their custodians, recovery and access arrangements, test results, dependencies, and unresolved failures. The transition record identifies outgoing and incoming responsibility, transferred obligations, untransferred material, permission limits, notices, and acceptance of custody.

CH-084 The governance authority shall use the continuity and transition elements in this annex when authorizing a transfer, prolonged suspension, or closure and shall record material gaps and their disposition.

A.5 Selection of assessment evidence

CH-085 The assessor shall select evidence appropriate to the requirement using the minimum evidence families in Table A.1. An assessment based on sampling shall identify the population, selection rationale, excluded cases, and limits on conclusions. Documentary completeness shall not replace observation of a route whose actual availability is claimed.

Table A.1 – Governance evidence families and assessment limits

Function	Evidence and method	Limitation requiring separate treatment
Founding and delegation	Inspect actual commitments, mandates, accepted appointments, effective conditions, and edition references.	A signature or role name does not establish authority beyond the scope supported by its recorded basis.
Participation	Inspect notices and accommodation records; exercise public and protected routes with authorized test material.	A working contact route does not demonstrate that affected perspectives were reached or their concerns considered.
Decision and challenge	Trace input versions, objections, replies, reasons, conflicts, independent review, and implementation of remedies.	Procedural completeness does not establish substantive truth or agreement of an absent constituency.
Resources and independence	Inspect support conditions, essential resource control, actual staffing, and response to concentration findings.	Stated independence does not demonstrate that a reviewer is available or free of the relevant interest.
Continuity and records	Observe a permitted recovery exercise and compare restored versions, access controls, identifiers, and unresolved losses.	A successful copy does not establish preservation of meaning, rights, or the ability to resume a pending review.
Transition and closure	Inspect notices, accepted custodial transfer, unresolved commitments, status changes, and accessible contact.	A declared closure does not dispose of external rights or eliminate consequences of earlier programme decisions.

Annex B

(informative)

Application examples and design rationale

B.1 Funding concentration

A prospective host offers free infrastructure subject to exclusive control over publication access. The funding record exposes the condition, while the authority record shows that the host has no adoption power. Review examines an alternative host, portable copies, protected records, and continuity costs. Acceptance depends on resolving the condition consistently with programme independence; the price alone does not determine the result.

B.2 Founding capacity shortfall

Prospective signatories complete draft charters and a synthetic appeal exercise but have no available independent reviewer. The governance assessment records completed drafting and rehearsal separately from missing operational capacity. Source inquiry and document development continue. Formal work-item initiation remains pending until accepted appointments and the actual review route meet the launch requirements.

B.3 Changed representation

A committee participant changes employment during a ballot. The coordinator examines whether the accepted capacity was individual or institutionally mandated and whether the new interest affects recusal or the roster. The applicable Directives determine whether correction requires a restarted ballot. The participant's earlier contribution remains attributed even if their decision capacity changes.

B.4 Basis for the selected model

Open individual contribution lowers initial organizational barriers but can concentrate influence among people able to contribute unpaid time. Bounded appointments, explicit affiliations, assistance routes, and review of missing perspectives address that risk without claiming universal representation. Institutional membership and hybrid chambers remain alternatives requiring demonstrated mandates and administrative capacity.

B.5 Unresolved adoption decisions

OPEN ISSUE Founding signatories, organizational form, actual appointments, neutral-review capacity, operating resources, protected contact routes, and operative contribution terms remain unresolved. This draft supplies the requirements against which their proposed resolution can be reviewed.

OPEN ISSUE The minimum accessibility target, longer-term participation model, and evidence needed to assess societal effects remain subjects for governance and work-item review. The Charter does not assume that successful programme procedure demonstrates restored social trust.

Bibliography

Source and interpretation: Programme Brief, version 0.5; comprehensive development plan, version 0.1; cross-domain programme; foundation traceability map, particularly FT-01 and FT-06. Local paths: `PROGRAMME_BRIEF.md` and `docs/planning/`. These explain the mission and candidate operational direction.

Source and interpretation: Foundation manuscripts: FM-001, `GRE_Chapter_01.pdf`, section 1.14.2–1.14.5, pp. 79–83; FM-003, `GRE_Chapter_03.pdf`, section 3.12, pp. 129–132; FM-005, `GRE_Chapter_05_Complete_First_Draft.pdf`, section 5.18, pp. 150–153. Files are in `foundation_manuscripts/`. These ground the orientation to representational instability, revisable action, and unequal evidential capacities; they do not enact these governance clauses.

Source and interpretation: WTO, Principles for the Development of International Standards, Guides and Recommendations, official presentation of the 2000 TBT Committee decision, consulted 2026-09-22: https://www.wto.org/english/tratop_e/tbt_e/principles_standards_tbt_e.htm. Its treatment of transparency, participation, impartial consideration, relevance, coherence, and resource barriers informs process design. Local requirements and organization are programme proposals, not a claim of WTO recognition.

Source and interpretation: United Nations, National Quality Assurance Frameworks Manual for Official Statistics, 2019: https://desapublications.un.org/publications/united-nations-quality-assurance-frameworks-manual; official overview consulted 22 September 2026. The sector-specific quality-assurance approach informs examination of institutional capacity alongside outputs. Programme governance remains local and does not acquire a national-statistics mandate through this comparison.

Source and interpretation: ISO, Model International Standard, third edition, 2023: https://www.iso.org/iso/model_document-rice_model.pdf. Its formal document organization informs the distinction among front matter, provisions, and annex status. Local scope and authority remain those recorded in this Charter.

GENERATIVITY STANDARDS PROGRAM

Directives Part 1

Governance Working Draft

Version 0.3 2026-09-22

Procedures for Development and Maintenance

WORKING DRAFT FOR REVIEW

This document contains proposed provisions for technical and institutional review. It is not an adopted Standard or an operative governance instrument. Its scope, application conditions and publication status are specified in the text.

Prepared by the Generativity Standards Program. Reference to external publications does not imply endorsement by ISO, IEC, IEEE or any United Nations body.

Foreword

Version 0.3 records the bounded substantive review of the archived 0.2 package. This edition clarifies valid ballots, unsuccessful attributable submissions, nonresponse accounting and retention of an earlier valid ballot; quorum and approval thresholds are unchanged. The review matrix, synthetic assessments and unresolved readiness questions are documented in `docs/reviews/validation_0.2/README.md`. These activities do not constitute adoption or an independent institutional assessment.

This document proposes an executable development procedure for the Generativity Standards Program. Its clauses govern the programme only after explicit governance adoption. It is a **PROVISIONAL Governance Working Draft**, not an adopted Standard, an approved project, or evidence that a committee exists. Its numbered requirements are proposed requirements. A rehearsal can test them without making them operative.

Responsible editor: `UNASSIGNED`. Canonical source: `governance/directives_part_1.tex`. Intended readers are founding participants, procedural administrators, editors, reviewers, affected people, and prospective implementers of the development procedure. The assessed subject is a particular project-development or maintenance procedure and its records, not the substantive truth of a resulting Standard.

This edition expands draft 0.1 while preserving the meaning of D1-001 through D1-058. The additional schedules specify evidence and handling responsibilities rather than constitute programme offices. Draft 0.1 remains a historical publication. The proposed local numerical defaults are unchanged.

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Introduction

The procedure supports inspectable, revisable recognition and practical action by preserving grounds, alternatives, objections, decisions, and subsequent changes in standards development itself. Its central object is a justified progression decision: who could contribute, what was considered, why a direction was selected, which disagreements remain, and how later correction can occur.

The programme examines standards-development practice without assuming the institutional resources or representative mandate of an established international standards body. Explicit work authorization, documented review, conflict-sensitive decision making, public scrutiny, and maintenance are adapted to actual available capacity. A short procedure can conceal an unavailable role just as easily as an elaborate organizational chart. These Directives consequently make vacancies and failures visible and prevent a document's apparent completeness from substituting for an operative institution.

Public participation and evidential adequacy are related but distinct. A numerical majority cannot establish a substantive fact, and a well-supported technical conclusion does not excuse exclusion from the prescribed process. Standards development can affect access, cost, classification, and future practical possibilities; review therefore examines these consequences alongside implementation and conformance.

1 Scope

1.1 General

These Directives specify development, review, decision, publication, maintenance, and appeal procedures for programme publications. They address officials, editors, contributors, reviewers, affected participants, and assessors. They do not determine the truth of recorded claims, settle GR theory by vote, or confer external legal authority. A procedure assessment identifies its project or decision scope and does not establish programme-wide fulfillment from a single dossier.

2 Normative references

2.1 Draft dependencies

The following companion Governance Working Drafts, version 0.3, provide proposed internal dependencies: the Standards Programme Charter, Directives Part 2, the GR/TC 1 Charter, and the Ethics, Conflict-of-Interest, and Contribution Rights Policy. Their source files are in `governance/`. References are dated to these draft editions for coordinated review; none is represented as adopted. The founding instrument identifies the exact adopted editions and applicable transition arrangements. A dependency change requires review of affected provisions and assessments.

External standards-development and United Nations system publications are informative comparison sources. No external voting rule, institutional mandate, or legal entitlement is incorporated by reference. The programme's own public-review periods and thresholds arise from its governance choice.

3 Terms and definitions

3.1 Operational procedural terms

Governance authority The body or bounded transitional authority constituted by the adopted Charter; its mandate determines which decisions it can take.

Technical committee An actually constituted committee with a bounded project mandate; not a label that itself establishes authority.

Substantive change A change that could alter scope, meaning, duties, permissions, conformance outcomes, interoperability, protection, or practical consequences.

Substantive objection A reasoned concern about technical adequacy, evidence, scope, procedure, rights, participation, harm, or feasibility relevant to the proposed decision.

Consensus assessment A documented assessment of participation, consideration of concerns, remaining disagreement, and grounds for progression. It is distinct from a ballot tally.

Eligible participant A person assigned decision rights under the Charter and recorded for the specific decision; authorship, payment, or attendance alone does not confer those rights.

Calendar day A day counted using the closing time and time zone stated in the notice. A notice states an exact closing timestamp.

4 Founding, responsibilities, and participation

4.1 General

D1-001 The programme shall apply the adopted Charter for decision authority and appointments, these Directives for development procedure, Directives Part 2 for drafting, and the adopted Ethics, Conflict-of-Interest, and Contribution Rights Policy for conduct, conflicts, and rights. A conflict between these instruments shall be referred to the governance authority and resolved before a dependent decision proceeds.

D1-002 Every procedural decision shall identify its accountable decision maker, operative authority and procedure versions, input document versions, grounds, outcome, date, and review or appeal route. Drafting, a repository merge, an ADR, or successful compilation shall not constitute governance adoption or Standard approval.

D1-003 An organizational function without an appointed holder and recorded mandate shall remain `UNASSIGNED`. Formal project initiation and adoption shall remain pending while required authority or an independent appeal route is unavailable. Preliminary research, drafting, and synthetic rehearsals may continue with explicit status labels.

D1-004 Before formal standards-project approval, the founding adoption record shall identify the founding basis, adopted governance texts and versions, participants and capacities, decision method, dissent, transitional limits, review date, and replacement route. Governance adoption shall follow the founding procedure recorded under the Charter, rather than assume that these draft Directives have already authorized themselves.

D1-005 The governance authority shall assign oversight, project progression, public-review administration, release, maintenance, conflict handling, and independent appeal functions. The assignment register shall identify holders, terms, delegated limits, substitutes, and contact routes. Combined roles shall be disclosed; an interested decision maker shall not determine their own procedural appeal.

D1-006 The Secretariat shall maintain an accessible work programme and participation route. A project notice shall identify the problem, scope, current status, available documents, contribution terms, comment routes, decision roles, and intended review dates. Public comment shall not require voting membership or endorsement of the proposal.

D1-007 The review chair shall document outreach to affected interests and relevant expertise, participation barriers, affiliations relevant to dominance, and remaining gaps. The chair shall provide an asynchronous contribution route and record requested accessibility or language accommodations and the response. Lack of response shall not be recorded as consent.

D1-008 Before a formal decision, the chair shall confirm current conflict declarations and apply the adopted recusal procedure. The record shall identify recusals and their effect on eligibility and quorum without disclosing protected details unnecessarily. If conflicts prevent a valid decision or impartial review, progression shall be deferred.

NOTE 1 Participant eligibility and appointment belong to the Charter; conduct and contribution permissions belong to the Ethics, Conflict-of-Interest, and Contribution Rights Policy. These Directives do not grant membership, impose a license, or establish a legal entity.

5 Project initiation and scope control

5.1 General

D1-009 A New Work Item Proposal shall identify purpose, intended users and affected people, publication class, bounded deliverables, exclusions, proposed conformance subjects, alternatives to new standardization,

source basis, dependencies, review expertise, pilot evidence, resource needs, and prospective maintenance responsibility.

D1-010 The proposal shall explain how the work addresses warranted recognition or generative trajectory and identify epistemic assumptions, ethical impacts, legal and institutional boundaries, public-policy implications, accessibility, protection needs, and distribution of recording and implementation burdens. A claimed institutional mandate shall identify its source and limits.

D1-011 The technical committee shall begin with the normative problem and assessment needs. A dependent Specification proposal shall identify the draft requirements requiring reusable technical infrastructure, the implementation alternatives, and intended tests. A protocol proposal shall additionally identify actors, interactions, states, transitions, outcomes, failure handling, and authority boundaries.

D1-012 The authorized project decision maker shall record accept, revise, defer, or reject, with reasons, scope, assigned responsibilities, dependencies, and review milestones. A coordinated proposal shall retain a separate bounded scope and progression record for each deliverable. A technical dependency shall not acquire Standard status through inclusion in a proposal.

D1-013 A proposed expansion beyond approved scope shall receive impact review and an explicit scope decision before dependent progression. A Specification intended for promotion to a Standard shall enter an explicit standards-track proposal and the applicable review stages; technical stability alone shall not authorize promotion.

5.2 Proposal handling and accountable capacity

D1-059 The Secretariat shall register a proposal with an identifier, receipt date, proposer, proposed class, scope version, and handling status. It shall acknowledge receipt within seven calendar days and identify the authority responsible for scheduling its consideration. An incomplete proposal shall receive a specific request for information or a reasoned deferral; registration shall not confer project approval.

D1-060 Before accepting a project, the decision authority shall verify that the editor and maintenance owner accept their responsibilities, required review competence can be obtained, the resource estimate includes participation and protection work, and the work plan states review dates and capacity limits. An unfilled essential role shall be resolved through assignment, a narrower scope, or deferral, rather than entered as an assumed resource.

D1-061 The project register shall distinguish proposed, active, suspended, closed, and completed work and retain the reason for a change of status. A proposer may withdraw a proposal before authorization; withdrawal shall preserve its record and relevant unresolved issues. Suspension or closure of approved work shall be authorized with affected-participant notice and a disposition of dependencies, contributions, and remaining records.

NOTE 1 Acceptance authorizes bounded work, not its expected conclusion. A negative pilot or a well-supported decision that standardization would add excessive burden can justify scope reduction or closure. A sponsor's preferred implementation remains an alternative to evaluate rather than the implicit criterion of success.

6 Stages and progression evidence

6.1 General

The following codes are the programme's local lifecycle. They retain the repository's grouping of review, revision, and withdrawal under stage 90. Specifications have separately declared maturity; stage 60 is reserved here for adopted Standards.

Table 1 – Local development stages and progression evidence

Stage	Local status	Evidence for progression
00	Preliminary	Need, preliminary sources, alternatives, and draft NWIP; no project authority presumed.
10	Proposal	Approved bounded scope, capacity, assignments, dependencies, and review plan.
20	Working Draft	Candidate clauses, source and decision traceability, assessment methods, and example or pilot design.
30	Committee Draft	Integrated requirements, review findings and dispositions, pilot evidence and limitations, proposed public-review package.
40	Public Review Draft	Versioned notice, accessible draft, comments and responses, material-change review, and remaining objections.
50	Final Approval Draft	Frozen approval package, consensus assessment, valid ballot, procedural checks, and appeal handling.
60	Published Standard	Recorded adoption and release authorization, verified publication package, maintenance owner and next review date.
90	Review / revision / withdrawal	Issue and impact evidence; recorded confirmation, correction, amendment, revision, supersession, or withdrawal.

D1-014 Each progression decision shall state the current and proposed stage, evaluate the relevant evidence, identify remaining limitations, and record approval, return for revision, deferral, or closure. A stage label shall not substitute for the decision record. No Standard shall skip public review or final approval by claiming that a prototype or pilot already establishes acceptance.

D1-015 The editor shall retain versioned drafts, a requirement-to-source and assessment map, an issue register, and substantive decision records identifying alternatives, selected direction, rationale, and affected artifacts. GR interpretation shall use relevant foundation manuscripts and preserve unresolved source differences; operational narrowing affecting architecture shall have an ADR.

D1-016 At committee review, named reviewers shall evaluate epistemic adequacy, practical usability, ethical and distributional effects, accessibility, preservation and protection, legal/institutional boundaries, and technical feasibility within declared competence. Missing expertise or evidence shall be reported and resolved, or the scope narrowed, before unsupported requirements advance.

D1-017 Pilot reports shall identify the tested versions, cases and negative cases, methods, participants' roles, failures, burdens, limitations, and resulting changes. Synthetic or author-operated tests shall be labelled accordingly. External institutional participation, access authority, independent validation, and legal validity shall not be inferred from a synthetic rehearsal.

6.2 Stage controls and project records

D1-062 The project lead shall assemble the entry and exit evidence specified in Annex A before requesting progression. The decision authority shall record its assessment of each applicable item, the evidence locator, responsible reviewer, result, and any required action. An inapplicable item shall have a scope-based reason; unperformed work or unavailable evidence shall not be recorded as fulfilled.

D1-063 A Working Draft shall identify open design alternatives and any unresolved requirements or dependencies. A Committee Draft shall integrate the selected proposal, source rationale, assessment method, and issue disposition sufficiently for a reviewer who did not participate in authoring. Neither designation shall imply that open issues have disappeared merely because the document has been renumbered.

D1-064 Before public review, the chair shall verify that applicable requirements have identified conformance subjects and assessment methods, examples are distinguished from obligations, material pilot failures are visible, and unresolved issues are bounded. A requirement whose interpretation depends on unavailable material or an unsettled contradiction shall be revised, narrowed, or withheld from the proposed normative scope.

D1-065 A coordinated package shall identify authoritative locations for shared requirements, exact dependency versions, change propagation responsibilities, and release sequencing. The responsible editors shall assess a material dependency change against affected scopes, tests, examples, and users before progressing any dependent release. Circular references shall not be used to conceal an unassigned obligation or unsupported conformance claim.

D1-066 A meeting used for a consequential decision shall have prior notice, an agenda and accessible materials, an assigned chair, identified participants and capacities, declared conflicts, and a decision record. A person unable to attend shall have the declared asynchronous opportunity to contribute before the decision closes. Meeting attendance alone shall not replace the prescribed ballot, public review, or reply period.

D1-067 The chair shall circulate a proposed decision record for correction of factual inaccuracies and attribute unresolved corrections before using it as progression evidence. An editorial correction to minutes shall not alter the decision taken; a proposed change to that decision shall use the relevant reconsideration or new-decision procedure. The register shall distinguish a proposal, recommendation, authorization, and completed action.

7 Public review and comment disposition

7.1 General

D1-018 Before opening public review, the chair shall freeze a uniquely identified draft and publish its scope, class, maturity, change summary, dependencies, known limitations, review questions, exact opening and closing times, submission routes, and intended treatment of commenter information. Required supporting material shall be accessible to reviewers under workable terms.

D1-019 Public review shall remain open for at least 60 calendar days. The chair shall record outreach, access interruptions, and accommodation needs; a material access failure shall receive an extension sufficient to restore meaningful opportunity, with reasons and revised closing time published.

D1-020 The Secretariat shall accept comments in an accessible free-text route as well as any structured template. It shall assign a stable identifier, record the affected version or topic, requested change if supplied, receipt date, and disclosure preference, and acknowledge receipt within seven calendar days. A comment shall not be rejected solely for lacking technical drafting expertise.

D1-021 The Secretariat shall offer a protected route for justified confidential submissions and explain its access limits. The chair shall arrange competent consideration and publish a safe summary of the issue and disposition where possible. If essential grounds cannot be exposed sufficiently for fair review, the chair shall record the limitation and defer or narrow the affected decision.

D1-022 The responsible review group shall give every in-scope comment a disposition of accepted, accepted with modification, not accepted, or deferred, with reasons and links to affected clauses or issues. Out-of-scope and duplicate comments shall retain identifiers and a reason or linked disposition. Deferral shall identify an owner, next action, and why the unresolved issue does not invalidate proposed progression.

D1-023 The chair shall target initial dispositions within 30 calendar days after review closes. If that target cannot be met, the chair shall publish reasons, interim status, and a new target before it expires. A

target extension shall not deem comments resolved. Commenters shall receive disposition notice and at least 30 calendar days to reply before final approval.

D1-024 The chair shall assess each reply and record remaining disagreement. Late comments shall be logged with reasons for current-cycle consideration or later referral; a newly identified material safety, rights, or validity defect shall receive assessment before adoption regardless of receipt date.

D1-025 A substantive post-review change shall undergo public re-review for at least 30 calendar days, showing the changed text, reasons, effects, and affected dependencies. The chair shall notify previous commenters and newly affected interests. A change that substantially alters the purpose, affected constituency, or conformance subject shall receive renewed scope approval and a full 60-day review.

D1-026 Re-review shall permit comments on changed material and its consequences for unchanged clauses. Further substantive changes shall repeat the applicable review. Editorial changes shall be logged with a reason why meaning and conformance remain unchanged.

7.2 Comment register and review administration

D1-068 The Secretariat shall maintain the comment and disposition register specified in Annex B. A combined response may address duplicate issues only if each original comment remains traceable and its distinct material grounds are considered. Splitting a submission into issues shall preserve the connection to its original meaning. Summary statistics shall not substitute for the disposition of an unresolved substantive concern.

D1-069 A review closure record shall identify the exact closing time, submissions received, submissions awaiting acknowledgement or clarification, late submissions, access failures, extensions, and next steps. The chair shall distinguish closure of intake from completion of dispositions. The count of unresolved comments shall not become zero merely because the public submission window has closed.

D1-070 For each proposed disposition, the review group shall identify the responsible respondent, material evidence, affected requirements, reason, resulting text or decision, and review required by the change. A not-accepted disposition shall address the substantive grounds rather than rely solely on lack of votes, institutional rank, drafting inconvenience, or an unsupported assertion that the issue was already settled.

D1-071 If a submission includes conduct allegations or protected information together with a technical objection, the Secretariat shall separate access and handling while retaining a safe cross-reference. The technical issue shall continue to receive consideration unless a recorded reason requires a stay. Protected reporting shall not confer permission to publish personal details in the public disposition register.

D1-072 When sending a disposition or re-review notice, the Secretariat shall record its intended recipients, authorized route, content version, dispatch time, and known delivery failures. Where a material failure prevents meaningful reply, the chair shall provide a workable alternative or extend the affected reply opportunity and record the resulting progression consequence. A failed delivery shall not be represented as silence by the recipient.

NOTE 1 A long review period does not demonstrate effective participation if a relevant person could not obtain the text, understand the submission route, or receive a response. Accessibility and outreach are assessed through the record of practical barriers and responses, not inferred from the existence of a public URL.

8 Consensus, ballots, and final approval

8.1 General

D1-027 Before recommending progression, the chair shall produce a consensus assessment identifying participation and gaps, objections, attempts at resolution, evidence and alternatives considered, remaining dissent, and reasons for the recommendation. Numerical approval shall not establish substantive truth or by itself dispose of an objection.

D1-028 A sustained substantive objection shall receive reasoned consideration and an opportunity for reply. It shall not automatically confer a veto. Unresolved defects in mandatory procedure, decision authority, rights to participate, or required evidence shall prevent progression until remedied. Other remaining disagreement shall be visible in the approval package and assessed by the authorized decision maker.

D1-029 For adoption, substantive maintenance decisions, and other decisions assigned a formal ballot by the Charter, the Secretariat shall circulate a frozen package and proposed resolution for at least 30 calendar days. It shall state eligible participants, recusals, closing time, threshold calculation, ballot options, and challenge route. Ballots shall be approve, disapprove, or abstain; nonresponse shall be recorded separately.

D1-030 The eligible non-recused roster shall be fixed before ballot opening. Each eligible person shall have one ballot in their declared capacity; proxies and duplicate capacities shall not count. Eligibility corrections or later recusals shall be recorded. A change materially affecting the electorate, quorum, or result shall require a new ballot; membership shall not be manipulated to obtain a desired outcome.

D1-031 Let N be the number of eligible non-recused participants, R valid returned ballots including abstentions, Y approvals, and D disapprovals. A ballot shall meet quorum only if $R \geq \lceil 2N/3 \rceil$. Approval shall also require at least three substantive ballots, $Y + D \geq 3$, and $Y \geq \lceil 2(Y + D)/3 \rceil$. Abstentions shall count for returned-ballot quorum but not the substantive-ballot minimum or approval denominator; nonresponses shall count for neither.

D1-032 The result shall include the frozen roster count, recusals, valid returned ballots, approvals, disapprovals, abstentions, eligible participants with attributable excluded or unresolved attempted submissions but no valid counted ballot, eligible participants without an attributable submission, calculation, minority grounds, and decision. The reconciliation shall distinguish $R = Y + D + A$, I eligible participants with such unsuccessful attempts and no valid counted ballot, and U eligible participants without an attributable submission, with $N = R + I + U$. Unattributable and ineligible submissions shall have a separate protected inventory and shall not be assigned to an eligible participant without grounds. Failure of quorum or threshold shall return the matter for further work or deferral, without deemed approval. A substantive change during ballot shall return to the applicable review stage.

D1-033 Final approval shall require a procedurally valid ballot, reasoned consensus assessment, completed dispositions and reply periods, resolved blocking findings, compatible normative dependencies, rights clearance, maintenance assignment, and an authorized adoption record. The Secretariat shall publish accessible decision notice, notify participants and commenters, and record when the appeal period starts. Release shall await that period and resolution of any appeal affecting adoption or publication.

OPEN ISSUE All numerical values in this draft are local proposals requiring author and participant review before governance adoption. They are not ISO/IEEE rules. A valid three-person ballot does not itself demonstrate stakeholder breadth or independent review capacity; the informative defaults annex identifies these participation-risk choices for explicit review.

8.2 Ballot administration and authorization

D1-073 The ballot notice shall include the exact resolution, frozen text and associated artifacts, consensus assessment, dispositions, remaining objections, eligibility basis, and required calculation. The Secretariat shall provide each eligible person a means to submit one attributable ballot without disclosing unnecessary personal information and shall identify a neutral route for challenges to ballot administration.

D1-074 A participant may replace their own ballot before the declared closing time; the Secretariat shall count only the latest valid submission and retain a protected audit of the replacement. An ambiguous or unverifiable submission shall receive a clarification request and shall not be silently converted to approval or abstention. The last valid submission shall remain counted unless withdrawn or invalidated under an identified applicable rule. A participant with a valid counted replacement shall not also be counted in the unsuccessful-attempt category in D1-032. Ballot validity decisions shall identify the rule applied, grounds, clarification status and available challenge route; unresolved validity shall not be relabelled as absence of an attempted submission.

D1-075 A ballot extension shall be announced before the original close, state the access or participation reason and new closing time, and apply equally to the eligible electorate. An extension shall not change the resolution or threshold or be used solely to solicit a desired result. A frozen package requiring substantive change shall be withdrawn from ballot and returned to applicable review.

D1-076 A non-conflicted person other than the person compiling the tally shall verify eligibility counts, duplicate or replacement handling, recusals, arithmetic, and the consistency of the declared result with the frozen resolution. The verification record shall identify any unresolved discrepancy. A numerical pass with an unresolved blocking procedural finding shall not authorize adoption.

D1-077 The adoption or release authorization shall identify the approved publication class and edition, resolution, vote result where required, consensus rationale, authority exercised, effective date, appeal notice, and conditions affecting release. The release owner shall distinguish this authorization from compilation, distribution, and commencement of an institution's use. An institution's uptake shall not be inferred from programme publication.

9 Procedural appeals and separate complaint routes

9.1 General

D1-034 A participant, commenter, or person directly affected by a programme decision may lodge a procedural appeal identifying the decision, alleged procedural failure, available evidence, and requested remedy. Membership or payment shall not be a condition. The ordinary filing period shall be 30 calendar days after accessible notice of the decision; lack of effective notice or newly discovered concealed procedural failure shall permit a reasoned extension by the independent reviewer.

D1-035 The Secretariat shall acknowledge an appeal within seven calendar days and refer it to an appointed reviewer independent of the disputed decision. The reviewer shall disclose relevant involvement and interests, consider conflict objections, and record independence. The decision's author, a materially interested participant, or a person deciding a related complaint about their own conduct shall not determine the appeal.

D1-036 The reviewer shall state scope, admissibility reasons, record access arrangements, and timetable; provide the appellant and responsible decision maker a meaningful opportunity to reply; and issue a reasoned determination. An initial determination shall be targeted within 30 calendar days of receipt, with reasoned extensions and updated dates notified before expiry. No response or elapsed time shall constitute rejection.

D1-037 An appeal concerning adoption, public-review exclusion, or authority shall pause the affected publication decision. Other appeals shall receive a recorded decision on whether a stay is necessary to prevent prejudice. If no independent reviewer is available, consequential contested progression shall remain pending while unaffected work continues.

D1-038 The reviewer may uphold the process, require disclosure or correction of records, set aside a procedurally defective decision, or remit the matter for renewed participation, review, or ballot. The reviewer shall not substitute a ruling on factual truth, external legal entitlement, or technical merit for procedural review. The accountable body shall record implementation of the remedy before renewed progression.

D1-039 Technical reconsideration, conduct complaints, record-specific access or correction requests, and external legal remedies shall have distinguishable routes. Misrouted submissions shall receive assisted referral rather than silent rejection. Protected conduct handling shall follow the adopted ethics policy; disagreement alone shall not be treated as misconduct. Internal review shall not be presented as replacing external rights or remedies.

9.2 Appeal case management

D1-078 An appeal record shall identify the challenged decision, appellant or protected reference, grounds, requested remedy, receipt and notice dates, admissibility assessment, appointed reviewer, disclosed conflicts, participation opportunities, stay status, outcome, reasons, and implementation responsibility. Refusal to admit an appeal shall receive reasons and the same independence safeguards as a determination on its merits.

D1-079 The reviewer shall distinguish an objection to the substantive proposal from an allegation that the operative process was not followed. A submission containing both shall receive coordinated handling without forcing the appellant to abandon either ground. A procedural remedy shall identify which decision or stage is affected and what evidence is required before the stay can be lifted.

D1-080 A protected appeal shall give each affected party sufficient grounds and opportunity to respond for the determination being made. If disclosure limits prevent fair determination, the reviewer shall narrow the finding, obtain an authorized independent examination, or defer with stated reasons. Confidentiality shall not be described as proof that the undisclosed account is correct.

D1-081 The Secretariat shall track implementation of an appeal remedy and provide the appellant with its status through the permitted route. A remitted decision shall cite the appeal and demonstrate completion of the required reconsideration or repeated stage. Closing the appeal file shall not establish that a correction, new review, or practical remedy has been completed.

NOTE 1 Repeated submissions of the same disposed procedural point can be consolidated with an explanation and a preserved reference. Newly available evidence, a different material procedural failure, or alleged nonimplementation of a remedy requires an assessment of whether the case should be reopened; a previous closure is not a universal bar.

10 Publication and release integrity

10.1 General

D1-040 The release owner shall verify that the exact publication package implements the approved text and decision. The package shall identify edition, date, class, maturity, adoption authority, conformance scope, dependencies, licenses or permissions, known limitations, maintenance contact, next review date, and superseded publications where applicable.

D1-041 The release manifest shall identify authoritative source files, rendered publications, schemas or fixtures where included, their versions and integrity checks, build instructions and tool versions, and

the approval record. A reviewer other than the final editor shall compare the rendered output with the approved source for omitted, altered, or unreadable requirements and record the result.

D1-042 The release owner shall resolve source/build discrepancies before release. Source corrections affecting meaning shall return to substantive review; a rebuild shall not silently change an adopted requirement. Public notices shall distinguish an adopted Standard, a Specification, an informative publication, and a policy recommendation and shall not claim ungranted endorsement or certification.

10.2 Release dependencies and distribution

D1-082 Before release, the owner shall complete the release register in Annex B, including dependency availability, permission basis, source/render verification, accessibility limitations, unresolved issues, appeal status, distribution locations, and withdrawal contact. A dependency that is unavailable on usable terms shall trigger scope revision or deferral rather than an unsupported interoperability claim.

D1-083 A corrected build or accessible alternative representation shall identify its relationship to the approved edition and whether substantive content is unchanged. Where two representations disagree, the owner shall issue a notice, determine the approved content from the decision record, and correct the affected artifacts under the applicable change procedure. A hidden preference for the newest file shall not resolve normative disagreement.

11 Maintenance, review, and withdrawal

11.1 General

D1-043 Every release shall have an assigned maintenance owner, issue intake route, and next review date. The default review interval shall be two years, shortened by a recorded risk-based decision. Loss of ownership, serious defects, changed dependencies, inaccessible implementation rights, or evidence of material exclusion or harm shall trigger earlier review. An overdue review shall be publicly marked and escalated; silence shall not confirm continued suitability.

D1-044 The maintenance owner shall log reported issues, classify their effect, identify affected versions and dependencies, and publish disposition or investigation status. A correction request shall not be rejected merely because the reported behavior matches the current text.

D1-045 A corrigendum shall correct an error without introducing a new obligation, altering intended meaning, or changing a valid conformance outcome. It shall identify the affected text, corrected text, justification, reviewer, and authorization. If semantic effect is uncertain, the change shall use the amendment or revision route. Historical publications shall remain identifiable rather than silently overwritten.

D1-046 An amendment shall make a bounded substantive change to a named edition; a revision shall issue a consolidated new edition. Both shall receive scope approval, assessment of dependent artifacts and users, appropriate pilots, committee and public review, and final approval under these Directives. An incompatible change shall include migration, coexistence, and deprecation information without claiming lossless conversion absent evidence.

D1-047 Periodic review shall invite evidence from users and affected parties and record confirmation, correction, amendment, revision, supersession, or withdrawal with reasons. Confirmation shall require a maintenance report and an authorized decision; it shall not erase known limitations.

D1-048 Proposed withdrawal or supersession shall receive a public notice of reasons, dependencies, transition consequences, and alternatives for at least 60 calendar days, followed by comment disposition, reply, and formal approval. Withdrawn editions shall remain identifiable with status and date; withdrawal

shall not retroactively change what a past conformance claim asserted. Necessary protection of underlying records shall follow D1-052, D1-053, and EIP-039.

11.2 Maintenance decisions and compatibility

D1-084 An issue assessment shall distinguish editorial error, conflicting requirements, implementation defect, changed external dependency, emerging misuse or harm, accessibility failure, and proposed new scope. The maintenance owner shall state the affected editions, current mitigation, evidence required, accountable next action, and review date. Classification shall be reconsidered when new evidence changes the issue's substantive effect.

D1-085 A proposed corrigendum shall be reviewed by a person other than its editor against examples and known conformance outcomes material to the correction. If the parties disagree whether meaning changes, the owner shall preserve the disagreement and use substantive review unless the uncertainty is resolved with recorded grounds. Issuing a corrected file shall not erase the original published error and its applicability interval.

D1-086 An amendment or revision proposal shall assess current users, dependencies, historical records, version negotiation, migration losses, and coexistence needs. The approval record shall distinguish prospective requirements from statements about previous editions. A deprecated feature shall have a reason, affected scope, intended alternative, and transition notice; deprecation alone shall not retroactively change an earlier conformance result.

D1-087 A confirmation decision shall identify the review evidence, known limitations, current maintenance capacity, dependency status, and next review date. If review cannot establish continued suitability, the authority shall select further investigation, narrowing, revision, suspension of programme recommendations, or withdrawal rather than confirm by default. A dormant publication shall remain findable with its actual status.

12 Emergency safeguards and continuity

12.1 General

D1-049 An authorized governance or release holder may issue a time-limited warning or suspend programme distribution or programme recommendations for new use where a documented serious protection, rights, or integrity risk requires immediate action. The action shall state evidence, scope, authority, duration, contact, affected users, and safe public reasons. It shall remain within programme authority and shall not create or amend normative requirements or purport to invalidate external legal decisions.

D1-050 Emergency action shall receive independent review within seven calendar days and expire within 30 calendar days unless the governance authority records a justified extension, next review date, and remedy plan. Unavailable independent capacity shall not authorize emergency adoption. Permanent amendment or withdrawal shall follow the ordinary procedure; protective handling of unlawfully or improperly disclosed material remains governed by the applicable policy and context.

D1-051 A vacant role shall trigger recorded reassignment within the Charter's mandate or deferral of dependent decisions. A temporary substitute shall meet the same conflict and independence conditions. Emergency procedure shall not be used to avoid consultation because ordinary development is late or under-resourced.

12.2 Incident follow-up

D1-088 The owner of an emergency action shall maintain an incident record identifying the triggering evidence, protection decision, consultations, users notified, independent review, expiry or extension, and restoration criteria. At closure, the governance authority shall assess whether ordinary maintenance, a procedural amendment, or further support is needed and publish permitted reasons. Repetition of temporary measures shall not conceal an unresolved need for substantive review.

13 Records, transparency, and external liaison

13.1 General

D1-052 The Secretariat shall preserve linked proposal, draft, comment, disposition, decision, ballot-result, appeal-outcome, release, and maintenance records. Public readers shall be able to follow the grounds and changes of a decision without mandatory access to private correspondence. Record corrections shall retain the prior account and correction relationship where lawful and appropriate.

D1-053 A records schedule shall state purpose, custodian, access category, retention period or trigger, restriction review, and authorized disposition for each record category. Public publication history and safe decision reasons shall be retained durably; sensitive submissions and personal data shall not be retained indefinitely by default. A restriction or deletion shall preserve a safe explanation when permitted, without revealing protected existence or identity.

D1-054 The governance authority shall publish an annual account of active work, decisions, unresolved objections, participation gaps, funding influence, overdue maintenance, and procedural incidents at a level that protects affected people. The account shall distinguish claimed representation from evidenced participation.

D1-055 External liaison shall have an explicit mandate identifying purpose, authorized speaker, commitments permitted, and reporting duties. A policy proposal shall identify its intended institution and review route and remain recommendatory. Liaison, use of external sources, and informal participation shall not imply affiliation, institutional endorsement, or adoption of another body's procedures.

13.2 Publication routes outside Standard adoption

D1-056 Before external release of a Specification or informative publication, the responsible authority shall approve a work-item review plan identifying publication class, maturity criteria, release authority, reviewers and needed competence, public-comment arrangements and period with rationale, objection disposition, appeal route, maintenance responsibility and rights clearance. The release record shall identify fulfillment and remaining limitations. Drafting alone shall not constitute that approval.

D1-057 A Specification release containing technical conformance requirements shall use the technical review, public review, disposition, ballot and appeal rules in this Part, while retaining Specification status and its declared maturity. Its release shall not use stage 60 or imply Standard adoption. Promotion shall require an explicit Standard work-item and adoption decision with review of changed scope, requirements and prior evidence.

D1-058 A Policy or Institutional Proposal shall receive a separate mandate-specific release decision identifying its intended addressee, institutional and affected-interest review, public-comment opportunity, considered alternatives and unresolved objections. Its review plan shall preserve a reasoned disposition and the procedural appeal route in this Part. An informative report or manual shall likewise identify its review and release decision without claiming technical Standard conformance authority.

13.3 Procedure assessment and continuing improvement

D1-089 An assessment against these Directives shall identify the procedure, project and decisions covered, operative or rehearsal editions, assessor and relationship, methods, evidence, and results for every applicable requirement. Documentary checks and observation of performed procedures shall be distinguished. An unobserved action shall remain not assessed when only a designed form or hypothetical record is available.

D1-090 The governance authority shall review procedural failures and participant feedback for recurring barriers, delay, concentrated influence, unavailable remedies, or unmanageable burden. The review shall identify corrective actions, owners, and follow-up evidence. A procedural amendment shall itself follow the Charter's review and transition rules and shall not retrospectively validate a defective decision.

Annex A

(normative)

Stage evidence and procedural schedule

A.1 General

This annex defines the evidence schedule invoked by D1-062. The stage labels apply to Standards-track development; D1-056 through D1-058 define how other publication classes use the applicable controls without acquiring Standard status. Evidence can be held in one coordinated dossier with references rather than duplicated in separate files.

D1-091 The stage dossier shall identify each scheduled evidence item, its location and version, custodian, access limitations, assessment result, and unresolved action. An item may be reused from an earlier stage when the responsible reviewer confirms that its scope and evidence remain applicable. Reuse shall not imply that a later change has been reviewed when it has not.

Table A.1 – Required stage-entry and exit evidence

Stage	Entry and work evidence	Exit and failure disposition
00	Identified problem, preliminary sources, affected interests, and alternatives, including reuse or no new publication.	A registered proposal with limitations; preliminary work retains that label if authority, need, or capacity is not established.
10	NWIP scope, class, conformance subjects, source questions, dependencies, impact and participation analysis, planned evidence and resources.	Authorized scope and accepted assignments, maintenance responsibility, review milestones, and decision rationale; incomplete capacity produces revise or defer.
20	Approved scope and candidate requirements, definitions, source map, ADRs for architectural choices, and assessment design.	Integrated Working Draft suitable for committee examination, with open issues, examples, and planned pilot; an editor's preference alone does not close an unresolved material issue.
30	Reviewer assignments and competence; integrated draft; pilot or other relevant evidence; dependency and rights review.	Committee findings and dispositions, horizontal review, known limitations, exact public-review package and outreach plan. Unsupported requirements return for revision or narrower scope.
40	Frozen Public Review Draft, available dependencies and evidence, notice, submission and protection arrangements.	Comment register, dispositions, replies, required re-review, remaining objections, and consensus assessment. A materially changed text does not advance on comments about its predecessor alone.
50	Frozen Final Approval Draft, eligibility and conflict records, completed review dossier, final resolution and maintenance proposal.	Verified valid ballot, authorized decision, notice and appeal record, resolved release blockers. A failed threshold returns to work or deferral rather than automatic withdrawal of the dissent.

Stage	Entry and work evidence	Exit and failure disposition
60	Release authorization and closed appeal conditions; exact source, render and artifact manifest; accessible status and terms.	Publication notice, maintenance route, next review date and archived decision trace. A build discrepancy prevents release until the applicable corrective process is complete.
90	Issue intake, usage and impact evidence, dependencies, maintenance capacity and review notice.	Reasoned confirmation, correction, amendment, revision, supersession or withdrawal. Substantive changes return through applicable stages; current limitations stay visible during investigation.

A.2 Timing and clock records

D1-092 Every notice governed by a period in Table A.2 shall state the starting event, time zone, closing timestamp, responsible function, extension rule, and next route if the period is missed. The period shall be measured from effective accessible notice or the specified receipt event. A changed closing time shall remain traceable to the prior notice and its reason.

Table A.2 – Local procedural periods and their effect

Action	Proposed period	Meaning and controlling requirement
Proposal, comment, appeal acknowledgement	Within seven calendar days of receipt	Receipt response; not acceptance of the substantive claim. D1-020, D1-035, D1-059.
Initial public review	At least 60 calendar days	Minimum opportunity; access failures can require extension. D1-019.
Material re-review	At least 30 calendar days	Full 60-day review when purpose, constituency, or conformance subject changes substantially. D1-025.
Initial comment disposition	Target 30 calendar days after close	Reasoned extension and updated target before expiry; no deemed resolution. D1-023.
Reply to dispositions	At least 30 calendar days before approval	Material reply assessed; renewed review where resulting change requires it. D1-023/024.
Ballot	At least 30 calendar days	Frozen resolution and roster; controlled extension or restart. D1-029/075.
Ordinary appeal filing	30 calendar days after accessible notice	Reasoned extension for ineffective notice or newly discovered concealed failure. D1-034.
Initial appeal determination	Target 30 calendar days from receipt	Independent handling and reasoned extensions; silence is not rejection. D1-036.
Maintenance review	Default two years	Earlier risk-based review; annual governance review remains separate. D1-043 and Charter.

Action	Proposed period	Meaning and controlling requirement
Withdrawal notice	At least 60 calendar days	Disposition, reply and formal approval follow; an emergency warning is distinct. D1-048.
Emergency review and expiry	Review within seven; expiry within 30 calendar days	Extension requires recorded reasons, next review, and remedy plan. D1-050.

D1-093 A missed acknowledgement or target date shall remain visible as a procedural event with reason, effect, corrective action, and notice to permitted recipients. An extension shall not erase the missed service obligation or cure exclusion retrospectively. An unresolved failure material to fair consideration shall prevent dependent progression until remedied.

Annex B

(normative)

Registers and minimum decision records

B.1 General

The schedule below defines record content, not a mandatory database schema. A protected locator can replace publicly identifying detail when the accountable custodian and basis remain available for authorized review. The applicable retention schedule determines what survives; the record of a disposition does not itself authorize indefinite preservation of its underlying sensitive evidence.

D1-094 The Secretariat shall maintain the registers in Table B.1 for applicable activities. Each record shall have a distinguishable reference, version or correction relationship, responsible custodian, creation time, and permitted access scope. A shared register may satisfy several functions if each required distinction remains retrievable.

Table B.1 – Minimum procedural register contents

Register	Required content in addition to common identification and custody
Work and scope	Need; proposer; class; current scope; exclusions; dependencies; status; assignments; resources; milestones; changes; decision and affected projects.
Roles and eligibility	Accepted capacity; mandate; term; criteria; nomination and selection reasons; interests; recusals; substitute; decision-specific eligibility; challenge and disposition.
Issues and alternatives	Source or trigger; affected clauses; materiality; alternatives; evaluation; selected direction; rationale; remaining uncertainty; affected artifacts; owner and next action.
Comments and dispositions	Submission and issue references; target version; grounds; requested change if supplied; receipt; protection preference; response; reasons; changed text; reply; remaining disagreement; re-review decision.
Consensus and decisions	Participants and gaps; substantial objections; resolution attempts; evidence; rationale; authority; operative procedure; outcome; date; limitations; notification and appeal route.
Ballots	Frozen package and resolution; roster and conflicts; valid and replacement ballots; exclusions and reasons; valid returned, yes, no and abstain counts; eligible unsuccessful-attempt and no-attributable-submission counts reconciled under D1-032; separate unattributable/ineligible submission inventory; calculations; verification; final decision.
Appeals and remedies	Challenged decision; grounds; standing; notice; independent assignment; disclosures; replies; stay; determination; remedy; responsible executor; verification and unresolved implementation.
Releases	Publication class and edition; approval record; dependency versions; source and build manifest; rights and accessibility review; corrections; distribution; appeal status; owner; next review.
Maintenance and incidents	Affected editions; reported issue; classification; severity and limits; interim protection; users notified; review and expiry; compatibility consequences; final disposition and follow-up.

D1-095 A public decision view shall preserve enough permitted information to identify the issue, authority, reasons, outcome, status, and challenge route. An authorized assessor shall be able to locate the underlying protected record when their mandate permits. A restriction that prevents assessment shall produce a stated assessment limitation rather than a presumed pass.

Annex C

(informative)

Proposed defaults and alternatives

C.1 General

These choices make the draft exercisable; they remain **PROVISIONAL** until explicit governance adoption. A future change to operative thresholds or minimum periods needs governance amendment and does not apply retrospectively to an open ballot or review.

Table C.1 – Local defaults, purposes, and alternatives

Proposed default	Purpose	Alternative and evidence needed
60-day public review; 30-day material re-review	Allow asynchronous participation while enabling bounded iteration.	Longer multilingual review or shorter narrow review; test notice reach, access, and actual response burden. Shortening minima needs prior governance amendment.
30-day disposition target and reply period; seven-day acknowledgement	Make receipt and delay visible while preserving substantive consideration.	Different service targets; test volunteer capacity and accessibility needs. A target is not an automatic closure rule.
30-day ballot and appeal periods	Give participants time to read a fixed package and challenge process.	Longer periods for complex work; test availability and remedy effectiveness.
Two-thirds returned-ballot quorum; three substantive votes; two-thirds approval	Prevent adoption based on one affirmative vote and abstentions; require substantial expressed support.	Larger minimum electorate or stakeholder balance conditions. Three voters do not demonstrate constituency breadth; assess actual participation and available competence.
Two-year maintenance review	Require periodic attention without continuous reballoting.	Annual or longer scope-specific review; evaluate dependency change, harms, issue volume, and maintenance resources.
Seven-day emergency review; 30-day expiry	Limit exceptional authority and expose delays.	Shorter periods for urgent privacy incidents; test reviewer availability and restoration of ordinary review.

Annex D

(informative)

Worked progression and rehearsal evidence

D.1 Worked progression

Consider a synthetic proposal for a record-correction protocol. Its first version assumes that only record custodians can challenge a classification. An affected-participant reviewer explains why that scope excludes people whose records are used in decisions. The editor proposes an accessible participant route and identifies the additional authentication and protected-contact infrastructure required. The Specification need follows the normative problem; it is not inferred from an available software library.

The committee records the competing alternatives: custodian-only correction, direct participant submission, and assisted representative submission. Its selected draft uses the latter two within a declared authority boundary. The decision retains the rejected alternative and reasons, including participation burden and risk of exposing identities. A public-review comment then demonstrates that the selected route still requires an unavailable identifier. Removing that prerequisite changes accepted inputs, requiring material re-review and corresponding changes to tests and explanatory examples.

Suppose the later ballot has five eligible non-recused people and four returns: two approvals, one disapproval, and one abstention. The numerical conditions pass because four returns meet the quorum, three substantive votes meet the minimum, and two approvals satisfy the two-thirds threshold. The objection still needs its disposition and consensus assessment. If the disapproving participant identifies a mandatory review omission, that blocking failure prevents approval despite the tally. The case distinguishes evidential reasons, consensus assessment, numerical support, and authority to progress.

A procedural appeal subsequently establishes that the affected reviewer never received the changed draft. The independent reviewer remits the decision for renewed notice and reply. The new decision cites the remedy and evidence that the opportunity was restored. No prior vote is silently relabelled as agreement with a text it did not consider. Publication then identifies the exact approved source, rendered edition, protocol artifact, and maintenance owner. Later correction of an example is evaluated for substantive effect before the owner chooses corrigendum or amendment.

This sequence is a design example only. Its people, comments, votes, appeal, and release have not occurred. The evaluated arithmetic cases in `examples/validation_0.2/p0-governance-rehearsal.md` cover finite calculations, not the operational behavior described here.

D.2 Rehearsal method and evidence

A useful rehearsal records actors as fictional or unassigned, uses identified draft versions, and leaves a complete decision trail. It is not actual public review, proof of representativeness, or governance adoption.

Assessment uses an evidence register with a row for each applicable D1 identifier, the procedure or decision assessed, required record location, reviewer, result (fulfilled, not fulfilled, not assessed, or not applicable), and unresolved action. A not-applicable result identifies the absent trigger. Document inspection assesses notices, disclosures, reasons, and manifests; arithmetic recalculation assesses ballot results; observed exercises assess intake, recusal, reply, appeal, and restoration behavior. Independent procedural review assesses contested fairness and authority. Missing records or unperformed procedures are not counted as fulfillment.

1. Process a bounded NWIP through accept, revise, and defer alternatives. Identify an infrastructure need without presuming a Specification or Standard already exists.
2. Receive an accessible free-text comment, a protected submission, and a sustained minority objection. Show acknowledgement, reasoned disposition, reply, and safe publication.

3. Re-review a material change and demonstrate why a change of constituency restarts full review. Preserve unsuccessful alternatives and source uncertainty.
4. Recalculate a ballot after recusal: with five eligible people, four returns meet quorum; two approvals, one disapproval, and one abstention satisfy the approval threshold. Repeat with two returns and show deferral.
5. Test three returns consisting of one approval and two abstentions. Record failure of the three-substantive-vote minimum even though returned-ballot quorum can be met.
6. Appeal exclusion from review; document independent appointment, conflict challenge, stay, reply, remedy, and renewed decision. Repeat with no independent reviewer and show pending progression.
7. Compare approved source and rendered output, detect an omitted requirement, and prevent release. Distinguish typographic correction from a changed conformance result.
8. Simulate maintenance, incompatible revision, withdrawal, an urgent warning, and role vacancy. Demonstrate that an emergency cannot adopt a Standard.

The rehearsal report records failures, required staffing, elapsed effort, participation and confidentiality barriers, revised clauses, and remaining questions before the founding participants assess readiness.

Annex E

(informative)

Source tailoring and open decisions

E.1 Comparison and local choices

The programme's Brief and comprehensive plan supply the mission and local lifecycle. The comparative planning study supplies the alternatives examined. This draft proposes its own procedures and values; it does not claim ISO, IEEE, or WTO conformity, accreditation, or international representativeness. For the expansion decision and alternatives, see `decisions/ADR-0005-expanded-drafts-and-source-models.md`. The external-model comparison is maintained in `docs/references/drafting_models.md`; neither record substitutes for governance adoption.

ISO's model document informs the separation of foreword, introduction, scope, references, terminology, clauses, annexes, and bibliography. IEEE's procedural material informs the distinction between project supervision, review, ballot, and appeal functions. ITU-T's working-method and author guidance provide a United Nations system comparison for organized technical contributions and Recommendation preparation. These are comparisons of document and procedural functions; this programme has neither those organizations' constituencies nor their institutional powers.

The United Nations National Quality Assurance Frameworks Manual supplies a complementary comparison: attention to institutional environment, production processes, and outputs helps avoid evaluating only the finished publication. D1-060, D1-062, and D1-089 accordingly examine capacity, process evidence, and the limits of the resulting claim separately. This is a programme interpretation, not a declaration that the statistical framework governs generativity standards.

OPEN ISSUE The comparative study records an access gap for the full ISO/IEC Directives Part 1:2026 and Part 2 amendment text. This draft makes no clause-level claim about those unverified texts. Founding authority, actual appointments, contribution terms, neutral review availability, and numerical defaults need explicit resolution before governance adoption.

Bibliography

Source and interpretation: ISO, *International harmonized stage codes*, official webpage checked 22 September 2026, https://www.iso.org/stage-codes.html. The source distinguishes publication, review, and withdrawal; this programme retains its existing local stage 90 grouping. No ISO substage deadlines or voting rules are imported.

Source and interpretation: IEEE SA, *Standards Board Operations Manual*, clause 5, official webpage checked 22 September 2026, https://standards.ieee.org/about/policies/opman/sect5/. Its separation of project supervision, review, and appeals informs comparison. The programme's staffing, deadlines, eligibility, and remedies above are new local proposals, not statements of IEEE requirements.

Source and interpretation: WTO, *Principles for the Development of International Standards, Guides and Recommendations*, official presentation of the 2000 TBT Committee decision, checked 22 September 2026, https://www.wto.org/english/tratop_e/tbt_e/principles_standards_tbt_e.htm. Its process principles inform scrutiny of transparency, participation, relevance, and coherence; no determination of legal status under the TBT Agreement is made.

Source and interpretation: ISO, *Model document of an International Standard*, 2023, https://www.iso.org/iso/model_document-rice_model.pdf. Informative structural model, not a conformance dependency.

Source and interpretation: ITU-T, *Recommendation A.1: Working methods for study groups of the ITU Telecommunication Standardization Sector*, September 2019, official edition/status record: https://www.itu.int/itu-t/recommendations/rec.aspx?rec=a.1; and *Author's Guide*, June 2023, https://www.itu.int/dms_pub/itu-t/oth/0a/0f/T0A0F0000040005PDFE.pdf. Informative organizational and drafting comparisons; no ITU procedure is incorporated.

Source and interpretation: United Nations, *United Nations National Quality Assurance Frameworks Manual for Official Statistics*, 2019, https://unstats.un.org/unsd/methodology/dataquality/references/1902216-UNNQAFManual-WEB.pdf. Informative comparison of institution, process, and output quality; no statistical-system mandate is claimed. The programme's comparison record is `docs/references/drafting_models.md`.

GENERATIVITY STANDARDS PROGRAM

Directives Part 2

Governance Working Draft

Version 0.3 2026-09-22

Structure and drafting rules for programme publications

WORKING DRAFT FOR REVIEW

This document contains proposed provisions for technical and institutional review. It is not an adopted Standard or an operative governance instrument. Its scope, application conditions and publication status are specified in the text.

Prepared by the Generativity Standards Program. Reference to external publications does not imply endorsement by ISO, IEC, IEEE or any United Nations body.

Foreword

Version 0.3 records the bounded substantive review of the archived 0.2 package. Its requirement text is retained in this coordinated edition; updated references identify the companion 0.3 drafts. The review matrix, synthetic assessments and unresolved readiness questions are documented in `docs/reviews/validation_0.2/README.md`. These activities do not constitute adoption or an independent institutional assessment.

This document establishes the proposed editorial and document-engineering rules of the Generativity Standards Program. It is intended for document editors, technical reviewers, terminology maintainers, implementers of associated artifacts and publication assessors.

Responsible editor: `UNASSIGNED`. Canonical source: `governance/directives_part_2.tex`.

This second preparatory draft develops the requirements of Working Draft 0.1 into a publication architecture, drafting method and assessment procedure. Requirement identifiers D2-001 to D2-045 are retained. Additional identifiers designate new provisions. The earlier edition is preserved in the programme's source archive. Neither edition has been adopted as an operative governance instrument.

The foreword, introduction, notes, examples, informative annexes and bibliography provide information. Requirements in the main body and normative annexes are proposed requirements for the declared assessment subject. Their use in a rehearsal does not constitute programme adoption. The publication models consulted include ISO, IEEE and United Nations system materials; their institutional authority and proprietary presentation elements are not incorporated.

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Introduction

A standardization programme requires documents whose provisions can be located, interpreted, implemented and assessed consistently. Length alone does not establish completeness. A short document can be complete for a narrow question, whereas a programme-wide recording or procedural document can require extensive definitions, conditions, assessment methods and interfaces.

The first publication cycle identified a recurring weakness: a list of requirements can state desirable outcomes without specifying how an implementer determines applicability, obtains the necessary evidence, handles exceptions or reports a failure. This edition requires those elements to be developed together. Formal drafting is used to increase precision and reviewability, while explanatory material retains a separate role.

The programme also requires distinctions that conventional technical documentation can leave implicit. A statement about a represented event differs from a claim about its evidence, an ethical evaluation, a legal allegation or an institutional decision. A manuscript can supply conceptual grounds without supplying normative authority. A schema can validate a representation without establishing its factual warrant. The drafting rules provide means to preserve these distinctions across publications.

The local publication profile draws selectively on established models. It uses decimal clauses, dated dependencies, separately identified annex status, controlled terminology and explicit assessment subjects. It does not reproduce another organization's foreword, approval process, legal status or branding. The detailed comparison and access record are maintained outside the normative provisions in `docs/references/drafting_models.md`.

1 Scope

This document specifies requirements for the structure, language, terminology, references, associated artifacts and editorial assessment of publications prepared within the Generativity Standards Program.

It applies to governance documents, Standards-track drafts, Specifications, Technical Reports, Manuals and Policy or Institutional Proposals. The applicable structural profile depends on publication class. The assessment subject is an identified publication package comprising the document source, rendered edition and explicitly associated artifacts.

This document does not prescribe a universal theory of generativity, select a technical interchange syntax, confer Standard status or determine the legal effect of a publication. Approval, review periods, release authority and maintenance decisions are governed by Directives Part 1 when adopted. Historical source manuscripts remain source records and are not retroactively edited to meet this document.

2 Normative references

2.1 Dated draft references

For coordinated assessment of this preparatory edition, the following programme drafts supply the provisions explicitly invoked in the text. References are dated to the stated draft version; later changes require dependency review.

- Standards Programme Charter, Working Draft 0.3: CH-010 and CH-011 on publication classes and the limits of Standard designation. Source: `governance/standards_programme_charter.tex`.
- Directives Part 1, Working Draft 0.3: D1-040 to D1-048 on exact-edition publication, correction, revision and maintenance, together with the procedure invoked for the applicable draft stage or publication class under D2-045. Source: `governance/directives_part_1.tex`.
- Ethics, Conflict-of-Interest, and Contribution Rights Policy, Working Draft 0.3: EIP-028 to EIP-031 on artifact-specific terms, source rights and intended distribution, and EIP-039 on custody and protected case information. Source: `governance/ethics_ip_policy.tex`.

These references form a proposed governance package. Listing them does not establish that they are operative. External drafting guides and foundation manuscripts are informative sources unless a particular requirement explicitly incorporates a separately identified technical provision. No ISO, IEEE or United Nations document is a normative dependency of this edition.

2.2 Bounded application and unavailable dependencies

D2-094 For coordinated assessment of this edition, the editor shall apply CH-010 and CH-011 to the publication-class and Standard-status statements required by D2-001 to D2-003; the applicable D1-040 to D1-048 provisions and the identified stage-specific procedure to the publication and change-control subjects invoked by D2-042 to D2-045; and EIP-028 to EIP-031 and EIP-039 to incorporated source material, intended distribution and protected case information where present. The dependency record shall identify the provisions triggered, exact editions, source locators and evidence. An unavailable or incompatible dependency shall leave the affected result not assessed pending resolution.

The incorporated scope concerns the named questions, not an assertion that this publication fulfils each governance instrument in its entirety. A draft without a release decision does not acquire adopted authority through editorial assessment. An absent distribution or case-information trigger can make the corresponding dependency provision inapplicable; missing rights evidence for an intended distribution is not an absent trigger. Programme authority, development procedure, rights and protection, and editorial

assessment remain distinct responsibilities. A conflict is recorded for the competent governance decision rather than resolved by treating a draft as already operative.

3 Terms and definitions

3.1 publication package

identified set of source texts, rendered documents and associated artifacts submitted for a stated review or release purpose

NOTE 1 A package can include a schema, assessment fixture or change record. Inclusion does not make every artifact normative.

3.2 provision

expression in a document that states a requirement, recommendation, permission or explanatory information

3.3 requirement

provision specifying an outcome or condition that is necessary to support the declared claim of fulfillment

3.4 conformance subject

identified object, practice, procedure, system or application against which requirements are assessed

3.5 applicability condition

stated circumstance that determines whether a requirement applies to the declared subject

3.6 normative reference

reference to an identified external provision whose fulfillment is necessary to fulfill an invoking requirement

3.7 informative reference

reference that supplies explanation, conceptual grounds, comparison or further information without adding a conformance obligation

3.8 profile

identified set of application conditions and permitted selections, additions or restrictions relative to specified parent requirements

3.9 editorial correction

change that corrects presentation without changing the meaning, applicability or assessment result of a provision

3.10 substantive change

change that can alter a provision’s meaning, applicability, authority, permitted behavior or assessment result

3.11 assessment evidence

material and recorded reasoning used to support a result for an identified requirement and subject

3.12 hanging paragraph

text attached directly to a clause that also contains numbered subordinate clauses, leaving its structural position ambiguous

4 Publication identity and document architecture

4.1 Identity and standing

D2-001 A publication shall identify its code or other identifier, title, publication class, maturity status, version, responsible editor or unassigned responsibility, and source location near its beginning.

D2-002 A draft shall state that it is not adopted and shall distinguish authoring progress from formally authorized project status. A publication shall not imply ISO, IEC, IEEE or governmental authority without a documented basis.

D2-046 A revision shall identify the preceding edition and summarize substantive changes. The publication package shall preserve a retrievable change relationship and the status of the earlier edition. A new rendering of unchanged text shall not be represented as a new normative decision.

The document identifier and the requirement identifier serve different purposes. A document identifier locates a publication family and edition. A requirement identifier supports the continuity of an obligation across editorial reorganization. A file name or page number is not sufficient to perform both functions.

4.2 Publication classes and audience

D2-003 An editor shall assign one principal publication class and state its intended readers, use and authority. A Standard, Specification, Technical Report, Manual, governance document and Policy or Institutional Proposal shall not be treated as interchangeable classes.

D2-004 A protocol description shall identify its containing publication class. Protocol behavior shall be distinguished from the institutional authority and procedure under which that behavior is used.

D2-005 A Policy or Institutional Proposal shall distinguish factual background, interpretation, objectives, options, mandate, implementation implications and unresolved questions. It shall not create technical conformance obligations through an unapproved policy recommendation.

D2-047 A document containing material of more than one publication class shall identify the principal class and separate the subsidiary material by a stated structural boundary. The editor shall state whether each part defines requirements, supplies guidance or proposes an institutional option.

Technical detail does not make a document an adopted Standard. A Specification can contain exact and testable provisions while retaining Specification status. A policy proposal can recommend adoption or experimentation without defining technical conformance. A protocol is a subject described within a publication, not an additional source of institutional authority.

4.3 Required structural components

D2-006 The scope shall identify the subject of conformance, intended use, relevant environment and exclusions. A claim of conformance shall be assessable within that stated boundary.

D2-007 Normative and informative material shall be distinguishable at clause, annex or artifact level. Notes, examples and informative annexes shall not introduce additional requirements.

D2-008 Every table, figure, annex and associated artifact shall have a stated role and, where interpretation depends on it, a stated authority status. A normative requirement represented in a diagram shall also have an identifiable textual formulation.

D2-048 A technical or governance draft prepared under this document shall contain a title and status statement, a foreword, a scope clause, a normative-reference clause, a terms-and-definitions clause, substantive provisions and an assessment or application clause. It shall identify the role of every annex and associated artifact. An informative bibliography shall be provided when informative external sources are cited.

D2-049 The foreword shall record publication history, responsible preparation and material edition changes without introducing technical requirements. The introduction, when present, shall explain the problem, approach and intended use without creating additional conformance obligations.

D2-050 The scope shall identify both inclusions and material exclusions. It shall not contain requirements that can be located only in the scope or imply applicability to environments for which the document supplies no assessment basis.

The principal body normally begins with Scope, Normative references and Terms and definitions, in that order. A document having no normative references states that fact. It does not populate the clause with a reading list. A vocabulary document can use a more extensive terminology structure, provided that definition entries and vocabulary-application requirements remain distinguishable.

4.4 Clause hierarchy and navigation

D2-051 The editor shall assign decimal clause and subclause numbers, use descriptive titles and place substantive text at an identifiable leaf of the hierarchy. If a clause has subclauses, introductory provisions belonging to that clause shall be placed in a General subclause or another identified subclause.

D2-052 A cross-reference shall identify a stable requirement, clause, table, figure or annex as appropriate. References such as above, below, elsewhere or the latest text shall not be the sole locator of content necessary for interpretation or assessment.

The depth of subdivision follows the complexity of the subject. Repeated one-sentence subdivisions can impair reading; long unstructured blocks can conceal distinct conditions. Editors select a hierarchy that permits a reviewer to identify the actor, trigger, action and evidence without reconstructing a paragraph's unstated scope.

5 Formulation of provisions

5.1 Requirement construction

D2-009 A requirement shall identify the responsible actor or object, the applicable condition, the required behavior or property, and an outcome or evidence by which fulfillment can be assessed.

D2-010 A requirement shall use a stable identifier independent of its displayed section number. An identifier shall not be reassigned to a different obligation after circulation; a withdrawn identifier shall remain traceable.

D2-011 A requirement shall not combine independent obligations whose applicability or assessment differs so materially that one result would conceal another. Related obligations can be grouped when their joint assessment is explicit.

D2-012 Terms such as adequate, appropriate, trustworthy or significant shall have a scoped criterion, declared decision responsibility or assessment procedure when they determine conformance. A broad aspiration alone shall not be presented as a testable requirement.

D2-053 Each requirement shall be linked to at least one discriminating assessment question. The question shall distinguish an acceptable outcome from a materially different outcome that would not fulfill the requirement.

D2-054 Where one identifier groups related obligations, the assessment schedule shall identify the components and record a result for each materially distinct component. Fulfillment of one component shall not conceal an unassessed or failed component.

An obligation normally identifies the responsible subject, any triggering condition, the required action or property and the information needed to determine fulfillment. A requirement can depend on a scoped judgment, but the judgment's criteria, decision responsibility and record are then part of the assessable arrangement. Formal drafting does not require every judgment to be reduced to a number.

5.2 Verbal forms

D2-014 The editor shall distinguish mandatory conditions, recommendations, permissions and capability statements consistently. A recommendation's non-fulfillment shall not be reported as failure of a requirement.

D2-055 The editor shall use shall and shall not for requirements and prohibitions, should and should not for recommendations, may for permission, and can for possibility or capability. Must shall not be used as an alternative requirement verb in programme-authored provisions.

D2-056 A statement of external necessity, including a stated legal constraint, shall identify its source and context. The editor shall distinguish that external constraint from an obligation created by the publication.

The grammatical present can describe a definition, process model or fact. It is not used to conceal an additional obligation. A statement that information can be recorded describes capability; it does not require the information to be retained in a particular record. Permissions are assessed in relation to mandatory limits, not as exceptions to them.

5.3 Conditions, exceptions and incomplete knowledge

D2-013 A permission shall not override a requirement implicitly. Exceptions shall identify the affected obligation, conditions, authority, required record and any limitation on the resulting conformance claim.

D2-015 A conditional requirement shall state its trigger and how applicability is determined. A result of not applicable shall include its reason; it shall not substitute for unavailable evidence or an unperformed assessment.

D2-016 When complete information is not realistically available, a recording requirement shall specify whether a justified unknown, limitation or restricted disclosure satisfies the obligation. It shall not require invented content to complete a mandatory field.

D2-057 A provision permitting an unknown value, unavailable source or restricted disclosure shall state the required declaration, responsible role and assessment consequence. The editor shall distinguish fulfillment of that declaration requirement from resolution of the underlying factual question.

D2-058 An exception shall state its eligibility condition, decision authority, permitted departure, duration or review trigger, required evidence and effect on the resulting claim of fulfillment. An exception shall not be implied solely by a resource limitation.

A conditional requirement remains mandatory when its condition is met. A requirement that has not been assessed is not made inapplicable by the absence of evidence. The document can require a justified declaration of uncertainty while leaving the substantive matter unresolved. It can also require access that the subject cannot provide, in which case the assessment reports the consequence rather than inventing an authorization.

5.4 Completeness and proportionality

D2-059 For each substantive topic in scope, the editor shall identify normal operation, material boundary cases, failure conditions and applicable interfaces. A topic shall not be treated as specified solely because it appears in a list of objectives.

D2-060 Where requirements can impose material recording, review or participation burdens, the document shall identify the intended operating scale and the evidence needed to assess that burden. A reduced profile shall state its limitations and shall not silently claim the coverage of the parent document.

Proportionality is expressed through explicit conditions, profiles and scope. It is not achieved by using undefined terms such as sufficient or appropriate as a substitute for deciding what an implementer records. Conversely, mandatory collection of every available detail can be inconsistent with purpose, protection and feasible participation.

6 Terminology and conceptual sources

6.1 Definition entries

D2-017 An operational definition shall state its scope and shall not imply that it exhausts a broader philosophical concept. A definition imported or adapted from a source shall identify that source, edition and the nature of the adaptation.

D2-061 A definition entry shall identify the preferred term, a unique term locator, the relevant domain where needed, and a definition that distinguishes the concept from adjacent concepts. Notes and examples shall remain separate from the definition.

D2-062 The editor shall use a defined term consistently within its declared scope. A synonym, abbreviated term, deprecated term or narrower profile-specific use shall be identified explicitly rather than introduced as an unexplained substitution.

Definitions describe concepts. They do not contain procedural obligations that belong in requirements. A definition can specify constitutive characteristics, while a later provision states when a conforming application has to record or satisfy those characteristics. Circular definitions and definitions consisting only of synonyms require revision unless the document explicitly identifies an unresolved terminology issue.

6.2 Foundation interpretation

D2-021 A draft shall distinguish occurrence claims, observations, evidence assessments, interpretations, normative evaluations, legal assertions and institutional determinations wherever conflation would strengthen a claim beyond its grounds or authority.

D2-018 For a substantive GR definition, the editor shall record the relevant foundation passage, alternatives, unresolved differences and the rationale for operational use. A material narrowing or departure shall have an Architecture Decision Record before the definition is stabilized for adoption.

D2-019 An operational definition of Entity, State, Event, Process, Relation or Property shall address admissibility, identity, temporal behavior, allowed relations, required and optional information, examples,

counterexamples and unresolved edge cases. A declaration that an item remains provisional shall identify the missing decisions.

D2-020 The editor shall not equate a formal state with an archival State, a mechanism with a Process, or formal change with an Event without an explicit argument and scoped decision. The six record roles shall not be presented as exhaustive constituents of reality.

D2-063 A source trace for a GR-specific operational definition shall identify the manuscript version, passage locator, interpreted distinction, operational narrowing, material alternative and affected provision. A source discrepancy shall remain visible until its disposition is recorded.

The foundation corpus supplies conceptual source authority. It does not determine the programme's approval procedure. A formal model's carrier, transition or mechanism does not automatically supply the identity or metadata of an archival State, Event or Process. A record ontology can support a practical distinction while leaving a deeper philosophical or mathematical question open.

6.3 Translations and mappings

D2-064 A translation or cross-vocabulary mapping used to determine conformance shall identify the source and target editions, responsible reviewer, correspondence asserted and known non-equivalences. An untranslated or unmapped distinction shall not be represented as preserved without supporting evidence.

Translations can be reviewed documents without being authoritative editions. The publication identifies which edition controls interpretation in the declared programme process. Disagreement over equivalence is recorded as a technical issue; an editor does not resolve it by silently changing the source term.

7 References and dependency management

7.1 Normative references

D2-022 An external reference used to support a normative or scholarly claim shall be verified against an identified primary source. Inaccessible text, uncertain edition, incomplete review and unverified compatibility shall be identified rather than reconstructed as fact.

D2-023 A normative reference shall identify the exact document and edition required to apply a requirement, the part relied on and a means of obtaining it. Informative motivation shall be listed separately from normative dependencies.

D2-065 Each normative reference shall be invoked by an identifiable requirement or application rule. The dependency record shall state the incorporated scope, required edition and assessment consequence of an unavailable or incompatible dependency.

The invocation can incorporate a whole profile or a bounded set of provisions. It does not automatically incorporate every recommendation, example or later amendment in the source publication. A draft dependency can be used for preparatory assessment if its status and exact edition are declared; it cannot supply an adopted authority that it does not possess.

7.2 Informative sources and external publication models

D2-024 A draft depending on another draft shall identify the dependency's version and status and the consequences of a change. It shall not imply the dependency has already been adopted.

D2-066 A bibliography entry shall provide enough information to distinguish the cited source and locate the relevant edition. Where an external model is used for drafting or comparison, the source record shall

distinguish directly inspected material from catalogue metadata, secondary description and unavailable text.

An organization's publication name does not establish that every document it issues has the same authority. For example, a technical Recommendation, a statistical manual and an institutional policy proposal can differ in their adoption procedure, audience and implementation effects. The programme therefore records the source's actual class before deriving a local design proposal.

7.3 Dependency review

D2-025 Before approval for publication, the editor shall produce a dependency review identifying incompatible versions, unavailable dependencies, circular requirements and licensing or access constraints material to implementation.

D2-067 A material dependency change shall identify affected requirements, definitions, assessment cases and associated artifacts. The editor shall record whether each affected element remains valid, requires revision or cannot yet be assessed.

A circular reference is not resolved by citing the two documents more precisely. Technical definitions and conformance conditions require a determinate interpretation. Governance instruments can be adopted as a coordinated package, but their allocation of authority, procedure and assessment still needs a documented reading order and conflict rule.

8 Conformance and assessment provisions

8.1 Subjects, scope and claims

D2-031 A draft shall state the limits of its conformance claims, including the distinction between record structure and factual truth, between source authentication and evidential warrant, and between technical conformance and legal or ethical judgment.

D2-026 A claim of equivalence, compatibility or interoperability with another model shall identify its direction, scope, tested cases, unsupported distinctions and known loss. Matching terminology alone shall not justify that claim.

D2-027 The conformance clause shall distinguish the assessed subject, publication edition, profile, applicable requirements, assessment method, assessor and result. It shall distinguish a record, producer, protocol participant, presentation, archive and organizational procedure when their obligations differ.

D2-068 A document allowing more than one conformance subject shall specify the requirement set applicable to each subject or state that the available assessment is partial. It shall distinguish examination of a record from observation of the practice or procedure represented by that record.

A statement about a completed institutional action requires evidence of that action. A narrative describing the action is evidence of an assertion and can be assessed as a record. It is not automatically sufficient evidence that the underlying action occurred or that an affected person received its result.

8.2 Assessment methods and results

D2-032 An automated check shall identify the constraints it actually assesses. A passing automated result shall not be presented as evidence of a human or institutional action that the check did not observe.

D2-028 Each requirement shall have at least one stated assessment method and evidence expectation. Structural checks, protocol tests, human interpretation and procedural review shall have separately identifiable results.

D2-029 A conformance report shall distinguish fulfilled, not fulfilled, not assessed and not applicable results. A missing assessment shall not be counted as fulfillment.

D2-069 An assessment method shall specify its objective, input conditions, procedure, relevant tools or competence, expected observations, result rule and material limitations. The method shall identify the conditions under which an inconclusive or not-assessed result is required.

D2-070 An assessment report shall retain failed and unassessed applicable requirements and their effect on the overall result. A summary shall not replace the underlying requirement-level evidence register.

Automated checks are suitable for such questions as syntax, identifier uniqueness or required structural elements. Evidential relevance, meaningful participation and the adequacy of a protected response can require competent judgment or observation. A document identifies these limits instead of describing every assessment as machine validation.

8.3 Profiles and optional features

D2-030 A profile shall state its parent requirements, additions, permitted restrictions, exclusions and intended users. It shall not silently weaken a parent requirement while claiming unqualified parent conformance.

D2-071 For an optional capability, a document shall state the condition under which associated obligations become mandatory. An implementation selecting that capability shall be assessed against the complete selected requirement set.

Optional selection and optional implementation quality are different questions. A subject can be permitted to omit a feature. If it claims to supply that feature, the relevant correctness, protection and failure-handling obligations apply according to the profile.

9 Information models, protocols and technical artifacts

9.1 Separation of semantics and bindings

D2-036 A schema, API or encoding choice shall be traceable to a stated requirement or interoperability need. Implementation convenience alone shall not be described as a philosophical necessity or universal institutional rule.

D2-072 A data dictionary shall distinguish semantic information requirements from serialization names, storage types and transport behavior. Each mandatory or conditional element shall identify its meaning, applicable subject and permitted absent or unknown states.

An abstract information requirement can be implemented in a narrative dossier, table or technical binding. The existence of a field in one implementation does not make its name or data type normative. When interoperability depends on that choice, a Specification work item provides the explicit binding and its assessment evidence.

9.2 Protocol behavior

D2-033 A protocol Specification shall define its participants, inputs, preconditions, state transitions, observable outputs, effects, refusal and failure cases, recovery behavior, version assumptions and authorization boundaries.

D2-034 An artifact package shall identify the relationship between its prose requirements and its schemas, examples, vocabularies, test fixtures and executable components. Conflicts shall have a documented resolution rule that does not silently amend an approved requirement.

D2-073 A protocol description shall distinguish sending, transport delivery, receipt, acknowledgment, acceptance for processing and substantive disposition when those states have different consequences. A transport success shall not imply institutional acceptance or completion of a remedy.

D2-074 Where concurrent updates or repeated messages are in scope, the protocol description shall specify correlation, version preconditions, duplicate handling, conflict disposition and recovery after interruption. If those behaviors are not specified, the interoperability claim shall identify that exclusion.

An institutional procedure can be implemented manually. A network protocol can support its exchanges but cannot itself assign legal competence, decide an evidential dispute or grant an institutional remedy. The document specifies the interface between technical behavior and the responsible institutional function.

9.3 Associated artifacts

D2-037 Executable validation or rendering shall not silently retrieve unpinned remote resources, disclose protected input or substitute a current external vocabulary for the edition declared in the package. Any required external processing shall be explicit.

D2-035 Examples intended to be valid shall identify the supported profile and expected result. Negative examples shall identify the intended defect. Synthetic evidence shall be labelled as synthetic.

D2-075 Each associated schema, vocabulary, executable example or test fixture shall identify its owner, version, publication class or role, controlling requirements and status. Its release manifest shall state whether the artifact is normative, informative or experimental.

D2-076 A discrepancy between prose and an associated artifact shall be recorded with affected conformance outcomes. The release package shall identify the controlling interpretation or remain pending resolution; implementers shall not be required to infer priority from file format.

10 Presentation, accessibility and contextual statements

10.1 Tables, figures and formulae

D2-077 Every substantive table and figure shall have a unique number, descriptive caption and an explicit reference or structural purpose in the surrounding text. Required information shall not be encoded solely by colour, shape or visual position.

D2-078 A formula used in a requirement or assessment method shall identify its variables, domain, units where applicable, assumptions and interpretation. Undefined quantities and unsupported numerical precision shall remain explicit limitations.

Table headings can state shared conditions, but a condition necessary for conformance is not left to typographic inference. Units and scales are attached to the represented quantity. A percentage without its denominator or a confidence score without an interpretation is insufficiently specified for a substantive assessment.

10.2 Examples and accessibility

D2-038 A publication shall use headings, table labels, link text and readable typography that expose its structure. Essential meaning shall not depend solely on color, visual position or a diagram.

D2-039 An editor shall provide a usable source or alternative reading representation and identify known accessibility limitations of the rendered document. Successful PDF compilation alone shall not establish accessibility conformance.

D2-079 An example shall state whether it is synthetic, adapted or empirical and identify any omitted material that affects its use. Expected behavior in an authored scenario shall remain distinguishable from observed behavior in an executed assessment.

D2-080 The publication assessment shall identify intended reading modes, known barriers and the evidence used to assess accessibility. Availability of source text, PDF text extraction or a successful build shall not alone establish accessibility conformance.

10.3 Legal, ethical and institutional assertions

D2-040 A legal or institutional assertion used in a requirement shall identify the context, asserted source of authority and scope. A proposed model rule or policy option shall be labelled as such rather than described as generally applicable law.

D2-041 The editor shall record cross-domain review findings relevant to scope, including epistemic, ethical, legal, institutional, political-economy, archival, security and accessibility questions. Unavailable competence or unresolved material objections shall remain visible in progression records.

D2-081 A policy or institutional recommendation shall identify the intended decision maker, asserted mandate, feasible alternatives, implementation conditions, affected interests and evaluation approach. Adoption of a technical requirement shall not be presented as resolving those policy choices automatically.

Contextual reviewers assess the questions within their competence. A legal statement identifies its jurisdiction and procedural status; an ethical statement identifies its evaluative grounds and affected interests. An unavailable review remains an identified gap rather than being replaced by a generic assurance sentence.

11 Versioning and publication production

11.1 Source and artifact control

D2-042 Each circulated edition shall identify its canonical source and rendered artifacts. Changes to proposed requirements shall be traceable through the change record, with superseded reasoning retained subject to justified access and retention rules.

D2-043 A release candidate shall be built from the declared source revision, with build instructions, required tooling and an artifact manifest sufficient to reproduce and compare its substantive content.

D2-044 The release check shall detect broken internal references, duplicate requirement identifiers, missing glyphs, visibly clipped material, mismatched status labels and disagreement between declared source and generated artifact. Unresolved defects shall be reported with their effect on use.

D2-082 The editor shall distinguish the canonical authoring source, any generated representation and the exact edition submitted for decision. A release manifest shall identify source and artifact integrity references, build instructions, tool versions and the associated review record.

Byte-identical rendering is not assumed. Compiler metadata and timestamps can change binary output without changing substantive content. Integrity references identify what was actually reviewed; comparison procedures identify whether the intended provisions, identifiers and status survived rendering.

11.2 Amendment and source preservation

D2-045 An editorial correction shall not silently change the substance of a requirement. A substantive change to an adopted normative edition shall use the amendment or revision procedure in Directives Part 1, including affected-artifact and compatibility review. A draft change shall follow the change-control and

re-review rules applicable to its current stage. Changes to a released Specification shall follow its declared maintenance procedure and promotion shall require a separate decision.

D2-083 A changed requirement shall retain its identifier when its continuity is defensible and identify the nature of the change. A withdrawn requirement shall remain traceable. Reorganization shall provide a correspondence map when clause numbering or placement changes materially.

D2-084 An archival source snapshot shall record the source set, edition and integrity references. A historical snapshot shall be marked as historical and shall not replace the current edition's status or dependency declarations.

12 Assessment of a publication package

12.1 Assessment declaration

D2-085 The assessor shall identify the publication package, assessed edition, applicable structural profile, assessment scope, assessor relationship and required competence before issuing an overall result. Missing expertise and unavailable artifacts shall be reported.

D2-086 The assessment shall use the record specified in Annex B and examine the structural schedule in Annex A. Each applicable requirement shall receive an individual supported result.

12.2 Disposition of findings

D2-087 A finding shall identify the affected provision or artifact, the observed defect, its effect on interpretation or assessment, the proposed disposition and the responsible action. A correction shall identify the revised edition and the evidence used to close the finding.

D2-088 An overall publication result shall distinguish structural checks, technical review, source interpretation, cross-domain assessment and authorization for release. Fulfillment of one category shall not be reported as fulfillment of an unperformed category.

Annex A

(normative)

Structural schedule for programme publications

A.1 Application

D2-089 The editor shall apply the structural schedule in Table A.1 according to the declared publication class. A departure shall identify its rationale, alternative location and effect on assessment. The schedule shall not require an empty clause to simulate completeness.

Table A.1 – Structural components and required treatment

Component	Technical or governance publication	Informative or policy publication
Identity and standing	Identifier, title, class, edition, date, responsible preparation and adoption status.	The same identity controls; identify recommendatory or informative authority.
Foreword	Preparation, edition history and principal changes; no technical requirements.	Publication context, responsibility and history where relevant.
Introduction	Optional problem and approach explanation; distinguish it from scope.	Purpose and context can be substantive, with recommendations distinguished from background.
Scope	Subject, intended use, operating environment and material exclusions.	Intended readers, question, context and limits of conclusions.
Normative references	Identify invoked dependencies or state that none apply.	Identify any incorporated requirements separately from a bibliography; no implied conformance authority.
Terms and definitions	Numbered operational definitions and referenced vocabulary.	Define terms needed to avoid ambiguity; do not restate an adopted vocabulary inconsistently.
Substantive body	Requirements, applicability, interfaces, exceptions and failure behavior.	Analysis, evidence, alternatives, recommendations and implementation implications.
Assessment or evaluation	Subjects, requirement sets, methods, result rules and limitations.	Evaluation questions and proposed evidence; distinguish proposed from measured results.
Annexes	Each annex designated normative or informative; references from the body.	Normally informative; any proposed normative model remains explicitly a proposal.
Bibliography	Informative sources and edition locators, distinct from dependencies.	Sources supporting analysis and recommendations, with access limits recorded.
Associated artifacts	Role, version, controlling requirements, integrity reference and maintenance owner.	Role and limitations; no implied normative priority from machine readability.

A.2 Minimum completion review

D2-090 Before submission for final approval, the package review shall determine whether each in-scope topic has a defined subject, required behavior or outcome, applicability rule and assessment basis. An unresolved topic shall be excluded explicitly, retained as an open issue preventing the affected claim, or returned for development.

Annex B

(normative)

Requirement assessment record

B.1 Record components

D2-091 The assessment record shall include the information specified in Table B.1. Protected evidence shall be referenced through a permitted locator and its examination limits shall remain explicit.

Table B.1 – Assessment record information

Component	Required information
Subject declaration	Publication, edition, source set, artifacts, profile, scope and exclusions.
Requirement locator	Stable identifier, containing clause and controlling edition.
Applicability decision	Trigger, determination, basis and any dependency affecting applicability.
Method	Inspection, recalculation, execution, competent review or user task; procedure and conditions actually used.
Evidence	Source or observation locator, relevant portion, acquisition date, access status and assessment rationale.
Result	Fulfilled, not fulfilled, not assessed or not applicable; component results where a clause groups obligations.
Attribution	Assessor, competence, relationship to the author or operator, and actual date.
Limitations	Unavailable evidence, unresolved interpretation, sampling scope and excluded conclusions.
Disposition	Required correction or additional evidence, responsible action, status and closure evidence.

B.2 Result rules

D2-092 Fulfilled shall be reported only when the stated assessment method and evidence support the applicable obligation. Not applicable shall identify an absent trigger. Unavailable evidence or an unperformed assessment shall be reported as not assessed unless another specified result rule applies.

D2-093 An unqualified claim of fulfillment of the declared publication profile shall not be issued while an applicable requirement is not fulfilled or not assessed. A partial result shall identify the assessed subset and excluded conclusions.

Annex C

(normative)

Publication self-assessment schedule

C.1 Method and applicability

D2-095 An assessment of this document or a publication prepared under it shall apply the topical checks in Table C.1 to every applicable D2 requirement, using the record in Annex B. Each requirement and each materially distinct grouped component shall receive its own result and evidence. A grouped table row shall not authorize one undifferentiated result for its identifiers.

The objective is to distinguish inspectable, correctly scoped provisions from plausible wording that loses a necessary distinction. Inputs are the declared source and rendered edition, dependency and source registers, associated artifacts, change history and actual review or build evidence. The assessor examines the identified passages, follows their references and applies the discriminating question in the table. Text searches and build checks support inspection; meaning, source interpretation and contextual authority require relevant review competence. Where execution or user examination is needed, a document describing that activity is not substituted for observing it.

The expected observation is the retained distinction or controlling evidence named in the check. A demonstrated contradiction or missing required component is not fulfilled; an unavailable examination or needed competence is not assessed; an absent stated trigger is not applicable. A fulfilled result requires evidence for every applicable component. The assessor may use a domain-equivalent check with its rationale and equivalent failure condition recorded. Results remain limited to the examined edition, artifacts, uses and procedures.

C.2 Topical checks

Table C.1 – Requirement groups, discriminating questions and evidence

Identifiers	Discriminating assessment question and evidence
D2-001, D2-002, D2-046	Compare title, foreword, metadata and preceding edition. Can a reader distinguish authoring revision from authorized initiation, adoption and an unchanged rebuild? Trace any authority assertion to its record.
D2-003, D2-004, D2-005, D2-047	Follow an implementation rule and a policy recommendation to their containing class and audience. Does a protocol or subsidiary policy passage silently acquire a different authority? Inspect structural boundaries.
D2-006, D2-007, D2-008, D2-048, D2-049, D2-050	Compare scope, body, annexes and associated artifacts. Is any necessary obligation present only in scope, a note, introductory narrative or an unclassified visual? Locate its controlling formulation.
D2-051, D2-052	Walk the clause tree and follow a substantive reference without surrounding conversation. Can its leaf, exact target and edition be identified, or does interpretation depend on an unlocated paragraph or latest text?
D2-009, D2-010, D2-011, D2-012, D2-053, D2-054	Apply a requirement to a normal and boundary case. Can the actor, trigger, criterion and outcome be determined? Compare grouped components with different results and check identifier continuity in the change record.
D2-014, D2-055, D2-056	Search modal verbs and inspect their contexts. Does an optional recommendation become a failure, a capability become an obligation, or an asserted legal necessity lack a scoped source?

Identifiers	Discriminating assessment question and evidence
D2-013, D2-015, D2-016, D2-057, D2-058	Apply an exception and an unknown value to a triggered obligation. Recover authority, permitted departure, review limit and result consequence; distinguish an absent trigger from an unavailable assessment.
D2-059, D2-060	Select a substantive topic and its failure case. Is behavior specified beyond an objective label, and can its burden be examined at the declared scale without assuming a reduced profile preserves full coverage?
D2-017, D2-061, D2-062	Trace a numbered term from definition to use and source. Do notes, synonyms or domain qualifications change its operative meaning without an explicit boundary? Compare an adjacent concept or counterexample.
D2-018, D2-019, D2-020, D2-021, D2-063	Compare an operational GR definition with its manuscript passage and decision record. Does a formal carrier become an archival class, or a source disagreement disappear, without a scoped argument and recorded disposition?
D2-064	Test a translation or mapping on a meaning that is narrower in one edition. Is the difference retained, with reviewer and editions, or silently described as equivalence?
D2-022, D2-023, D2-065	Follow an invoked dependency to the exact primary provision. Can a reader obtain the incorporated edition and determine what failure or inaccessibility means, rather than relying on a reading-list citation?
D2-024, D2-066	Compare the bibliography with access records and draft status. Does catalogue-only or unavailable material appear as directly inspected content, or a dated draft as an adopted authority?
D2-025, D2-067, D2-094	Examine an affected dependency version or unavailable source. Are incorporated clauses, impacted results and resolution recorded, including bounded Charter, Part 1 and ethics obligations? Check for circular or incompatible interpretations.
D2-026, D2-027, D2-031, D2-068	Compare a record-only result with a practice or interoperability claim. Is unobserved performance, lost meaning or legal/factual assurance incorrectly inferred from structure or vocabulary agreement?
D2-028, D2-029, D2-032, D2-069, D2-070	Reconstruct one assessment from its inputs, method and evidence. Can a failed or unavailable component be recovered from the summary, and does an automatic check claim only what it actually examined?
D2-030, D2-071	Select an optional feature and compare the profile to its parent. Are its triggered obligations assessed together, or is selecting the feature used to excuse a correctness or protection requirement?
D2-036, D2-072	Trace a mandatory data element to its semantic need and allowed missing states. Can another encoding preserve the meaning, or is a software convenience presented as a philosophical necessity?
D2-033, D2-034, D2-073, D2-074	Replay a refusal, duplicate or interrupted exchange where applicable. Can participants distinguish delivery, receipt and disposition, identify controlling text and recover without inventing institutional acceptance?
D2-035, D2-037, D2-075, D2-076	Run or inspect an associated fixture against its declared result and controlling edition. Are remote inputs or protected processing explicit, and does a prose/artifact conflict have a recorded resolution?
D2-077, D2-078	Read a table, figure or formula without relying on colour or position. Are role, variables, scale, units, assumptions and controlling textual requirements recoverable? Inspect unsupported numerical precision.
D2-038, D2-039, D2-079, D2-080	Examine source and rendered reading modes and available user evidence. Does an authored example appear as observed performance, or successful compilation as tested accessibility? Record barriers and unperformed examination.

Identifiers	Discriminating assessment question and evidence
D2-040, D2-041, D2-081	Follow a legal, ethical or policy assertion to its context and reviewer. Can mandate, affected interests, alternatives and evaluation be located without assuming technical adoption resolves the political choice?
D2-042, D2-043, D2-044, D2-082	Compare source, manifest and rendered artifact. Can the exact reviewed edition be rebuilt and inspected for omitted provisions, missing glyphs, clipped content, duplicate IDs and incorrect status?
D2-045, D2-083, D2-084	Compare an alleged editorial correction with prior permitted outcomes. If a single character changes an obligation, is substantive review triggered and the earlier edition still locatable?
D2-085, D2-086	Inspect the assessment declaration and its annex records. Are subject, profile, competence and unavailable artifacts identified before an overall result rather than supplied by a generic assurance?
D2-087, D2-088	Trace a finding to correction and closure evidence. Does closure identify the new artifact and actual recheck, and remain separate from unperformed technical review or release authorization?
D2-089, D2-090	Compare an in-scope topic against the structural schedule and final-approval evidence. Is an unresolved gap explicitly excluded, blocking or returned for work, rather than hidden by an empty heading?
D2-091, D2-092, D2-093	Inspect a mixed-result assessment record. Does unavailable evidence remain not assessed and prevent unqualified fulfillment, with protected evidence linked only through permitted locators?
D2-095	Compare this schedule with the completed requirement register. Does each applicable identifier and distinct component have evidence and a result, rather than inheriting a single group pass?

Annex D

(informative)

Drafting examples and discriminating assessments

D.1 A recording obligation

The sentence “The system should contain trustworthy information” does not identify a conformance subject, a meaning of trustworthy or an assessment method. An operational alternative is to require an attributed claim, its scope and version, the evidence role assigned to cited material, and the responsible assessment. The resulting assessment asks whether these distinctions are present and whether the stated evidential reasoning is inspectable. It does not infer that every recorded claim is true.

D.2 A conditional disclosure obligation

A requirement to publish the entire history would conflict with some legitimate protection and retention arrangements. A bounded provision can require the responsible practice to identify permitted public material, the basis of a restriction, its effect on examination and the available review route. The assessor then examines those decisions and the resulting view. The mere existence of a privacy statement is not equivalent to observing that access control was enforced.

D.3 A protocol acknowledgment

A message receipt and a favorable decision are different states. A technical specification can define a receipt identifier, correlation reference and retry behavior. A procedural document can define who determines admissibility and gives reasons. A test that confirms transport delivery establishes neither the substantive decision nor the legitimacy of the deciding body.

D.4 A numerical result

An assertion that an outcome has high confidence is ambiguous unless the assessed question and grounds are stated. Where a number is used, the document identifies the quantity, scale, method, assumptions and scope. Where heterogeneous uncertainties cannot be commensurated, separate descriptions are preferable to an unsupported aggregate score. This is a requirement to preserve meaning, not a prohibition on quantitative methods.

D.5 An editorial correction

Changing a misspelled word without altering meaning can be editorial. Changing a response period, required metadata element, exclusion rule or approval denominator changes permitted outcomes. The latter requires substantive change control even if it occupies only one character. The classification follows the effect of the change, not its visual size.

Annex E

(informative)

Editorial model, differences and unresolved matters

E.1 Selected local model

The programme combines a conventional standards-document structure with its own traceability identifiers and explicit publication classes. ISO's publicly available model provides an example of ordered preliminary elements, numbered requirements and labelled annexes. ITU's authoring guide distinguishes integral annexes from supplementary appendices. This programme instead labels each annex normative or informative, maintaining one alphabetic sequence. The source distinction is preserved in function without adopting two incompatible naming systems.

IEEE's published procedural guidance informs the separation of draft status, normative material and informative support. UN statistical quality guidance supplies a useful comparison for linking institutional arrangements, production processes, output quality and improvement evidence. Those functions are adapted to the programme's own subjects; a statistical quality framework does not supply a universal test of factual truth or generativity.

E.2 Implementation choices

The current authoring system uses TeX sources, a shared preamble and a manifest-driven LuaLaTeX build. Roman pagination distinguishes preliminary pages from the Arabic-numbered main body. Clauses run continuously; annexes have explicit status headings. No target page count, blank filler or enlarged type is used as a completeness criterion. The assessment includes substantive coverage, traceability, counterexamples and known limitations.

E.3 Open matters

The final accessibility target and a tested alternative reading representation remain open. The exact incorporation of licensed external terminology requires rights review. The full IEEE style-manual download and the complete ISO/IEC Directives edition identified in the external register were not retrieved during this revision; no conformity claim is made to unavailable text. Local participation and approval choices remain matters for programme governance rather than editorial styling.

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GENERATIVITY STANDARDS PROGRAM

GR/TC 1 Charter

Governance Working Draft

Version 0.3 2026-09-22

Generativity Records and Infrastructure

WORKING DRAFT FOR REVIEW

This document contains proposed provisions for technical and institutional review. It is not an adopted Standard or an operative governance instrument. Its scope, application conditions and publication status are specified in the text.

Prepared by the Generativity Standards Program. Reference to external publications does not imply endorsement by ISO, IEC, IEEE or any United Nations body.

Foreword

Version 0.3 records the bounded substantive review of the archived 0.2 package. Its requirement text is retained in this coordinated edition; updated references identify the companion 0.3 drafts. The review matrix, synthetic assessments and unresolved readiness questions are documented in `docs/reviews/validation_0.2/README.md`. These activities do not constitute adoption or an independent institutional assessment.

This document specifies the proposed mandate and working obligations of GR/TC 1. It is a Governance Working Draft and does not constitute the committee or approve a work item. Version 0.2 retains the original TC requirement identifiers and develops the operational steps, review records, pilot controls, and readiness evidence required to exercise the mandate.

Responsible editor: `UNASSIGNED`. Canonical source: `governance/technical_committee_charter.tex`. Intended readers are the programme decision authority, prospective committee participants, editors, domain reviewers, affected people, implementers, and maintenance owners.

The Charter concerns committee performance and the evidence submitted for programme decisions. Programme authority, formal review periods, voting, and appeals remain governed by the companion programme Charter and Directives. Technical requirements are adopted through those procedures, not through this document's existence.

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Introduction

Developing infrastructure for warranted recognition requires coordination across several kinds of work. A coherent representation can remain evidentially weak; an accessible presentation can expose protected people; and a successful prototype can rely on an institutional authority that does not exist. Committee work therefore needs explicit responsibilities for source interpretation, requirements, practical procedures, implementation, multidisciplinary review, and evidence of effects.

The committee's organizing task is to preserve distinguishable histories of the situation under inquiry, evidence and judgment, and the categories or methods used to recognize it. Requirements begin with a bounded practical or normative problem. Specifications implement reusable infrastructure where that need is demonstrated. Pilots test the resulting practices and reveal costs, exclusions, loss, and failures as well as successful behavior.

One coordinated committee is proposed initially. Additional working groups are activated by actual scope and accepted participation rather than by a list of anticipated disciplines. Review of epistemic, ethical, institutional, legal, political-economic, archival, and technical issues remains distributed across competent and affected participants, with missing capacity reported.

1 Scope

1.1 Committee subject

This Charter specifies constitution, work-item control, assignment of functions, source and requirements discipline, multidisciplinary review, pilot management, publication progression, and maintenance coordination for GR/TC 1. The assessed subject is an identified committee activity or deliverable-development process within its recorded mandate.

1.2 Limits and portfolio

The proposed scope includes vocabulary, recording requirements, epistemic representation, evidence and interpretation, contestation and revision, institutional use, information models, exchange, presentation, preservation, access, and assessment.

2 Normative references

2.1 Internal dependencies

The following Governance Working Drafts, version 0.3, contain provisions required by this Charter. Their exact operative editions are fixed by the recorded programme adoption and committee mandate.

Standards Programme Charter. `governance/standards_programme_charter.tex`; authority, participation, appointments, resources, reserved decisions, and governance launch.

Directives Part 1. `governance/directives_part_1.tex`; work-item initiation, stages, public review, decisions, appeals, and maintenance.

Directives Part 2. `governance/directives_part_2.tex`; publication structure, normative drafting, dependencies, conformance, and production.

Ethics, Conflict-of-Interest, and Contribution Rights Policy. `governance/ethics_ip_policy.tex`; conflict, protection, substantive impact, and contribution-rights handling.

2.2 Edition control

TC-031 The convenor shall record the governance editions applicable to committee work and identify unresolved conflicts before dependent action. A new draft or external source shall not change an operative committee obligation by implication.

Foundation manuscripts and external documents cited in the bibliography provide informative sources. A technical publication's own normative references are assessed separately.

3 Terms and definitions

3.1 Work item

An authorized bounded activity with a problem, scope, intended outputs, responsibilities, dependencies, review plan, and expected evidence. A preliminary proposal is not an authorized work item.

3.2 Requirement baseline

An identified edition of candidate provisions and their associated source, decision, dependency, and assessment records used for a specified review or exercise.

3.3 Review finding

A recorded assessment of a stated question within a reviewer's competence, identifying evidence, reasons, limits, effect on progression, and requested disposition.

3.4 Blocking finding

A finding that a mandatory procedural, authority, protection, rights, or evidential condition for the proposed progression remains unmet. Its materiality is recorded against that progression, not asserted by a label alone.

3.5 Pilot

A bounded exercise of proposed practices or implementations under a declared purpose, case, authority, permissions, evaluation method, and stopping arrangements.

3.6 Independent evidence

Evidence produced or reviewed with the relevant organizational, authoring, financial, and practical dependencies declared and assessed for the particular independence claim.

3.7 Assessment method

A specified means of evaluating an applicable requirement, including its inputs, procedure, expected evidence, result categories, and limits.

3.8 Coordination issue

A disagreement or dependency spanning deliverables or domains whose resolution affects scope, meaning, implementation, assessment, or authority.

4 Mandate and work programme

4.1 Authorization and entry

TC-001 The committee shall become active only through a recorded mandate under the adopted programme Charter. The mandate shall identify its convenor, responsible decision authority, participating capacities, accepted work items, review resources, and mandate review date.

TC-002 The committee shall develop coordinated recording and practical procedures that support warranted, contestable, revisable recognition and preservation of consequential generative trajectories. Each accepted work item shall state its contribution to this purpose and the limits of its expected effects.

TC-003 Committee work shall distinguish changes in the situation under inquiry, changes in evidence and judgment, and changes in categories or methods of recognition. A technical representation connecting these histories shall preserve their distinguishable meaning.

TC-004 The committee shall retain the distinctions between theoretical metamodel, operational record ontology, epistemic representation, normative assessment, jurisprudential status, institutional governance, political economy, and implementation when defining scopes or allocating work.

TC-005 The committee shall not claim authority to certify substantive historical truth, resolve a complete metaphysics, determine legal rights across jurisdictions, endorse a political choice on technical grounds alone, or mandate unrestricted disclosure of recorded material.

TC-006 The committee shall preserve existing publication identifiers when refining scopes. A proposal to change a publication's class, merge or divide its scope, or introduce a new identifier shall record the reason, dependencies, alternatives, and authorizing decision before the change is treated as operative.

TC-007 A work-item proposal shall identify purpose, scope and exclusions, conformance subjects, affected interests, foundation sources and tensions, existing alternatives, related publications, anticipated Specifications, reviewer competence, practical evidence, and maintenance ownership.

TC-010 A proposed substantive scope expansion shall return to the responsible decision authority with its consequences for participation, sources, dependencies, review, and resources. Work outside the authorized scope shall remain exploratory pending a decision.

TC-032 On acceptance of a work item, the convenor shall create a project record linking the authorized proposal, actual decision, bounded outputs, accepted assignments, resources, milestones, dependencies, and unresolved conditions. The record shall distinguish preliminary drafting already performed from work formally authorized.

TC-033 Before scheduling a progression review, the convenor shall verify that the work remains within its mandate, that required responsibilities are staffed, and that necessary evidence is available. A scope or capacity defect shall receive correction, narrowing, or deferral rather than an unsupported stage label.

4.2 Programme coordination

TC-008 The committee shall record work-item dependencies and allocate requirements to their responsible publication before producing a normative technical binding. A shared requirement shall have one authoritative location, with versioned references from dependent work.

TC-009 Editors shall begin with the normative or procedural need and create a Specification proposal when reusable infrastructure is required to satisfy or assess it. A prototype shall not silently determine a theoretical definition or institutional obligation.

TC-034 The committee shall maintain a dependency register identifying each shared concept, requirement, interface, profile, or artifact; its responsible publication and owner; its exact version; and the consequence of change. Competing normative homes shall be resolved before the affected requirement is stabilized.

TC-035 For a coordination issue, the convenor shall identify affected editors and reviewers, record alternatives and semantic or institutional consequences, and seek an explicit decision within the appropriate authority. Technical convenience shall not resolve a normative, legal, or theoretical disagreement without that decision.

TC-036 A split, merger, pause, or termination of a work item shall identify the fate of requirement identifiers, comments, evidence, responsibilities, dependencies, and publication expectations. The programme decision authority shall authorize the revised scope before dependent formal progression.

4.3 Specification and protocol initiation

TC-037 A Specification proposal shall identify the candidate requirement it supports, the need for a reusable technical contract, implementation alternatives, version assumptions, and the evidence expected from a prototype. An institutional procedure shall identify its actual authority separately from protocol mechanics.

TC-038 Before treating a protocol draft as ready for implementation, its editor shall define participants, inputs, preconditions, state transitions, observable outcomes, refusals, failures, recovery, authorization boundaries, and responsibility for interrupted or conflicting operations. Unresolved behavior shall be marked and excluded from unsupported completeness claims.

5 Organization and conduct of work

5.1 Assignments and competence

TC-011 For each active deliverable, the committee shall record an accepted editor or lead, a maintenance contact, required review competence, available reviewers, and unfilled roles. Multiple roles held by one person shall be declared.

TC-012 A new working group shall have a bounded scope, actual willing participants, an accountable lead, dependencies, intended outputs, and review or closure conditions. Its formation shall not imply autonomous adoption authority.

TC-013 A reviewer shall identify the domain and scope of their assessment, relevant competence or situated knowledge, interests, material limitations, and whether they contributed to the material reviewed. A self-review shall not be labelled independent.

TC-014 Where required expertise or affected perspectives are unavailable, the committee shall record the gap and its material effect on progression. It shall narrow claims, seek additional review, or defer the affected decision when the gap prevents a justified assessment.

TC-039 An editor shall accept responsibility for the deliverable's current baseline, change record, source and requirement trace, pending comments, and progression evidence. A reviewer shall accept a bounded assessment assignment rather than an unspecified endorsement of the entire publication.

TC-040 The convenor shall compare each work item's planned drafting, review, accessibility, protection, and maintenance tasks with actual participant capacity. A shortage affecting mandatory evidence or a safeguard shall change the schedule or scope and be reported to the programme decision authority.

5.2 Meetings and asynchronous work

TC-041 For a substantive committee discussion, the convenor shall circulate the purpose, input versions, questions, expected output, access arrangements, and route for asynchronous contributions before the decision is taken. Participants unable to attend shall have the applicable opportunity to contribute under Directives Part 1.

TC-042 The discussion record shall distinguish persons present from represented institutions, information reported from findings accepted, and recommendations from authorized decisions. Material reasons, alternatives, objections, actions, owners, and affected baseline versions shall be recorded.

TC-043 Where new material changes the basis of a proposed decision during a meeting, the chair shall identify the change and apply the relevant further-review procedure. Attendance or an informal show of support shall not replace required notice, reply, or ballot.

5.3 Handover and group closure

TC-044 An editor or working-group handover shall provide the current baseline, requirement and source registers, unresolved comments and findings, dependencies, permissions, build or assessment instructions, and pending deadlines. The convenor shall verify receipt and record any gap before further reliance on the work.

TC-045 A working group that has no accepted lead or capacity to discharge its mandate shall be reported as inactive or pending reassignment. Its outputs shall retain their actual maturity, and unfinished responsibilities shall be reassigned or explicitly deferred.

6 Source interpretation and requirements

6.1 Foundation and external sources

TC-015 Before introducing or materially changing a GR definition, notation, ontology class, or compatibility claim, the responsible editor shall examine the relevant foundation manuscripts and record exact source locations, terminology, scope, historical differences, and the proposed operational translation.

TC-016 The committee shall preserve unresolved foundation differences rather than harmonizing them silently. A material operational narrowing or departure shall be recorded through an architectural decision with alternatives, rationale, affected publications, and remaining uncertainty.

TC-017 A candidate record-class definition shall identify its definition, admissibility conditions, identity criterion, temporal behavior, permitted relations, required and optional metadata, examples, counterexamples, and unresolved edge cases, or explicitly identify which elements remain under development.

TC-018 An external compatibility or reuse proposal shall identify the exact source and edition, verified relevant provisions, mapping assumptions, exclusions, and evidence needed to support the claimed relationship. Similar terminology shall not alone establish equivalence.

TC-046 The source register shall distinguish source wording, editorial paraphrase, historical variant, operational proposal, and accepted programme decision. Each material interpretation shall identify the relevant passage and version, verification status, and unresolved difference.

TC-047 When a source is revised, newly available, or found to have been misinterpreted, the editor shall identify affected definitions and requirements, assess the consequence, and submit necessary changes through the appropriate procedure. Earlier interpretations and the reason for revision shall remain traceable.

6.2 Requirement formation

TC-048 For each candidate requirement, the editor shall identify the responsible actor or subject, applicability condition, required outcome, assessment method, evidence expectation, source or operational rationale, and related issue or decision. A requirement with unresolved scope or testability shall retain a visible development issue.

TC-049 The editor shall separate independently assessable obligations where one result would conceal different applicability or failure. Recommendations, examples, and explanatory theory shall remain distinguishable from mandatory provisions.

TC-050 Before stabilizing a requirement baseline, the review group shall examine examples, counterexamples, unknown or unavailable information, restricted records, and relevant conflicting interpretations. Required uncertainty declarations shall not be replaced by invented information to complete a record.

6.3 Assessment design and claims

TC-026 A conformance proposal shall identify the assessed subject, edition, profile, applicable requirements, methods, evidence, unresolved findings, and limits of the resulting claim. Syntax checks, semantic interoperability, procedural compliance, usability, and substantive warrant shall receive distinguishable results.

TC-027 The committee shall substantiate an interoperability claim with independent implementation or exchange evidence appropriate to the claim. A single internally consistent prototype shall be reported as such.

TC-051 The requirement-to-assessment register shall identify which findings arise from automated checks, observed human tasks, documentary review, independent implementation, or substantive expert judgment. The reported result shall not claim evidence beyond what the chosen method establishes.

TC-052 A proposed profile shall identify inherited requirements, additions, permitted restrictions, applicability, and assessment consequences. The editor shall identify any divergence that prevents unqualified parent conformance and propose an appropriately bounded claim.

TC-053 An asserted external mapping shall identify direction, supported distinctions, unsupported cases, loss, and the exact tested source versions. An untested mapping shall be labelled proposed rather than interoperable.

7 Multidisciplinary review

7.1 Planning and scope

TC-019 At work-item scoping, before a real pilot, and before publication progression, the committee shall maintain a review dossier covering applicable epistemic, ethical, jurisprudential, institutional, political-economic, archival, privacy/security, accessibility, and technical questions. Each domain shall have findings or an explicit justified statement of non-applicability or unassessed scope.

TC-020 The review dossier shall identify evidence, reviewers and their capacities, affected perspectives, conflicts, alternative designs, findings, dispositions, owners of corrective action, and residual limitations. A metadata field or completed checklist shall not by itself count as domain assessment.

TC-054 The review plan shall state the questions, needed competence and affected perspectives, evidence, review independence sought, access arrangements, and decision points for each applicable domain. It shall distinguish non-applicability from unavailable review capacity.

7.2 Findings and disagreement

TC-055 Each domain reviewer shall classify a finding by the affected requirement or assumption, evidence and uncertainty, consequence for the proposed decision, and proposed disposition. A disagreement about values or policy shall be identified as such rather than converted into an unexplained technical defect.

TC-056 The editor shall respond to each material finding with acceptance, modification, reasoned non-acceptance, or deferral, linking the resulting text or action. A deferred finding shall retain an owner, next action, and explanation of whether progression is prevented.

TC-057 Where reviewers disagree across domains, the convenor shall preserve their respective questions, evidence, competence, and reasons and obtain a decision from the authority competent for the matter. A technical majority shall not substitute for an absent legal mandate or resolve a philosophical source conflict by assertion.

TC-058 Before recommending progression, the convenor shall verify that material findings and replies have been considered and that mandatory authority, evidence, rights, and protection conditions are satisfied. A decision to narrow scope shall identify the excluded behavior and prevent it from appearing in the resulting conformance claim.

7.3 Jurisprudential and policy interfaces

TC-021 A legal or institutional profile shall state its jurisdiction or forum, target action, relevant sources and status, claimed authority, temporal scope, unresolved conflicts, and reviewing competence. Generic technical conformance shall not replace assessment of actual applicability.

TC-022 A policy proposal arising from committee work shall follow the separate policy-publication route and compare plausible institutional options, including existing infrastructure or deferral when relevant. The committee shall not present participation in technical review as assent to a policy recommendation.

TC-059 A jurisdictional or institutional reviewer shall distinguish a party's assertion, an applicable source identified by the reviewer, an institution's operative decision, and an unresolved interpretation. The profile shall state the temporal and contextual limits of that review.

TC-060 For an institutional or international-policy proposal, the committee shall identify which technical findings are evidence for the proposal and which recommendations concern mandate, funding, distribution, oversight, or adoption choices. Unaccepted institutional participation shall remain prospective.

8 Pilot preparation and authorization

8.1 Protocol and evidence plan

TC-023 Before a pilot begins, its record shall identify the case and baseline, questions and success criteria, participants and actual authority, material and access permissions, resource burden, anticipated harms, challenge and correction routes, stop conditions, and responsible reviewers. Synthetic cases shall be labelled synthetic.

TC-024 The initial coordinated demonstration shall exercise a claim and its grounds, a consequential relation or contribution, an alternative or challenge, a reasoned response, a historical revision, a protected or unavailable record, and a presentation that makes their distinct status understandable.

TC-061 The pilot plan shall pin the requirement baseline, artifacts, scenario, input material, evaluation tasks, expected results, assessors, and comparison baseline before results are interpreted. A change during the exercise shall identify the reason and its effect on comparability.

TC-062 For a real pilot, the responsible authority shall verify participant and institutional permissions, rights to material, protection arrangements, accessible challenge routes, available remedy, and stopping authority before the affected activity starts. A planned safeguard shall not be reported as operational without evidence of implementation.

TC-063 A pilot relying on restricted evidence shall identify how authorized assessors can evaluate the relevant requirement and how a public result can communicate limitations safely. Lack of public access shall not be equated with absence of evidence or accepted as proof of adequacy.

8.2 Execution and interruption

TC-064 The pilot operator shall retain observations of performed tasks, relevant inputs and outputs, failures, participant assistance, departures from the plan, and protection incidents, within the approved access and retention conditions. Simulated events shall remain distinguishable from observed real behavior.

TC-065 When a stopping condition is met or an unanticipated material harm or authority defect is identified, the pilot operator shall pause the affected activity, notify the responsible authority, protect necessary evidence, and obtain a recorded disposition before restart. Unaffected activity may continue only within its existing authority and safeguards.

TC-066 A pilot restart shall identify the corrected condition, evidence that the response is operational, changed baseline or scope, required further permissions or notice, and the decision maker. A technically successful repair shall not alone establish restored participant protection.

9 Pilot evaluation and implementation evidence

9.1 Results and learning

TC-025 Pilot findings shall report failed tasks, missing or conflicting evidence, excluded participants, unmet assumptions, and burdens alongside successful behavior. The committee shall trace each material finding to a requirement change, retained decision with reasons, further inquiry, or scope limitation.

TC-067 The evaluator shall report the actual participant population, excluded or unavailable perspectives, resource burden, supported tasks, failed cases, assistance required, uncertainty, and limits on transfer to other contexts. A small cooperative exercise shall not be presented as evidence of general institutional adoption.

TC-068 The committee shall compare pilot results with the declared objectives and assessment criteria and trace each material finding to a requirement change, retained decision with reasons, further inquiry, or narrower claim. Unexpected benefits and harms shall be identified separately from the planned criteria.

TC-069 Where an outcome depends on later institutional action or effects on future capacity, the report shall state whether that action or effect was observed, is pending, or was outside the study period. A corrected record shall not be treated as evidence that downstream consequences were repaired.

9.2 Reproducibility and independence

TC-070 An implementation-evidence package shall identify source and artifact versions, configuration, test material, expected and actual outcomes, access or licence constraints, and instructions sufficient for an authorized reviewer to repeat the relevant assessment. Reproduction gaps shall be disclosed.

TC-071 For an independence claim, the convenor shall record who authored the requirements, implemented the artifacts, selected the cases, performed the assessment, and funded or controlled the work. The claimed degree of independence shall be limited to the separations actually evidenced.

10 Progression, maintenance, and publication

10.1 Readiness dossier

TC-028 For each requested progression decision, the convenor shall assemble the current draft, requirement and source trace, comment dispositions, unresolved objections, multidisciplinary findings, pilot or other assessment evidence, rights-clearance status, and maintenance proposal. The programme decision authority shall apply Directives Part 1.

TC-072 The progression dossier shall identify the requested decision and provide a requirement-by-requirement evidence status, unresolved finding register, dependency review, public-comment status where applicable, source and rights clearance, and implementation or pilot limitations. Missing evidence shall remain visible rather than being treated as tacit approval.

TC-073 Before forwarding a public-review or release package, an assigned reviewer shall check that the source, rendered document, associated artifacts, and declared status agree and that references, identifiers, and essential content remain usable. Material discrepancies shall be corrected through the applicable change procedure.

10.2 Change and maintenance

TC-029 The committee shall retain a link from a corrected or superseded requirement to the prior text, reason, decision, affected dependencies, and migration consequence. Historical decisions shall remain

distinguishable from the current authoritative edition.

TC-030 The committee shall submit scope, participation, resource, and outstanding-risk information at its mandate review and when material conditions change. An inactive or unstaffed work item shall receive an explicit status and continuity disposition.

TC-074 A substantive change shall identify affected requirements, interpretations, assessment fixtures, profiles, dependencies, existing users, and migration consequences. The maintenance owner shall distinguish a correction from an altered obligation and invoke the corresponding Directives route.

TC-075 On evidence of a serious defect or loss of a necessary dependency, the convenor shall notify the authorized maintenance or release holder with the affected versions, evidence, consequences, and proposed interim response. The committee shall not issue a permanent normative change through an informal implementation update.

11 Committee assessment

11.1 Assessment method

TC-076 An assessment of committee performance shall declare the activity, period, mandate and governance editions, assessor, interests, applicable TC requirements, evidence, and result for each requirement. Results shall distinguish fulfilled, not fulfilled, not assessed, and not applicable.

TC-077 The assessment shall include a trace from a selected material problem through source interpretation, candidate requirement, alternatives, assessment method, pilot or review evidence, disposition, and authorized decision. Breaks in the trace shall be recorded with their effect on the claimed readiness.

11.2 Correction and oversight

TC-078 The convenor shall assign owners and review dates for material performance findings and report unresolved scope, participation, capacity, or protection issues to the programme decision authority. Closing an action shall identify evidence of completion and any remaining limitation.

Annex A

(normative)

Committee dossier and record content

A.1 Work-item and baseline record

TC-079 The committee shall maintain a work-item and baseline record containing the authorized problem and scope, decision and mandate, output classes, accepted roles, sources, dependencies, versions, requirements, assessment methods, review milestones, permissions, resources, and remaining conditions. Each substantive update shall identify the responsible actor and reason.

A.2 Source and requirement trace

TC-080 The editor shall maintain a trace for each material requirement identifying its stable identifier, responsible publication, condition and subject, source passage or operational proposal, alternatives, decision rationale, assessment method, evidence, dependency versions, and unresolved question. Superseded interpretations shall remain linked to their replacements.

A.3 Domain finding record

TC-081 A domain finding record shall identify the question, scope, reviewer and competence, relevant interests, evidence and access limitations, assessed alternatives, finding and reasons, progression effect, response, reply, action owner, and closure evidence. A safe public account shall be linked where the full record is restricted.

A.4 Pilot and assessment record

TC-082 A pilot record shall identify its authorization, actual participants, baseline versions, scenario, data and permissions, evaluation tasks, expected and actual outcomes, failures, burdens, deviations, stopping or restart decisions, evidence limitations, and requirement dispositions. Synthetic and independent elements shall be explicitly identified.

A.5 Progression and handover index

TC-083 The convenor shall provide an index linking the current baseline, scope decision, review and comment dispositions, pilot evidence, blocking findings, rights status, artifact manifest, maintenance assignment, and requested decision. The index shall identify unavailable or incomplete elements and their proposed treatment.

Annex B

(informative)

Worked review and implementation cases

B.1 Missing evidence mistaken for non-occurrence

A synthetic institution records an uncalibrated instrument because no calibration field was present. A participant later supplies a restricted maintenance log. The exercise tests whether the representation distinguishes absent metadata from an occurrence claim, whether authorized review can consider the log, and whether the presentation exposes the changed basis without disclosing protected detail. Source and requirements review examine the inference; institutional review examines who can reconsider the consequential decision.

B.2 Technically successful but incomplete exchange

Two implementations exchange a current judgment successfully but omit its prior category and an unresolved objection. A syntax result can remain successful while trajectory and presentation requirements fail. The failure becomes evidence for a changed exchange requirement or an explicitly narrower profile, rather than being hidden by the successful parse.

B.3 Conflicting review considerations

An archival reviewer favors retaining an earlier attribution, while a protection reviewer identifies a risk in public release. Their findings address different questions. The committee examines preservation with restricted access, a safe public correction, and retention limits. A decision states the authority and evidence for each outcome without declaring either archival value or protection irrelevant.

B.4 Deferred theory and bounded implementation

A proposed mapping treats Property and the metamodel manuscript's Attribute as identical. The foundation register retains the difference and identifies the exact operational scope being proposed. An exploratory implementation can test one mapping with an experimental label. Stabilizing it requires the recorded interpretation and architectural decision; implementation convenience does not supply the missing conceptual argument.

B.5 Unresolved matters

OPEN ISSUE Committee appointments, accepted work items, domain-review capacity, actual independent implementers, and real institutional pilot mandates remain unassigned or unapproved. An exercise against this draft does not fill those roles.

OPEN ISSUE Property/Attribute interpretation, manuscript version precedence, and the relation between fixed-carrier semantics and broader emergence remain source questions. Their resolution is separate from the constitution of the committee.

Bibliography

Source and interpretation: Programme Brief, version 0.5; comprehensive development plan, cross-domain programme, protocol plan, and foundation traceability map in `docs/planning/`. These establish the local mission and proposed work architecture.

Source and interpretation: Foundation orientation: FM-001, Chapter 1, section 1.14, pp. 79–83; FM-003, Chapter 3, section 3.12, pp. 129–132; FM-005, Chapter 5, section 5.18, pp. 150–153. Exact files and unresolved source chronology are indexed in `foundation_manuscripts/MANIFEST.md`.

Source and interpretation: ITU-T Recommendation A.1 (09/2019), Working methods for study groups of the ITU Telecommunication Standardization Sector. Official edition and status page, consulted 22 September 2026: https://www.itu.int/itu-t/recommendations/rec.aspx?rec=a.1. The source concerns meetings, study management, coordination, rapporteurs, and contributions. It informs comparison of functional responsibilities; its membership and approval authority are not imported.

Source and interpretation: United Nations, National Quality Assurance Frameworks Manual for Official Statistics, 2019. Official publication overview, consulted 22 September 2026: https://desapublications.un.org/publications/united-nations-quality-assurance-frameworks-manual. It addresses assurance across national statistical systems and different data sources. This committee uses a narrower local comparison: quality questions belong throughout the development process and cannot be reduced to artifact syntax. No official-statistics mandate or UN endorsement is inferred.

Source and interpretation: ISO, Model International Standard, third edition, 2023, https://www.iso.org/iso/model_document-rice_model.pdf; IEEE SA policy comparisons and source-edition limits recorded in `docs/planning/standards_development_comparison.md`. Structural adaptation is separate from adopting those organizations' procedures.

GENERATIVITY STANDARDS PROGRAM

Ethics and IP Policy

Governance Working Draft

Version 0.3 2026-09-22

Ethics, Conflict-of-Interest, and Contribution Rights Policy

WORKING DRAFT FOR REVIEW

This document contains proposed provisions for technical and institutional review. It is not an adopted Standard or an operative governance instrument. Its scope, application conditions and publication status are specified in the text.

Prepared by the Generativity Standards Program. Reference to external publications does not imply endorsement by ISO, IEC, IEEE or any United Nations body.

Foreword

Version 0.3 records the bounded substantive review of the archived 0.2 package. Its requirement text is retained in this coordinated edition; updated references identify the companion 0.3 drafts. The review matrix, synthetic assessments and unresolved readiness questions are documented in `docs/reviews/validation_0.2/README.md`. These activities do not constitute adoption or an independent institutional assessment.

This document specifies proposed programme requirements for conduct, conflict management, ethical impact assessment, contribution rights, and implementation-rights concerns. It is a Governance Working Draft. Version 0.2 preserves the EIP identifiers from version 0.1, clarifies the distinction between the mandatory acknowledgement period and extendible determination target in EIP-014, and adds operational handling, assessment, and evidence requirements.

Responsible editor: `UNASSIGNED`. Canonical source: `governance/ethics_ip_policy.tex`. Intended readers are contributors, affected people, ethics and rights reviewers, project leads, custodians, and the programme decision authority.

Adoption requires the programme's actual authority and recorded procedure. This text is not a licence offer, copyright transfer, patent assurance, or legal determination. The specific organizational and jurisdictional context remains to be established for commitments that depend on it.

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Introduction

The infrastructure being developed can affect whose experience becomes visible, whose evidence receives consideration, and who can challenge an authoritative account. Programme participation can reproduce unequal access, while publication and preservation can expose people or depend on rights the programme does not hold. Ethical assessment therefore concerns both development conduct and the effects of proposed practices.

This policy separates four inquiries: whether programme conduct meets its rules; whether an interest impairs a particular role; whether a design or pilot has unacceptable or unresolved effects; and whether a proposed use of material has an established basis. Evidence of one does not resolve another. A well-attributed contribution can remain inaccurate; an ethically desirable publication can lack distribution permission; and a contribution from an interested person can still contain relevant evidence.

The policy supplies procedures and records rather than a universal score of ethical adequacy or generativity. It retains value disagreement, limitations of inquiry, and the distinction between internal programme remedies and external legal proceedings.

1 Scope

1.1 Subjects and application

This policy applies to participants acting in programme functions, programme decisions about conduct and conflicts, impact review of work items and pilots, and intake or distribution of contributed material. Its assessed subject is a specified activity, decision, contribution, or handling process under a declared edition.

1.2 Authority boundary

Internal corrective measures concern participation, assigned functions, programme access, and programme publications. Financial compensation, enforceable legal duties, jurisdiction, and findings of legal liability require separately established authority. Contribution rights and legal applicability remain subject to their actual context.

2 Normative references

2.1 Internal provisions

The following Governance Working Drafts, version 0.3, supply provisions needed by this policy. Exact operative editions are fixed through recorded adoption.

Standards Programme Charter. `governance/standards_programme_charter.tex`; appointments, decision authority, participation, resources, reserved powers, and neutral review.

Directives Part 1. `governance/directives_part_1.tex`; handling periods, appeal, emergency measures, release, retention, and maintenance.

Directives Part 2. `governance/directives_part_2.tex`; source discipline, publication claims, dependencies, evidence, and production.

GR/TC 1 Charter. `governance/technical_committee_charter.tex`; domain review, pilot authorization, findings, and progression evidence.

2.2 Application of timing and sources

The mandatory acknowledgement period and the initial-determination target cited in EIP-014 apply the specified Directives provisions to conduct handling without changing its substantive route. Only the initial-determination target has the cited reasoned-extension provision. External sources in the bibliography are informative; no external treaty, recommendation, statute, or institutional policy is incorporated as a generally applicable legal obligation.

EIP-041 The responsible handler shall identify the operative policy and procedure editions for each matter and record any conflict affecting authority, timing, protection, or available remedy. A consequential dependent determination shall await resolution of a material conflict within actual authority.

3 Terms and definitions

3.1 Material interest

A financial, institutional, personal, authorship, funding, or infrastructure-control interest relevant to impartial performance of a specified programme function.

3.2 Conflict-management decision

A reasoned determination of whether an interest affects a particular function and what disclosure, oversight, separation, recusal, replacement, or deferral is required.

3.3 Report

Information submitted concerning possible conduct, protection, conflict, or rights problems. Receipt does not establish the allegation.

3.4 Reported person

A person whose programme conduct is the subject of a report or inquiry. The term does not imply a concluded finding.

3.5 Protective measure

A temporary action intended to limit an identified immediate risk while fair consideration remains incomplete. It is distinct from a final conduct finding or sanction.

3.6 Rights clearance

A scoped programme determination that an identified use of particular material is supported by recorded permissions or another reviewed basis, subject to stated limitations.

3.7 Contribution

Material submitted for a stated programme purpose, including prose, comments, schemas, software, examples, data, or source materials. Submission alone does not establish ownership or a licence for further uses.

3.8 Impact finding

An assessed actual or anticipated consequence of a proposed practice, identifying affected interests, evidence, uncertainty, values, alternatives, and proposed response.

3.9 Retaliation

Adverse programme treatment because a person raised a concern, gave relevant evidence, participated in review, or exercised a permitted challenge route. A reasoned response to independently established misconduct is assessed separately.

4 Responsibilities and readiness

4.1 Assignment and independence

EIP-001 The programme shall identify the adopted edition, effective scope, responsible ethics contact and alternate, protected reporting route, decision authority, and neutral-review route before treating this policy as operational. Until then it shall retain Governance Working Draft status.

EIP-002 The programme shall assess conduct, conflicts, substantive impacts, and contribution rights through distinguishable findings. A favorable finding in one area shall not be represented as clearance in

another.

EIP-042 The governance authority shall assign an ethics contact, an alternate, conflict-decision responsibility, competent rights review, record custody, and neutral procedural review before relying on those functions. Each holder shall accept a bounded mandate and declare interests; an unassigned function shall remain visibly unavailable.

EIP-043 The ethics contact shall receive and triage reports, arrange appropriate consideration, communicate status, and protect access. The investigator or assessor shall examine the stated question; the authorized decision maker shall determine programme findings and remedies. Where functions are combined, the record shall identify resulting limits and independent review needed.

EIP-044 Before opening a protected reporting route, the custodian shall verify restricted access, a safe alternate contact, retention arrangements, incident handling, and the information provided to reporters about confidentiality limits. If the route fails, the custodian shall publish or directly provide a safe alternative and prevent further avoidable disclosure.

4.2 Capacity and access to assistance

EIP-045 The responsible authority shall provide information on feasible assistance with language, access, or submission format and shall record unmet needs and their effect on fair consideration. A person shall not be required to expose protected information publicly to obtain assistance.

EIP-046 A material capacity gap in impartial handling, rights competence, or protection shall be reported to the governance authority with a proposed reassignment, narrower scope, or deferral. Continued drafting within existing permission shall remain distinct from approval of the affected use or finding.

5 Conduct and evidential integrity

5.1 Participation and attribution

EIP-003 Participants acting in programme roles shall not engage in harassment, threats, retaliation, discriminatory exclusion, or coercive disclosure of protected information. Critical disagreement about sources, methods, policy, and requirements shall remain eligible for reasoned consideration.

EIP-004 A participant presenting a factual or source-based claim shall distinguish observation, quotation, interpretation, inference, and proposal where that distinction affects review. Known material errors, fabricated evidence, or falsely attributed sources shall not be retained as support after discovery without correction or explicit disputed status.

EIP-005 Editors shall preserve attribution of material contributions and competing positions within actual permissions and protection needs. Authorship, acknowledgement, evidential reliability, ownership, and decision authority shall remain distinct.

EIP-047 A participant identifying a material error in their earlier contribution shall notify the responsible editor and supply the correction or known uncertainty. The editor shall assess affected arguments, decisions, and artifacts and retain an attributable correction record.

EIP-048 A claim that a contribution was deliberately fabricated or knowingly misattributed shall be assessed through the conduct procedure. A disputed interpretation, incomplete evidence, ordinary error, or unsubstantiated report shall not by itself establish intentional misconduct.

5.2 AI and external processing

EIP-006 A participant using AI assistance for a material draft, analysis, evidence synthesis, or disposition proposal shall identify the consequential assistance and the responsible human reviewer in the development record. The reviewer shall verify material sources and conclusions before relying on them.

EIP-007 Participants shall not submit protected, confidential, or third-party material to a tool or service without an established basis for that disclosure. Uncertainty about such a basis shall be resolved before the disclosure.

EIP-049 A consequential AI-use record shall identify the task, material source categories, transformations relied on, responsible human reviewer, verification performed, and known limits relevant to the resulting claim. Protected prompts or source contents shall not be exposed solely to demonstrate that assistance occurred.

EIP-050 When external processing terms or data handling change materially, the responsible user shall reassess permitted disclosure and reliance before further affected use. A tool's technical availability shall not establish permission to disclose material or confidence in its output.

6 Interests and influence

6.1 Disclosure and assessment

EIP-008 Before accepting a decision or review role and when relevant circumstances change, a participant shall disclose interests that could materially affect, or reasonably call into question, their impartial performance of that role. The disclosure shall include relevant financial, employment, funding, authorship, institutional, personal, and infrastructural-control interests.

EIP-009 The responsible coordinator shall record a conflict assessment, its author, the affected decision, the disclosed interest, protection limits, and the selected management action. Disclosure alone shall not be treated as resolving a conflict.

EIP-010 A person shall not determine the disposition of a complaint against themselves, act as neutral reviewer of their own decision, or independently assess a rights clearance in which they have an unresolved material interest. The alternate route shall be used.

EIP-011 Conflict management shall identify whether disclosure with oversight, separation of roles, partial recusal, replacement, or deferral is required. A recusal shall identify the decision scope and substitute authority without suppressing relevant technical evidence from the recused contributor.

EIP-012 The decision authority shall examine material concentration of funding, affiliation, available unpaid labor, infrastructure access, and agenda control when assessing fair consideration. If the concentration impairs review, it shall record corrective measures and reassess progression.

EIP-051 An interest disclosure shall identify the affected role or decision, nature and duration of the interest, relevant relationships, and protection needs. The conflict assessor shall distinguish an actual conflict, a reasonably perceived conflict needing management, and an interest not material to the stated role, with reasons.

EIP-052 Before the affected decision proceeds, the conflict assessor shall communicate the management decision to the role holder and responsible chair and record any objection. A challenged assessment involving the assessor's own interests shall be referred to the alternate or neutral route.

6.2 Recusal and control measures

EIP-053 A recusal arrangement shall identify prohibited decision participation, permitted factual or technical contribution, access limitations where justified, substitute authority, duration, and reconsideration trigger. The chair shall verify that the recusal was applied and record its consequence for eligibility or quorum.

EIP-054 If an undisclosed material interest is discovered after a decision, the governance authority shall assess the affected procedure and outcome, obtain independent consideration where needed, and record whether disclosure, renewed review, repeated decision, or another remedy is required. Retrospective disclosure shall not alone cure a defective process.

EIP-055 Measures addressing concentrated influence shall identify the actual mechanism, such as agenda control, dependence on one host, repeated affiliations, or unequal time resources, and the proposed response. The assessment shall not treat head count alone as evidence of balanced influence or stigmatize a contributor solely for an affiliation.

7 Report intake and triage

7.1 Receipt and route

EIP-013 The programme shall provide a reporting route to an ethics contact and an alternate independent of a reported person. Its notice shall explain receipt handling, who can access material, limits on confidentiality, possible outcomes, record retention, and the procedural-review route.

EIP-014 A report shall receive acknowledgement, triage, status communication, and a reasoned disposition. The seven-calendar-day acknowledgement requirement in D1-035 and the 30-calendar-day initial-determination target, with reasoned extensions notified before expiry, in D1-036 shall apply to report handling without converting the report into a procedural appeal. An extension of the determination target shall not extend the acknowledgement requirement. Triage shall distinguish immediate protection needs, conduct issues, procedural appeals, substantive technical objections, and record-specific correction or access requests.

EIP-015 A report shall not be rejected solely because its author requests protected handling or lacks a formal role. The reviewer shall record whether limited identity or unavailable evidence constrains investigation and what fair assessment remains possible.

EIP-056 At intake, the ethics contact shall assign a stable identifier, record the reported concern and relevant programme connection, acknowledge the requested protection, identify immediate risk, and explain the next handling step. Requests for additional information shall be limited to what is needed for that step.

EIP-057 Triage shall identify scope, required authority and competence, potential conflicts, available evidence, immediate protection needs, and whether another programme or external route is relevant. A referral shall preserve the original receipt history and explain what the programme will and will not determine.

EIP-058 When a report contains both a technical objection and a conduct allegation, the handler shall provide linked but distinct handling records. The technical concern shall not lose consideration because the conduct allegation is unsubstantiated, and a conduct concern shall not be dismissed solely because the technical proposal is accepted.

7.2 Protected, anonymous, and repeated submissions

EIP-059 The handler shall assess an anonymous or partly identified report to the extent supported by available information and record limits on verification, reply, and remedy. Identity disclosure shall not be demanded without a stated handling need and consideration of a less intrusive alternative.

EIP-060 A repeated submission shall be linked to earlier handling and assessed for new evidence, unaddressed grounds, or changed circumstances. Limits on repetitive or abusive contact shall state the conduct basis, safe route for materially new information, scope, review date, and challenge route. Mere persistence in disagreement shall not establish abuse.

8 Inquiry and fair response

8.1 Scope and evidence plan

EIP-016 Before an adverse conduct finding, the responsible reviewer shall provide the affected person a sufficient account of the concern and an opportunity to respond, using redaction or a protected intermediary when necessary. Where protection prevents a fair determination, that limitation shall remain explicit.

EIP-061 Before a substantive inquiry, the appointed assessor shall state the questions, applicable programme rules, scope, evidence sources, access arrangements, opportunities to respond, intended timetable, and decision authority. A material expansion shall be notified to affected participants with an adequate response opportunity.

EIP-062 The assessor shall distinguish direct information, testimony, contemporaneous records, inference, hearsay, and disputed interpretation where that distinction affects the finding. Relevant contrary evidence and plausible alternative explanations shall be examined; source status alone shall not determine credibility.

EIP-063 The assessor shall document evidential gaps and the reasons material may be unavailable, including protection, loss, or lack of access. An unavailable record or a person's inability to participate shall not automatically be treated as proof of the alleged conduct or its absence.

8.2 Opportunity to respond and protection

EIP-064 A response invitation shall identify the material concern and grounds sufficiently for a meaningful reply, the response route and deadline, available assistance, and the proposed decision scope. If safe disclosure cannot support a fair finding, the limitation shall prevent an unsupported adverse determination.

EIP-065 The assessor shall avoid unnecessary repeated disclosure of sensitive experiences and shall record how protected testimony can be tested fairly through safe summaries, questions, or an authorized intermediary. A summary materially interpreted by another person shall retain that mediation and any confirmation or dispute by its source.

EIP-066 The handler shall obtain an appropriate rights and protection assessment before disclosing case material to an external institution. A claimed obligation to disclose shall identify the competent authority, context, basis, and unresolved questions; the policy itself shall not be treated as creating that obligation.

9 Protective measures and determinations

9.1 Interim action

EIP-017 A temporary protective measure shall identify the immediate risk, authority, limited scope, review point, and route to challenge. It shall be distinguished from a concluded misconduct finding.

EIP-067 The authority issuing a protective measure shall identify less restrictive feasible alternatives, the effect on participation and evidence access, the person responsible for review, and the conditions for ending or modifying the measure. The D1-050 controls shall apply to temporary protective measures under this policy, including participation restrictions: independent review within seven calendar days and expiry within 30 calendar days unless the governance authority records a justified extension, next review date, and remedy plan. Continued restriction shall retain renewed reasons and an available challenge route; temporary protection shall not become a permanent sanction through elapsed time alone. These controls shall not expand the programme's substantive authority.

EIP-068 A person subject to a protective measure shall receive its scope, safe reasons, duration or review point, and challenge route to the extent consistent with immediate protection. Any delayed notice shall be justified and reviewed rather than omitted indefinitely.

9.2 Findings and evidential criterion

EIP-018 A final conduct disposition shall identify the applicable rule, assessed evidence and limits, conflicts and recusals, finding, reasons, proportionate remedy, responsible implementer, and review route. Available programme remedies include correction, facilitated participation, role reassignment, limited access, suspension, or removal under the Charter.

EIP-020 If a fair, sufficiently independent review cannot be provided, the programme shall record that limitation, preserve appropriate protections, and defer the affected consequential determination. It shall not represent inability to investigate as proof that a report is false or established.

EIP-069 For an internal conduct finding, the decision maker shall distinguish substantiated, not substantiated on available evidence, outside mandate, and resolved by an agreed measure without a conduct finding. A substantiated finding shall explain why the alleged conduct is more likely than not on the assessed evidence, address material contrary information and plausible alternatives, and identify limits. A numerical probability shall not be required. Where the assessment does not favor the alleged conduct over its non-occurrence, including an unresolved balance, the allegation shall not be classified as substantiated. This criterion shall not override EIP-016, EIP-020, or EIP-064 concerning fair response and sufficiently independent consideration, and shall not be represented as an external legal finding or burden of proof.

EIP-070 The decision maker shall distinguish the conduct established, any intention or effect separately supported, the rule engaged, and the resulting programme consequence. A serious remedy shall be supported by reasons addressing severity, impact, recurrence, context, and feasible alternatives within programme authority.

EIP-071 A disposition based on an agreed measure shall record the actual agreement, its scope, responsible parties, review point, and treatment of unresolved allegations. Agreement shall not be presumed from silence or obtained by making access to the ordinary complaint route conditional on acceptance.

9.3 Remedies and review

EIP-019 The programme shall monitor agreed remedies and potential retaliation and shall publish a non-sensitive account sufficient to inspect procedural handling. Confidential material shall not be published merely to demonstrate transparency.

EIP-072 A remedy plan shall identify required actions, owners, practical resources, dates or triggers, completion evidence, and consequences of non-performance. Correcting a record, restoring participation, changing a role, and addressing downstream effects shall be distinguished.

EIP-073 The disposition notice shall explain the finding and safe reasons, the operative procedure, available procedural review, and the basis for any restricted evidence. A request concerning substantive reconsideration shall be distinguished from an appeal alleging procedural failure.

EIP-074 A material new fact or demonstrated handling error shall trigger an assessment of reopening, revised remedy, or referral. The record shall retain the original determination and reasons for changed status; reopening shall not silently erase prior reliance or its consequences.

EIP-075 Monitoring for retaliation shall identify a safe contact and review trigger without imposing unnecessary surveillance on participants. A reported adverse response shall receive separate assessment of its connection to protected participation and any independently stated reason.

9.4 Scoped substantive reconsideration

EIP-099 A reporter or reported person may request substantive reconsideration through the ethics contact or non-conflicted alternate on grounds of material new evidence, an identified material error in assessment or application of the conduct criterion, or a remedy materially unsupported by the stated findings. The request shall identify the disposition, grounds, available evidence, and requested change. Mere repetition without identified grounds may receive a reasoned refusal; disagreement shall not itself constitute misconduct. The disposition notice shall explain this scoped route separately from the procedural appeal route.

EIP-100 The ordinary filing period for substantive reconsideration shall be 30 calendar days after accessible notice of the disposition. The non-conflicted reconsideration reviewer may extend that period with recorded reasons for ineffective notice, newly available material evidence, or a previously concealed assessment defect. The ethics contact shall acknowledge receipt within seven calendar days and arrange an initial admissibility or substantive determination targeted within 30 calendar days of receipt, with reasoned extensions and revised dates notified before expiry. Silence shall not constitute rejection.

EIP-101 The governance authority shall assign substantive reconsideration to a competent person or function that did not determine the challenged finding and has no unresolved material conflict, with a mandate identifying the issues and available programme remedies. The reviewer shall give an admissibility decision with reasons and provide affected parties an opportunity to respond to material new grounds before a consequential outcome. An admitted request shall have a notified timetable for replies and reasoned disposition; a change shall have reasons and notice before the affected target expires. If sufficiently independent competence is unavailable, EIP-020 shall govern deferral; reassessment by the original decision maker shall not be presented as independent reconsideration.

EIP-102 The reconsideration reviewer shall identify the record examined, grounds admitted, evidence and replies considered, criterion applied, reasons, outcome, and implementation responsibility. Within the recorded mandate, the reviewer may uphold, qualify, set aside, or remit a conduct finding or remedy for renewed consideration; a remedy outside that mandate shall be referred to its authorized decision maker. The record shall preserve the earlier finding and explain any changed effect, notice, or practical action. Substantive reconsideration shall not determine external legal liability or replace access to procedural appeal under Directives Part 1.

EIP-103 On a substantive reconsideration request, the responsible authority shall record whether an existing remedy requires a stay, modification, or continued operation within programme powers, considering protection, participation, evidence, and consequences. The decision shall have reasons, a review point, and permitted notice. Neither an automatic stay nor automatic continuation shall be inferred solely from the request. Any temporary restriction retained shall remain subject to EIP-067, and implementation of a reconsideration remedy shall be monitored under EIP-072.

10 Ethical impact assessment

10.1 Question, affected interests, and alternatives

EIP-021 Each work item shall assess whose experiences become visible, who can challenge classifications, who bears recording and review burdens, and who gains control or access through the proposed infrastructure. Assessment shall consider relevant alternatives, evidence, and residual uncertainty.

EIP-022 An impact assessment shall distinguish observed effects, predicted effects, value commitments, and institutional choices. It shall identify material tradeoffs involving recognition, privacy, autonomy, unequal participation, maintenance labor, ecological conditions, and future capacities where relevant to the use case.

EIP-024 A proposal involving contribution or generativity return shall distinguish descriptive attribution, normative evaluation, and any proposed allocation of benefits or responsibilities. It shall not infer a monetary amount, entitlement, or contractual obligation solely from a generativity record.

EIP-076 The impact reviewer shall identify the proposed use, affected interests and absent perspectives, decision context, baseline, foreseeable benefits and harms, evidence and uncertainty, and alternatives including reduced collection, restricted access, different institutional arrangements, or deferral where relevant.

EIP-077 Where values conflict, the assessment shall state the values and affected people, reasons for the proposed priority, alternatives rejected, expected distribution of benefits and burdens, and conditions requiring reconsideration. A single aggregate score shall not replace those reasons.

EIP-078 A participation or recognition proposal shall assess whether people can refuse optional recording, challenge an attribution, or obtain an explanation without disproportionate burden. A claimed exception shall identify its actual institutional basis and consequences rather than present coercion as technical necessity.

10.2 Authorization, monitoring, and intervention

EIP-023 Before a real pilot or consequential expansion, the responsible authority shall record its purpose, actual participants and mandate, permitted material, accessible notice and challenge routes, protection measures, monitoring, stop conditions, and capacity to implement correction or repair.

EIP-025 A material unresolved ethical or participation finding shall receive a recorded disposition before the affected publication or pilot decision. Completion of a form shall not alone establish that an impact is acceptable or a remedy effective.

EIP-079 Before relying on mitigation to authorize a pilot or use, the responsible authority shall verify its owner, resources, operational status, and assessment method. Unimplemented mitigation shall remain a condition or limitation and shall not be counted as an achieved safeguard.

EIP-080 Monitoring shall identify observations capable of challenging the intervention rationale, emerging burdens or exclusions, and stopping or revision triggers. Findings shall distinguish absence of observed harm from evidence of absence of harm within a sufficiently examined scope.

EIP-081 After a material protection or ethical failure, the responsible authority shall assess immediate containment, affected people and uses, correction or repair, continued-use conditions, and lessons for requirements. Restart shall depend on recorded evidence addressing the failure, not solely on a revised description.

11 Contribution intake and permission

11.1 Artifact identity and intended uses

EIP-026 For contributed material proposed for incorporation or distribution, the rights register shall identify the artifact and version, contributor and stated capacity, claimed rights holder, source, intended uses, asserted permission or licence, restrictions, third-party components, evidence of authority, and unresolved questions.

EIP-027 A contribution record shall distinguish permission to examine material from permission to incorporate, edit, redistribute, sublicense, or publish it. Repository access, submission of comments, acknowledgement, or the absence of a licence notice shall not alone be treated as permission for those further uses.

EIP-028 The programme shall keep terms for prose, schemas, software, examples, datasets, and foundation manuscripts separately identifiable. A licence applying to one artifact class shall not be presumed to cover the others.

EIP-029 Foundation manuscripts and third-party sources shall retain their recorded source terms. Incorporating a source in the foundation manifest, citing it, extracting concepts from it, or placing it in the repository shall not be represented as relicensing the source.

EIP-082 The contribution handler shall identify the submitted version, source and included components, contributor's stated capacity, intended examination or incorporation, and the scope of any assertion about rights. A claim of ownership or permission shall retain its source and verification status.

EIP-083 Before incorporating material, the editor shall determine whether its intended modification, combination, publication, implementation, or retention is within the reviewed basis. New uses or components shall receive renewed clearance rather than inherit approval from an earlier narrower purpose.

11.2 Clearance and unresolved rights

EIP-030 Before public distribution of an artifact, the designated rights reviewer shall record that the intended distribution and included material are covered by identified permissions or another reviewed basis. Unclear rights shall block the affected distribution, while drafting and review within established permissions may continue.

EIP-031 Where an intended use exceeds available permission, the editor shall obtain suitable permission, replace or remove the material, narrow the use, or retain the affected artifact as restricted. The disposition shall preserve the source and reason without exposing restricted content.

EIP-032 A change in contribution or publication terms shall identify the artifacts and versions affected, authority for the change, contributor acceptance needed, and transition treatment. A new licence shall not be represented as retrospectively covering existing contributions without an established basis.

EIP-084 A clearance decision shall identify the artifact and exact intended use, claimed rights holder and authority evidence, applicable terms and version, third-party components, review competence, restrictions, unresolved issues, and expiry or reconsideration triggers. Clearance shall be limited to that recorded use.

EIP-085 If a rights claim or permission dispute arises after incorporation, the rights contact shall record affected material and uses, preserve appropriate evidence, seek competent assessment, and notify the authorized release holder of any needed restriction or correction. The programme shall not declare the claim valid or invalid solely from its receipt.

EIP-086 A contributor's request to withdraw or change permission shall be assessed against the actual terms, prior uses, downstream distributions, protection concerns, and relevant authority. The response

shall distinguish feasible programme action from uses or rights outside programme control.

12 Terms, implementation rights, and publication

12.1 Selection and acceptance of terms

EIP-033 Before offering contribution terms or choosing publication licences, the programme shall record its organizational and jurisdictional context, intended rights and obligations, artifact classes, alternatives, implementation consequences, and review by a person competent for the relevant rights questions.

EIP-034 The programme shall make operative contribution terms available before requesting assent to them and shall retain the accepted version and scope. A record of assent shall not assert that the contributor holds rights that remain unverified.

EIP-087 The terms-selection record shall compare rights needed for the intended artifact use, contributor interests, implementation and redistribution conditions, attribution, modified versions, translation, dependency compatibility, and maintenance. Prose, code, schemas, datasets, examples, and manuscripts shall receive distinct treatment where their requirements differ.

EIP-088 An acceptance record shall identify who assented, their stated authority, the exact terms and covered contribution, date, and evidence of assent. A form submission or repository action shall count as assent only where the announced process clearly established that meaning and actual acceptance is evidenced.

12.2 Implementation-rights concerns

EIP-035 A participant aware of a potentially material rights obstacle to implementing a proposed requirement shall report the known concern and its basis to the designated rights contact. The report shall distinguish actual knowledge, an asserted claim, and unresolved inference; it shall not be presented as a legal determination.

EIP-036 The programme shall record a material implementation-rights concern, affected requirements, available public information, review competence needed, feasible alternatives, and its disposition before approving an implementation claim that depends on the concern.

EIP-037 No programme participant shall make a licensing promise, patent assurance, rights waiver, or financial commitment on behalf of another person or institution without documented authority. A declaration under another organization's process shall not be represented as a programme agreement without review of its actual scope.

EIP-038 Where implementation rights remain materially unresolved, the responsible decision authority shall narrow the claim, select a reviewed alternative, or defer the affected normative adoption. An empty concerns register shall not be described as proof that implementation is free of third-party rights.

EIP-089 The handling of a potential essential-rights concern shall distinguish notification, factual clarification, specialist assessment, exploration of alternatives, and an authorized decision. A request for information shall not be phrased as a programme licensing commitment or as a determination of validity or essentiality.

EIP-090 Where a technical alternative is proposed to address a rights concern, the committee shall assess whether it satisfies the affected requirement and whether it introduces other material constraints. Selecting an alternative shall not be reported as resolving all implementation rights without the corresponding evidence.

13 Records, oversight, and assessment

13.1 Custody and publication of case information

EIP-039 Ethics, conflict, and rights records shall identify an accountable custodian, access rules, retention or review basis, correction route, and treatment of protected information. Public decision evidence shall avoid unnecessary disclosure while making authority, procedure, and unresolved limits inspectable.

EIP-091 The custodian shall separate public disposition information from protected evidence, restrict access to accepted roles with a handling need, and retain access and disclosure decisions. Changes in custodianship shall verify transfer of restrictions and pending response or retention duties.

EIP-092 Before releasing a case summary, the responsible handler shall assess whether combinations of facts disclose protected identity, existence, or content. The summary shall state material limits on public inspection without creating a false impression that an allegation or rights assertion was conclusively established.

13.2 Review and performance

EIP-040 The programme shall review this policy with the governance review cycle and after a material complaint, rights dispute, change of legal or organizational context, or change in publication arrangements. A revision shall preserve the prior edition and unresolved cases' transition treatment.

EIP-093 An assessment against this policy shall identify the subject, period, edition, assessor and interests, applicable EIP requirements, evidence, and results as fulfilled, not fulfilled, not assessed, or not applicable. Unperformed handling steps and blank templates shall not demonstrate fulfillment.

EIP-094 The governance authority shall review repeated complaints, unresolved conflicts, rights-clearance delays, protection failures, unequal burdens, and remedy effectiveness using protected or aggregated information as appropriate. Corrective actions shall have owners, review points, and evidence of completion.

Annex A

(normative)

Handling records and state transitions

A.1 Minimum case record

EIP-095 A case record shall contain identifier, scope and applicable editions, receipt history, requested protection, roles and conflicts, alleged issue distinguished from findings, evidence and limits, notices and replies, interim measures, decision and reasons, remedy, review route, access and retention basis, and current state. Changes of state shall identify their actor, date, grounds, and linked evidence.

A.2 Case states

EIP-096 The handler shall use the case states in Table A.1, or an explicitly mapped equivalent, so that receipt, examination, pending capacity, determination, remedy, and closure remain distinguishable. A transition shall preserve linked prior states and shall not imply completion of an unperformed step.

Table A.1 – Case state meanings and transition evidence

State	Meaning	Evidence supporting a transition
Received	Submission logged; no finding.	Receipt identifier, safe contact, requested protection, acknowledgement.
Triaged	Scope and route assessed.	Authority, conflicts, immediate risk, referral or inquiry decision.
Under consideration	Evidence and replies being assessed.	Questions, responsible assessor, evidence plan, notices, replies.
Pending capacity or information	A stated limitation prevents the next step.	Missing item or role, action owner, review date, protection retained.
Determined	Authorized finding or scoped disposition recorded.	Reasons, evidence limits, response consideration, remedy and review route.
Remedy under implementation	Agreed or directed action remains open.	Owners, resources, deadlines or triggers, follow-up evidence.
Closed or referred	Programme handling completed or assigned elsewhere.	Closure grounds or referral acceptance, residual limits, reopening/contact route.

A.3 Conflict and impact records

EIP-097 A conflict record shall identify the interest, affected function, assessor and independence, materiality reasons, management action, objection and response, implementation evidence, and review trigger. An impact record shall identify affected interests, evidence, values, alternatives, distributional effects, safeguards, authority, monitoring, and unresolved limitations.

A.4 Rights decision and acceptance records

EIP-098 A rights record shall identify artifact and version, source and components, contributor and asserted authority, intended uses, terms or other reviewed basis, competent assessment, restrictions, decision, acceptance where needed, and reconsideration triggers. Public licence statements shall be checked against that record before release.

A.5 Assessment of timing, findings, and reconsideration

EIP-104 An assessment claiming fulfillment of conduct-handling procedure requirements shall exercise the applicable conditions in Table A.2, identify the tested edition, input and expected outcome, and record performed actions, results, and limitations. A documentary assessment shall distinguish a complete specimen record from evidence that acknowledgement, independent consideration, notice, or remedy actually occurred. Unobserved performance shall remain not assessed rather than fulfilled.

Table A.2 – Conduct-review assessment conditions and limits

Condition	Relevant provisions and evidence	Discriminating result
Receipt and extended inquiry	EIP-014; actual receipt and acknowledgement, determination target, extension reason and notice.	A timely determination extension does not turn an acknowledgement later than seven days into timely performance.
Temporary participation restriction	EIP-017, EIP-067/068; authority, alternatives, independent review, expiry or justified extension and next review.	A restriction cannot continue indefinitely through a missing expiry or be relabelled a final sanction without determination.
Unresolved evidential balance	EIP-016/020/064/069; assessed grounds, contrary material, response opportunity and competence.	An unresolved balance does not substantiate the allegation; a numerical score is unnecessary; the outcome does not assert that the report was false.
Material reassessment request	EIP-099–102; identified grounds, receipt, admissibility, independent assignment, timetable, response and outcome.	A reasoned finding can change within mandate; the original decision maker is not described as independent; mere silence does not reject the request.
Unavailable reviewer or continuing action	EIP-020, EIP-072, EIP-101/103; capacity gap, stay assessment, protection, remedy ownership and verification.	Missing capacity remains visible and the consequential determination deferred; a planned remedy is not reported as completed.

Annex B

(informative)

Worked applications and unresolved choices

B.1 Interested expertise and neutral decision

An implementer funds an editor who proposes an exchange feature. The editor's evidence remains relevant, while the funding and implementation interest require assessment against the decision role. Oversight or separation can preserve the contribution while preventing the editor from determining a complaint about suppression of alternatives. The record shows which capacities were retained and which decisions were reassigned.

B.2 Protected testimony and limited finding

A participant reports exclusion but cannot safely publish identifying details. Intake records the protection need and available evidence. A neutral assessor considers whether a safe summary permits a meaningful reply. If the material cannot be tested sufficiently for an adverse finding, the result remains limited; it is not converted into a conclusion that the account is false. Feasible access improvements can still be considered without pretending that an allegation was proved.

B.3 Rights to read and rights to publish

A manuscript is available to project members for background reading. An editor proposes attaching it to a public package. The contribution record distinguishes examination from redistribution. The proposed attachment awaits a reviewed basis; source interpretation and new drafting continue within actual permission. A licence selected for the new programme prose does not automatically cover the manuscript.

B.4 Record correction and consequential repair

A synthetic pilot corrects an inaccurate attribution after a challenge. The correction record establishes that the current account changed. A separate remedy record asks whether excluded participation, lost access, or other practical consequences were addressed. Where those effects were not examined, the report states the limitation rather than claiming that the corrected text restored the affected person's position.

B.5 Local choices requiring review

The internal evidential criterion for conduct findings is a programme proposal that makes decisions reviewable; it does not purport to prescribe a court's procedure. Remedies remain bounded by actual programme authority. Different organizational contexts could justify revised procedures through the governance amendment process.

The proposed criterion requires a reasoned comparison of the assessed grounds, not a compulsory probability calculation. Alternatives include a more demanding internal threshold for particular findings or leaving the criterion to case-specific choice. The present draft selects an explicit common criterion, alongside fair-response and independence conditions, so that participants can examine its application and request scoped reconsideration. The choice, its error and participation risks, and the local reconsideration periods require review before governance adoption; see `decisions/ADR-0005-expanded-drafts-and-source-models.md`. No finding becomes valid merely because its author asserts that the threshold was met.

OPEN ISSUE Organizational and jurisdictional context, operative contribution agreements, publication licences, patent policy, named contacts, protected infrastructure, and specialist rights-review capacity remain unresolved. The policy supplies conditions for reviewing those choices without making the commitments itself.

OPEN ISSUE Procedural rehearsal needs to test handling burden, neutral-review availability, language and disability access, protected evidence, recusal, rights disputes, and remedy follow-up. Synthetic success does not establish capacity for a live consequential case.

Bibliography

Source and interpretation: Foundation manuscripts: FM-005, Chapter 5, section 5.18, pp. 150–153, on evidential capacity, epistemic justice, and risks of visibility; FM-001, Chapter 1, section 1.14, pp. 79–83, on representational instability, reliance, and control of verification infrastructure. Exact source files and status are indexed in `foundation_manuscripts/MANIFEST.md`.

Source and interpretation: Local programme basis: Programme Brief, version 0.5; `docs/planning/cross_domain_programme.md`, particularly sections 3.4–3.7; and `docs/planning/standards_development_comparison.md`. The operational requirements in this policy are programme proposals.

Source and interpretation: UNESCO, Recommendation on the Ethics of Artificial Intelligence, adopted 23 November 2021. Official text consulted 22 September 2026: https://www.unesco.org/en/legal-affairs/recommendation-ethics-artificial-intelligence. Its attention to impact assessment, plural values, inclusion, oversight, and consequences across an AI life cycle informs review questions for AI-mediated programme work. It does not provide the complete ethics of every generativity use or establish this programme's legal duties.

Source and interpretation: IEEE SA Standards Board Operations Manual, clause 6, official online text consulted 22 September 2026: https://standards.ieee.org/about/policies/opman/sect6/. Separate treatment of contributions, patent matters, and open-source artifacts informs the distinction among rights questions. No IEEE agreement or assurance is adopted by citation.

Source and interpretation: ISO Standards and Patents, official resources consulted 22 September 2026: https://www.iso.org/iso-standards-and-patents.html. The linked policy and declaration resources are comparison material; they establish no permission to implement a particular technology in this programme.

GENERATIVITY STANDARDS PROGRAM

GR-100

Standards-track Working Draft

Version 0.3 2026-09-22

Foundations and Vocabulary

WORKING DRAFT FOR REVIEW

This document contains proposed provisions for technical and institutional review. It is not an adopted Standard or an operative governance instrument. Its scope, application conditions and publication status are specified in the text.

Prepared by the Generativity Standards Program. Reference to external publications does not imply endorsement by ISO, IEC, IEEE or any United Nations body.

Foreword

Version 0.3 records the bounded substantive review of the archived 0.2 package. This edition separates the general metamodel distinction from the conditional mapping check in the V100-011 assessment schedule. The review matrix, synthetic assessments and unresolved readiness questions are documented in `docs/reviews/validation_0.2/README.md`. These activities do not constitute adoption or an independent institutional assessment.

Responsible editor: UNASSIGNED.
Canonical source: `standards/GR-100-foundations-vocabulary/GR-100.tex`

This document is a standards-track Working Draft of the Generativity Standards Program. Its maturity is **PREPARATORY; PROVISIONAL**. It is available for substantive review and experimental assessment. It is not an adopted Standard, evidence of formal project initiation, or approval of GR/NWIP-001. Appointment of an editor, adoption of the governance instruments, work-item approval, review and final adoption require their own recorded decisions. Draft requirement language has no programme adoption or independent legal effect.

Edition 0.2 expanded edition 0.1; both earlier editions remain historical material. Existing requirement identifiers V100-001 to V100-012 retain their meanings. The body supplies candidate normative definitions and requirements. Annex A is a normative assessment schedule. The remaining annexes and bibliography are informative. No informative example or note adds a requirement.

The publication structure separates scope, dated references, numbered terms, requirements, conformance and annexes. Structural resemblance to another organization's publications establishes no affiliation, endorsement or compliance with its development procedures. Foundation manuscripts provide conceptual sources rather than adopted normative authorities.

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Introduction

The programme responds to instability in the connection between representations, their targets, institutional classifications and practical trust. An authentic or fluent account can be mistaken for a warranted account of what happened. Correction can also erase the history of an earlier claim's influence. Inspectable recording requires these differences to remain expressible before a technical model standardizes interchange.

Reality is not reduced to what a recording institution recognizes. Manifestations, traces, accounts and judgments can disclose a target partially; they can also enter subsequent action and change conditions of further generation. A mistaken classification can remain historically important after its evidential warrant has been rejected. Its occurrence, interpretation and practical effects require distinguishable descriptions.

The foundation manuscripts distinguish abstract metamodel concepts from richer analytical categories and distinguish ontological questions from evidential access. This document uses those distinctions without turning six record roles into ultimate kinds of being. Its operational definitions do not exhaust GR theory. They support partial knowledge, contested identity, overlapping roles, changing categories and revisable interpretation.

Interoperability requires more than shared spelling. One institution can use evidence for an accepted document, another for material bearing on a claim and another for a procedural exhibit. Similarly, a numerical property can be a category code, an ordinal rating or a measurement. A common format does not make their operations equivalent. Vocabulary application therefore includes scope, source, transformation and assessment duties.

1 Scope

1.1 General

This document supplies a bounded operational vocabulary for recording and examining claims about generative histories. It addresses a practical problem: a record can accurately preserve an assertion while the assertion is mistaken, an authentic document can contain an unsupported inference, and a later correction can conceal the historical consequences of an earlier judgment. Inspectable practice requires distinctions among what is claimed to have happened, how it became accessible, what was recorded, what was inferred, and how the account was used.

The scope includes vocabulary use, the separation of levels of description, identity and temporal distinctions, and a candidate description of six record roles. It does not define truth, a complete metaphysics, a universal theory of evidence, legal validity, a universal generativity score, or a machine-readable schema. Domain methods can provide stronger criteria within a declared scope.

GR-110 develops trajectory recording requirements. GR-200 develops the epistemic record package. GR-120 and associated Specifications are intended to resolve technical representation after requirements and cases expose a reusable need. GR-210 is intended to address assessment and contestation procedures. References to these publications identify coordinated draft work; none is an adopted normative dependency.

2 Normative references

2.1 General

There are no external normative references in this edition. All requirements needed for assessment are contained in its body and Annex A. Foundation manuscripts and programme documents in the bibliography are informative sources for interpretation and drafting rationale, not supplementary conformance requirements.

2.2 Dated applications and mappings

An application can identify an additional dated domain vocabulary or profile in its declaration. That source becomes part of the application's own commitments, not a normative dependency of GR-100. The assessment distinguishes fulfillment of this document from fulfillment of that additional source. A current online resource does not silently update the meaning used in an assessed edition.

3 Terms and definitions

3.1 General

The following definitions apply within this document's recording scope. Capitalized Entity, State, Event, Process, Relation and Property name the operational record roles in Clause 5. Lowercase ordinary uses remain possible when their meaning is evident. Terms concerning uncertainty and missingness describe an inquiry rather than settle the truth values of the underlying world.

These definitions support linked descriptions, not a mandatory class hierarchy. Several terms can concern one activity: observation can involve interpretation and inference, and its result can become evidence for another claim. The application identifies these functions rather than treating their coexistence as an error.

3.2 Target

That about which a claim is made.

NOTE 1 A target can be a situation, participant, occurrence, relation, condition, possibility, record, or another claim. Its identification can remain partial or contested. A target reference is an act of reference; it does not establish existence or identity.

3.3 Manifestation

For recording purposes, an identified way in which a difference becomes available to encounter, registration, measurement, expression, or classification under specified conditions.

NOTE 2 This is a limited operational use informed by FM-004; it does not exhaust that manuscript's account of manifestation.

3.4 Representation

A description or arrangement of signs used to describe, classify, model, or otherwise stand for a target.

NOTE 3 Representations can themselves become targets of inquiry and participants in later action.

3.5 Record

An identified retained representation, together with the context needed to interpret its declared recording purpose.

NOTE 4 A record can contain several claims, and several records can concern one target. Retention need not mean public disclosure or indefinite preservation.

3.6 Record package

A declared collection of records and contextual references presented together for a specified purpose and version.

NOTE 5 A package can contain protected components and a restricted or public view. A view's limitations are part of its declared scope.

3.7 Claim

An attributed assertion with identifiable content and target, expressed under a stated scope.

NOTE 6 The assertion can concern an occurrence, a possibility, an interpretation, a value judgment, or institutional or legal status. Recording it does not endorse it. Several parties can assert the same content with different grounds.

3.8 Attribution

A recorded association between a claim or activity and the person, institution, system, or source represented as originating or performing it.

NOTE 7 Attribution can be pseudonymous, unknown, disputed, or mediated through another source.

3.9 Observation

A situated activity of attending to or registering a manifestation through a stated method.

NOTE 8 An observation report is a claim about that activity or its result; "direct" does not mean free of mediation or interpretation.

3.10 Inference

A step that relates identified premises or material to a conclusion under a stated method or reasoning.

NOTE 9 An inferred claim has a different epistemic role from the claim that its premises were recorded.

3.11 Interpretation

An attributed assignment of meaning, classification, or significance within a stated context.

NOTE 10 Interpretation can participate in observation and inference; these terms do not partition human or machine activities into exclusive kinds.

3.12 Judgment

An attributed assessment or determination made using identified grounds and criteria.

NOTE 11 A judgment can assess evidential warrant, ethical acceptability, legal status, or institutional action. These functions carry different bases of authority.

3.13 Assessment

A recorded examination of a specified question using identified criteria and material, with a result and limitations.

NOTE 12 In GR-200 an evidence assessment concerns a claim-relative evidential role. A syntax check concerns a different assessment target.

3.14 Uncertainty

Specified unresolved limitations or alternatives affecting a claim's content, identification, observation, method, interpretation, timing, boundary, or warrant.

NOTE 13 An uncertainty description is itself attributed and scoped. A numerical quantity is one possible representation, not a mandatory universal measure.

3.15 Trace

Material, behavior, testimony, inscription, or another manifestation identified as a remainder or consequence relevant to a target inquiry.

NOTE 14 The proposed connection to its generative conditions is a claim with its own grounds; calling an item a trace does not establish the proposed origin.

3.16 Evidence

A role assigned to identified material in assessing a specified claim, with an account of relevance, reliability, and alternative explanation.

NOTE 15 The material can support, challenge, limit, or fail to discriminate the claim. Evidence is not an intrinsic status permanently attached to a file or person.

3.17 Evidential warrant

The grounds offered for accepting, qualifying, or rejecting a specified claim under stated methods, assumptions, and scope.

NOTE 16 This draft records those grounds without imposing one universal sufficiency rule.

3.18 Provenance

A recorded account of origins, attribution, derivation, custody, or transformations of an identified item.

NOTE 17 Provenance can be incomplete or disputed. Provenance of a claim's expression differs from evidence for the claim's content.

3.19 Authenticity assessment

An assessment of whether an item is what it is represented to be, within a specified question and method.

NOTE 18 Authenticity of an utterance or document does not establish truth of its substantive claims.

3.20 Missingness

A stated condition in which information sought for a recording purpose is absent or unavailable.

NOTE 19 Not observed, not recorded, lost, withheld, unknown, inapplicable, and disputed describe different conditions and are not interchangeable with a zero, false value, or non-occurrence claim.

3.21 Record reference

A designation sufficient to distinguish a record or a particular version within a declared context.

NOTE 20 A reference scheme does not itself determine the identity of the represented target.

3.22 Identity criterion

A stated basis for treating two appearances or descriptions as concerning the same target within an inquiry.

NOTE 21 Identity claims can be contested and criterion-dependent. Similar behavior, equal content, shared names, and common descendants do not alone establish target identity.

3.23 Lineage

A directed account of derivation, succession, or continuation.

NOTE 22 Lineage can branch or merge. Its use does not automatically assert that predecessors and successors are one identical target.

3.24 Target time

The time or interval a claim concerns, including an explicitly unknown or uncertain temporal location.

3.25 Observation time

The time at which an observation or acquisition is represented as occurring.

NOTE 23 It can differ from target time and recording time.

3.26 Recording time

The time at which a record or identified version was made or entered into a recording context.

NOTE 24 It does not automatically date the target occurrence.

3.27 Assessment time

The time of a stated assessment or judgment, distinct from the time to which that judgment applies.

3.28 Descriptive regime

The declared categories, definitions, methods, scales, or boundary choices used to describe a target within an inquiry.

NOTE 25 This is an operational term; it does not require a fixed family of regimes or a particular mathematical construction.

3.29 Revision

An identified change to a representation, claim, assessment, or descriptive regime, with its relationship to an earlier formulation and the stated reason.

NOTE 26 Revision of an account of the past does not itself change the past occurrence.

3.30 Trajectory

A scoped account linking conditions, occurrences, continuations, alternatives, and consequences over a declared temporal or ordering frame.

NOTE 27 A reconstructed trajectory can remain partial and contested; it need not be a single fully ordered sequence.

3.31 Generativity-related claim

In this operational vocabulary, a claim about how relations, conditions, or activity generate, sustain, transform, restrict, or destroy subsequent states, capacities, relations, distinctions, or possibilities.

NOTE 28 This defines the programme's recording subject; it is not a comprehensive definition of GR generativity.

3.32 Generative condition

A condition claimed to enable, constrain, or shape a specified trajectory or possibility.

NOTE 29 Its role needs attribution and grounds; contemporaneous presence alone does not establish contribution.

3.33 Possibility claim

A scoped claim that a continuation was or is available, feasible, blocked, lost, or conjectured under identified conditions.

NOTE 30 An unchosen proposal differs from an evidenced feasible alternative, and each differs from a later imagined counterfactual.

3.34 Contribution

An attributed participation or influence in a specified trajectory or outcome.

NOTE 31 Contribution, credit, causal responsibility, entitlement, and legal liability remain distinct questions.

3.35 Practical uptake

An identified use of a representation or judgment in action, classification, allocation, or institutional decision.

NOTE 32 Its consequences can become new recording targets.

3.36 Generativity return

A research and recording topic concerning claimed return pathways through which generated effects alter conditions of further generation.

NOTE 33 Its operational measurement, evaluative meaning, and any allocation rule remain **OPEN**; no universal quantity or entitlement is defined here.

3.37 Vocabulary application

A named and versioned use of specified terms within a declared document, record package, profile, register or implementation description.

NOTE 34 Its boundary identifies which uses are claimed to follow this document and which belong to external or ordinary-language vocabularies.

3.38 Vocabulary extension

An additional term, narrower operational meaning or application-specific relationship introduced for a declared purpose.

NOTE 35 An extension does not change the meaning of this document's terms in other applications or become a programme term merely through local use.

3.39 Term correspondence

An attributed and scoped relationship between meanings in identified vocabularies or editions.

NOTE 36 Correspondence can be equivalent for a particular use, narrower, broader, overlapping, conditional or unresolved. Similar labels do not establish equivalent meanings.

3.40 Record-role correspondence

An explicit relationship between descriptions using different record roles or different boundaries within one role.

NOTE 37 It identifies which targets or occurrences the descriptions concern and which information is retained, added, omitted or unresolved.

3.41 Actuality or modality statement

A statement of whether a target is claimed as actual, attempted, planned, possible, hypothetical, counterfactual, unrealized or unresolved within a specified frame.

NOTE 38 These qualifications are not a universal exclusive enumeration. An attempted action can have occurred while its intended result remained unrealized.

3.42 Epistemic mode

The way a claim is presented as known, reported, inferred, interpreted, reconstructed, hypothesized or stipulated.

NOTE 39 Epistemic mode differs from actuality or modality and from assessed warrant. An inference can concern an actual occurrence; a direct observation report can be disputed.

3.43 Definedness condition

A condition determining whether a characteristic, classification or operation has an applicable value for a subject under its definition.

NOTE 40 Inapplicability differs from unavailable evidence about an applicable value. A representation can require both a definedness condition and a missingness reason.

4 Vocabulary application and semantic safeguards

4.1 General

V100-001 A vocabulary application shall identify this document and version, its own boundary and version, the terms it uses, and any local extensions or narrower domain meanings. It shall describe departures explicitly and shall not claim unqualified GR-100 vocabulary conformity for a conflicting use of a defined term.

4.2 Reality, manifestation, and representation

The foundation's ontological, relational, and manifestational registers concern different analytical questions. They are not exclusive categories of objects or a mandatory temporal sequence. A practice can operate before its recognition, and a classification can subsequently change the practice. This document does not require every target to receive a philosophical register label.

V100-002 A vocabulary application shall distinguish a represented target, an identified manifestation or trace, a retained record, and a claim wherever it uses those roles. It shall not treat a record identifier, representation, or manifestation as establishing the existence, complete nature, or identity of its target solely by being recorded.

4.3 Claim, observation, inference, and judgment

V100-003 A vocabulary application shall distinguish assertion, observation report, inference, interpretation, and assessment where those functions occur. Where one item performs several functions, it shall identify the functions and their scopes rather than infer one function's warrant from another.

4.4 Trace, evidence, and provenance

V100-004 A vocabulary application shall represent an evidential role relative to an identified claim. It shall keep provenance or authenticity results, evidential assessments, technical conformance, institutional acceptance, and normative or legal judgments distinguishable. It shall not describe success in one of these assessments as success in another without a separately stated argument.

4.5 Identity, time, and history

V100-005 A vocabulary application shall distinguish record reference, target identity, and lineage. A stated identification of targets across appearances shall identify its criterion and the scope in which it is used. Unresolved identity shall remain expressible without forced merger.

V100-006 A vocabulary application shall distinguish target, observation, recording, and assessment times wherever it uses them. It shall preserve uncertainty about time or order rather than derive occurrence order solely from record entry order.

V100-007 An application that represents revision shall distinguish change in the target situation, change in evidence or assessment, and change in the descriptive regime. It shall allow more than one reason to apply and shall not silently replace the earlier formulation with a later one. Where earlier content cannot be retained or disclosed, it shall identify the resulting limit on historical reconstruction.

These are three linked histories rather than three mutually exclusive event types. Publication of a revised classification can change a target situation as well as its description. A later assertion that the earlier situation differed is an epistemic revision; it does not backdate the physical act of correction.

4.6 Generativity and practical consequences

V100-008 An application using generativity-related terms shall identify the claimed change or continuation, affected target or participants, relevant conditions, and scope. It shall distinguish a generative attribution from a value judgment and shall not infer beneficialness, entitlement, or legitimacy from the term “generative” alone.

5 Six operational record roles

5.1 General

These role descriptions are standards-specific proposals, informed by FM-007 and earlier programme vocabulary. They describe how a target is represented for an inquiry. They neither exhaust reality nor require exclusive schema classes. The term Property is retained from the programme; FM-007 uses Attribute. No equivalence between them is asserted.

In the descriptions below, *minimum metadata* means the information required when the role is applied under V100-009. V100-025 distinguishes structural designations and criteria from contextual factual values that permit an explicit unknown or restriction. Common metadata means record reference and version, role, described target, recording responsibility and time, and links to relevant claims and their epistemic context. Referenced context can be shared across a package without duplication.

V100-009 An application of a six-role description shall identify the applied role, its admissibility and identity criteria, the common metadata, and the role’s minimum metadata below. It shall disclose unresolved boundaries and use the temporal meaning associated with the role. Missing information shall retain its stated reason rather than be converted to a substantive negative claim.

V100-010 An application shall allow a target to be described through more than one applicable record role without treating role overlap as evidence of inconsistency. A restriction in an application profile shall state its recording purpose and information limits. A Relation whose own identity, state, properties, or history matters to the declared inquiry shall remain independently referenceable.

V100-025 The application shall supply its reference and version, applied term labels and definition locators. Each applied role shall have an identified role, record reference and version, target designation and responsible recording role; an unresolved target designation shall state the target question or description. These structural designations shall not be replaced by an unknown value. An unavailable contextual factual value may be represented by an explicit unknown, disputed, lost or restricted state, with the stated reason, attributing role and assessment limitation. Required admissibility or identity criteria shall be stated; a provisional assignment with unresolved criteria shall not receive a fulfilled result for a criterion-dependent obligation.

A target designation can identify an unresolved historical subject without establishing its identity. An accountable role can use a protected reference without public disclosure of a person's name. These are supplied designations with declared limits, not empty values. Conversely, a known absence of a required criterion is a recording defect; unavailable evidence for deciding whether an identified criterion is met is an assessment limitation. A fulfilled declaration of unknown context does not resolve the underlying fact.

5.2 Entity

Definition and admissibility. A record role for a focal subject tracked across appearances under a declared continuity criterion. Admissible when the inquiry needs cross-context or cross-time reference; use does not require an unchanging substance.

Identity. The stated reidentification criterion and evidence determine the claim of continuity. A database key identifies a record, not automatically the represented subject. A disputed criterion can remain unresolved.

Temporal behavior. Properties, membership, and relations can change while continuity is asserted. Formation, dissolution, replacement, or uncertain duration can be recorded separately.

Relations to other roles. Participation in Events and Processes; possession of described States or Properties; participation in Relations; lineage links to other Entity descriptions. These are candidate meaningful links, not an exhaustive edge schema.

Minimum metadata. Focal subject and appearances in scope; continuity criterion; temporal scope; attributed identity judgment or unresolved status.

Optional metadata. Names, identifiers assigned by other systems, formation history, known predecessors and successors.

Example and counterexample. An association tracked across a change of premises under a stated organizational continuity criterion. Two unrelated associations sharing a name are not thereby one Entity.

OPEN edge. A split into two successors can preserve lineage while leaving continuity with the predecessor disputed.

5.3 State

Definition and admissibility. A record role for a scoped description of conditions of a target at a stated time or interval. Admissible when the question concerns those conditions rather than an exhaustive inventory of reality.

Identity. Same target, temporal scope, and descriptive regime identify the intended condition description; record versions and conflicting accounts remain distinct. Equality of observed values alone does not establish equality of target conditions.

Temporal behavior. A condition can persist over an interval or be known only at an observation time. Persistence between observations requires a claim. Predictive sufficiency is relative to specified questions and continuations.

Relations to other roles. Conditions of Entities or Relations; preconditions and results of Events; intermediate descriptions in Processes; values articulated through Properties.

Minimum metadata. Target; time or interval; description boundary and regime; conditions described; observation or inferential basis.

Optional metadata. Supported queries, omitted conditions, comparison horizon, warranted persistence interval.

Example and counterexample. A committee's recorded membership on a given date. A timestamped snapshot alone does not establish every member's continuing participation throughout a month.

OPEN edge. A reduced state adequate for a current report can omit historical memory needed for a later operation.

5.4 Event

Definition and admissibility. A record role for an individuated happening or attempted happening under a declared occurrence criterion. Hypothetical, planned, or reconstructed events remain admissible as explicitly qualified targets of claims.

Identity. An occurrence criterion distinguishes event tokens; a description can refer to one event in several records. Repetition of the same operation or outcome does not merge occurrences.

Temporal behavior. Duration, boundaries, sequence, or overlap can be exact, interval-based, partial, or unknown. Failure or interruption does not imply non-occurrence of an attempt.

Relations to other roles. Participants represented as Entities or Relations; changes between States; steps of Processes; Properties of the occurrence.

Minimum metadata. Proposed happening; occurrence and individuation criteria; claimed actuality or modality, such as occurred, attempted, planned, hypothetical, or unresolved; separate epistemic basis, such as reported, observed, or retrospectively inferred; temporal scope; participating targets where known. A retrospectively inferred event can be claimed to have actually occurred.

Optional metadata. Place, before/after conditions, attempted purpose, completion status, links to repeated occurrences.

Example and counterexample. Two separately evidenced permission issuances with the same final status. A formula for the effect of an issuance does not establish that either occurred.

OPEN edge. Different temporal resolutions can treat one prolonged happening as an Event, Process, or several Events; the segmentation rationale matters.

5.5 Process

Definition and admissibility. A record role for activity linked by a declared ordering and criterion of unity. Admissible for goal-directed, recurrent, interrupted, branching, or otherwise connected activity; achievement of an intended endpoint is not required.

Identity. The stated grouping and boundary criterion individuates the process. Equal endpoints or equal modeled composite effects do not establish the same process history.

Temporal behavior. Ordering can be partial; duration and completion can be uncertain. Alternative possible paths remain distinct from the reconstructed actual path.

Relations to other roles. Comprises or links Events and intermediate States; involves Entities and Relations; has scoped Properties; connects to dependent Processes.

Minimum metadata. Unity and boundary criterion; activity in scope; supported ordering; claimed actuality or modality, distinguished from its observational or reconstructive basis; time scope and completion/continuation status.

Optional metadata. Intended purpose, branches, interruptions, excluded steps, retained intermediate conditions.

Example and counterexample. A proposal–revision–authorization sequence with a recorded failed earlier attempt. A factorization of an outcome into mathematically possible operations is not evidence of that history.

OPEN edge. Overlapping practices can belong to several processes; no universal segmentation rule is proposed.

5.6 Relation

Definition and admissibility. A record role for an identified connection, arrangement, or dependence among specified targets or conditions within a stated context. Admissible when its incidence, formation, continuity, or effects are relevant. Potential efficacy requires a further claim.

Identity. A stated criterion distinguishes a continuing arrangement from a renewed or separate one. Equal participants and equal current effects do not alone establish the same relation.

Temporal behavior. Formation, persistence, dormancy, change of terms, and ending are separately attributable. A relation can change while participants remain identified.

Relations to other roles. Participants can be targets described by any relevant role, including other Relations; Events can form or change it; Processes describe its history; States and Properties describe its conditions.

Minimum metadata. Relation reference; participant or condition references with roles; context; relation criterion and temporal scope; stated identity basis.

Optional metadata. Formation history, dependency claims, terms, changing states, prospective effect comparisons.

Example and counterexample. Two separately identified agreements between the same parties, each with its own renewal history. Co-occurrence in a table alone does not establish cooperation, trust, or dependence.

OPEN edge. Uncertain or changing participants can prevent a complete incidence description without eliminating the recorded relation claim.

5.7 Property

Definition and admissibility. Provisionally, a record role for an attributed characteristic or value of a specified subject under a stated definition, time, and context. Admissible when the meaning and subject of the attribution are explicit. This operational use does not resolve the broader Property/Attribute relationship.

Identity. A property assertion is distinguished by subject, characteristic definition, contextual and temporal scope, attribution, and version. A type of characteristic differs from a particular assignment of its value.

Temporal behavior. A value can change with the subject; a later correction can instead revise knowledge of an earlier value. The two histories remain distinguishable.

Relations to other roles. Describes a target represented through any role; measurement or classification can be linked to an Event or Process; multiple conflicting assignments can concern one subject.

Minimum metadata. Subject; characteristic definition; value or explicit missingness state; time and context; method or attribution; scale and unit when used.

Optional metadata. Measurement uncertainty, valid domain, derivation, calibration reference, alternatives.

Example and counterexample. A reported resource quantity for an organization at a specified time. A numbered nominal category is not a measurement permitting arithmetic solely because its code is numeric.

OPEN edge. FM-007's Attribute has explicit domain, interpretation, scale, and definedness conditions. Equivalence to Property, separation, or renaming needs source comparison and a recorded decision.

5.8 Role boundaries and admissibility decisions

Admissibility concerns whether a description can perform the stated recording role. It does not establish the claim about its target. A proposed historical Entity can be admissible as the subject of inquiry while its identity is contested. A hypothetical Event can support counterfactual analysis while its modality excludes it from the asserted actual history. Role metadata and epistemic context preserve both distinctions.

A role's minimum metadata is semantic information, not a prescribed collection of database columns. Shared references can supply context when their version and scope are clear. A narrative dossier can supply information through identified passages. An empty field, unexplained code or link to a changing resource does not necessarily supply an inspectable meaning.

An unknown value can satisfy a duty to disclose unavailable context where a requirement permits it. It does not satisfy a duty to demonstrate continuity, observed occurrence or contribution. A protected identity can use a stable reference without publishing a name; protection does not establish that two references identify one person.

An agreement can be a Relation while tracked as an Entity for continuity. Its negotiation can be a Process; its signing an Event; its operative terms at a time a State described through Properties. These descriptions coordinate different questions. They need not assert six independently existing objects or duplicate a single occurrence six times. A technical profile that restricts overlap needs a route for retaining the distinctions relevant to its declared use.

6 Boundaries between layers

6.1 General

V100-011 A vocabulary application shall distinguish operational record roles from metamodel concepts. It shall not identify a formal carrier state with a record State, a mechanism with a Process, or formal change with an Event without an explicit scoped mapping and argument.

V100-012 A vocabulary application shall keep descriptive, epistemic, evaluative, legal, institutional, and technical assertions distinguishable by their stated question and grounds. It shall not represent technical conformance as automatically creating factual truth, rights, duties, liability, admissibility, jurisdiction, or institutional authority.

The same dossier can connect these assertions. For example, an institutional decision can cite an evidential assessment and an asserted rule, while each remains separately attributable and open to the appropriate

form of review. This is separation of questions and authority, not a requirement for independent databases.

7 Vocabulary management and correspondences

7.1 General

Vocabulary management concerns inspectable meaning across local uses, languages, profiles and versions. A register can be a small table or a documented specification mapping. It need not duplicate a dictionary, but an exact definition and its application scope need to be recoverable. When a source is unavailable, the adopted local wording and that limitation remain visible.

7.2 Terms, sources and local extensions

V100-013 The application shall maintain a term-use register identifying the terms used, their definitions or dated definition references, their recording scope, their source status and the role responsible for interpreting local use. An imported label shall not establish equivalence without an identified correspondence and rationale.

V100-014 A local extension shall identify its purpose, definition, admissibility conditions, relation to existing terms, affected uses and limitations. A conflicting meaning shall use a distinct qualification or label and shall not be presented as an unchanged GR-100 definition.

An extension can address a specialized institutional process without claiming that its categories are universal. For example, a profile can define a reviewed submission within its own procedure. It identifies the relationship to Record and Claim, the criterion for entering the review category and the information the category omits. The label does not imply that the submission is true or that every recording context has the same procedure.

7.3 Languages, editions and mapping

V100-015 A term correspondence across languages, domains or editions shall identify the source and target meanings, direction, scope, responsible attribution and known non-equivalence. A narrower, broader, partial or conditional correspondence shall not be represented as unrestricted equivalence.

A translation can preserve an operational distinction even when ordinary words carry additional meanings in one language. The operational definition travels with the label. Where a translation is contested, alternative formulations and grounds remain available. A terminology register need not require every language to borrow the same word or every application to create a universal dictionary.

Renaming a field does not by itself change meaning. Retaining the same label while changing its definition can change the descriptive regime. The register identifies both situations. A mapping that loses information describes the uses for which the mapped representation remains adequate and the uses it no longer supports. Switching to a finer vocabulary does not recreate distinctions absent from the source material.

7.4 Modality, epistemic function and status expressions

V100-016 An application describing an occurrence or possibility shall distinguish its asserted actuality or modality, the epistemic mode of the assertion and the assessment disposition. It shall preserve combinations such as an actual occurrence inferred retrospectively and a directly reported observation whose accuracy is disputed.

V100-017 Where an application uses fact, verified, valid, confirmed or an equivalent status expression, it shall state the question resolved, applicable criterion, attributed assessor and grounds or assessment

reference. An unspecified status expression shall not erase known uncertainty, an unresolved identity question or the limited scope of a check.

Recorded fact can mean a statement treated as settled by an institution, an asserted occurrence, or a database entry. This document does not make these meanings interchangeable. A historical account can preserve that a claim was institutionally accepted without endorsing its substantive content. Similarly, a valid structure can contain a false claim; a verified signature can authenticate a mistaken statement.

7.5 Correspondence between roles and levels

V100-018 A relied-on correspondence between record roles or descriptive levels shall identify the linked descriptions, intended relationship and use, retained distinctions and known losses or unresolved links. A transformation shall not silently create target identity, occurrence multiplicity or historical detail unsupported by its source.

Table 1 – Role correspondences and distinctions requiring attention

Correspondence	Recording question	Distinction at risk
Event–Process	One prolonged occurrence examined through internal activity; a process treated as a bounded episode	Segmentation, attempts, partial order and intermediate conditions.
Relation–Entity	An agreement or dependence tracked across renewal	Continuity criterion, incidence context and whether renewal creates a separate arrangement.
State–Property	Conditions described through characteristic assignments	Domain, time, omitted conditions and observational or inferential basis.
Process–State	Activity summarized by a resulting condition	Different histories can share an endpoint; the endpoint does not establish the path.
Entity–type	Subjects classified by a shared characteristic	Type equality does not establish token identity or continuity.
Record–target	Several reports linked to a proposed occurrence	Record multiplicity differs from occurrence multiplicity; linkage can remain disputed.

Table 1 is a boundary guide, not an exhaustive allowed-edge schema. A profile can add relationships with stated meanings. An Event description can aggregate several occurrences only when that aggregation is explicit and does not purport to preserve individual occurrence counts or intermediate history. Conversely, decomposing an Event into a possible Process does not establish that the proposed steps occurred.

7.6 Missingness and definedness

V100-019 An application shall distinguish missingness and definedness states material to its use, including zero or false values, unknown values, non-observation, non-collection, inapplicability, disputed assignment and restricted access where present. A mapping that combines these states shall state the loss and shall not infer a substantive negative claim from the combined code.

Unknown is an epistemic condition rather than a third truth value imposed on the world. Inapplicable means the stated characteristic lacks an applicable value under its definition. Not measured means an

applicable measurement was not performed. Withheld concerns access and can coexist with a known value in a protected view. Disputed can describe incompatible assignments with available evidence. These differences affect later counting, assessment and revision.

An application need not claim knowledge of why a value is absent. Unknown reason is legitimate when supported. It also need not reveal protected material's existence to an unauthorized audience. A reduced view can state its collection and access scope while a protected accountable record retains a more specific explanation where permitted.

7.7 Properties, scales and aggregates

V100-020 A numerical Property description shall identify its characteristic definition, applicable domain, scale meaning and unit where relevant. Any arithmetic, weighting or aggregation relied on shall state its interpretation, included population or components and material limitations. Numerical labels alone shall not establish the validity of the operation.

A nominal code supports differentiation, not automatically addition. An ordinal rating supports ordering under its interpretation, not automatically meaningful distances or averages. A measurement with a unit still depends on an instrument, boundary and procedure. The distinctions remain relevant when values have the same software numeric datatype.

An aggregate can change because underlying values change, because composition or weights change, or because a classification rule changes. These are different interpretive questions. A rate can require its numerator, denominator, inclusion criteria and period for interpretation. A pooled increase does not establish improvement for every group; a pooled decrease does not by itself establish causal deterioration in practice. The inference needs its own grounds.

7.8 State sufficiency and retained history

V100-021 An assertion that a State description is sufficient shall identify the question or operation family, comparison horizon, relevant observations, assumptions and known omitted distinctions. Sufficiency for a current report or specified prediction shall not be represented as historical completeness or sufficiency for undeclared continuations.

Two subjects can have the same current reported flag while retaining different conditions that affect a future response. Conversely, a reduced description can predict a selected response while omitting whether the condition arose by agreement or imposition. Predictive and historical purposes need different evidence. A statement of adequacy identifies the question answered, rather than converting that question into a universal account of the subject.

7.9 Identity decisions

V100-022 A relied-on identity judgment shall state whether the proposed relation is identity, similarity, identifier correspondence, succession or another defined relation, and shall preserve material competing criteria and unresolved cases. Automated matching or shared lineage shall not be promoted to target identity without the stated criterion and its supporting attribution.

Organizational registration, membership continuity, operational practice and historical self-description can support different identity inquiries. Agreement under one criterion need not resolve another. A split or merger can be represented by directed lineage without identifying each successor with every predecessor. A shared name does not decide which relation is intended.

Identity also differs from access. Redaction can hide information needed to assess a match while a custodian retains it. A public view can report a scoped assertion and its limits without claiming independent external verification. Lack of disclosure does not justify inventing either identity or non-identity.

8 Conformance

8.1 General

The conformance subject is a declared vocabulary application at an identified edition and boundary. Requirements concerning extensions, numerical Properties, transformations or particular roles are conditional on those features being present. An absent feature can make its specific requirement not applicable. It does not exempt a general safeguard already used elsewhere in the application.

8.2 Declaration and assessment boundary

V100-023 A conformance statement shall identify the application, edition, boundary, GR-100 edition, applied terms, applicable requirements, assessor and evidence. It shall distinguish full fulfillment of applicable requirements from partial assessment and shall not imply assessment of excluded uses or unavailable evidence.

A scope can be small without being vague. A short profile using only Record, Claim, Trace and Evidence identifies those uses and definitions. It does not need examples for an unused Process role. A profile using a numerical Property and an aggregate triggers V100-020 even when its label is score rather than Property. Applicability follows meaning and use, not convenient field spelling.

8.3 Results and mandatory schedule

Fulfilled means that the required evidence was examined and met the check within scope. Not fulfilled means examined evidence demonstrates a failure. Not assessed means necessary evidence, access or method was unavailable or the check was not performed. Not applicable means the triggering feature is absent, with a documented reason. Lack of access is not non-applicability.

V100-024 The assessment shall follow Annex A and retain a result, evidence locator, assessor and reason for every requirement. A failed or unassessed applicable requirement shall prevent an unqualified conformity claim for the declared application. Each not-applicable result shall identify the absent trigger.

V100-026 Where one requirement groups obligations whose results can differ materially, the assessment shall retain a result and evidence for each such component. The overall requirement shall be fulfilled only when every applicable component is fulfilled. A failed or unassessed component shall remain visible in the requirement-level and overall application result.

A vocabulary result does not establish factual truth, philosophical exhaustiveness, effective institutional participation or legal validity. Syntactic checking can assist assessment, but cannot determine whether a term is coherently applied to a contested case. The report distinguishes automatic checks from substantive examination of meaning.

8.4 Maintenance of an assessment

A change in definition, scope, role criterion, correspondence or assessment-relevant use changes the assessed subject. The application identifies the affected edition and results requiring review. Correcting spelling alone need not change semantics; an unchanged label does not prove semantic stability.

An implementation can retain multiple vocabulary editions for historical records. Assessment identifies which meaning governed each record and which mappings support a combined view. A later interpretation does not retrospectively give earlier actors access to the newer vocabulary. If the historical definition cannot be recovered, that is a reconstruction limitation rather than permission to silently substitute the current one.

Annex A

(normative)

Vocabulary assessment schedule

A.1 General

This schedule specifies required assessment checks for applicable features; it does not report executed tests. The assessor examines the declared subject and reports fulfilled, not fulfilled, not assessed or not applicable for each requirement, with an evidence locator. Not applicable requires an absent trigger, not an inconvenient result. Unavailable examination evidence or an unperformed check receives a not-assessed result. A review cannot establish an external fact merely from compliant vocabulary.

Table A.1 – Vocabulary assessment checks

Requirement	Evidence and discriminating check
V100-001	Declaration names version, boundary, terms, extensions. Compare a local "fact" label against its stated meaning; detect an undisclosed conflicting use.
V100-002	Trace a target, manifestation, record, and claim in the subject. An authentic but incorrect report remains representable.
V100-003	Inspect a summary combining observation and inference. Recover which content was registered and which was inferred, by whom.
V100-004	Inspect one material item used differently for two claims. A successful authenticity check does not become a truth result.
V100-005	Inspect a merger, split, or disputed identification. Recover identity criterion and directed lineage without an automatic merger of targets.
V100-006	Inspect a late-entered report. Target time, observation time, recording time, and review time remain distinguishable or explicitly unknown.
V100-007	Compare target change, corrected report, and changed category. Prior meaning and reasons remain recoverable to the declared retention/access extent.
V100-008	Inspect a generative attribution. Scope and affected targets are present; description of expanded capacity is separate from its evaluation.
V100-009	For each applied role, locate admissibility, identity, temporal meaning, and required metadata; inspect a missing value's explicit reason.
V100-010	Inspect a relation with changing terms and an event analyzed as a process. Relevant identity/history and overlapping views remain expressible.
V100-011	Always inspect whether operational record roles remain distinct from metamodel concepts. Separately, if a mapping is asserted, examine its scope and additional premises. An absent mapping makes only the mapping-specific component not applicable.
V100-012	Compare event report, institutional determination, legal assertion, ethical judgment, and technical check. Their distinct grounds remain visible.
V100-013	Inspect the term-use register, source status and dated definitions; a reused label has an argued correspondence.
V100-014	Examine a local extension's definition, admissibility, scope and limits; it does not silently replace a core meaning.
V100-015	Examine an inter-language or inter-edition mapping; partial correspondence is not represented as unrestricted equivalence.

Requirement	Evidence and discriminating check
V100-016	Compare actuality/modality, epistemic mode and assessment disposition, including an actual but retrospectively inferred occurrence.
V100-017	Inspect uses of fact, verified, valid and confirmed; recover the question, criterion, assessor and grounds.
V100-018	Inspect a correspondence between roles; retained references and stated losses prevent invented identity or occurrence detail.
V100-019	Compare zero, false, unknown, disputed, withheld and inapplicable values before and after a mapping.
V100-020	Examine numerical meaning, units, scale and aggregation; recover included population and weighting interpretation.
V100-021	Examine a sufficiency claim; recover the supported question, operations, horizon and omitted history.
V100-022	Examine an identity decision with alternative criteria; distinguish identifier matching, similarity, lineage and identity.
V100-023	Check the conformance statement's edition, boundary, terms and evidence; excluded uses do not acquire a result.
V100-024	Check the complete assessment register; every exclusion has an absent-trigger reason and every fulfilled result has evidence.
V100-025	Check mandatory designations and criteria separately from unavailable contextual facts; an unknown declaration does not resolve a criterion or replace a reference.
V100-026	Inspect a grouped requirement with one unassessed or failed component; its other fulfilled components do not produce an overall fulfilled result.

A.2 Execution and evidence record

The assessor first identifies the application and term-use register, then the feature-triggered requirements. For an applicable check, the evidence includes the definition or dated reference and an actual use. A boundary case is included when needed to distinguish alternative meanings. A documented equivalent case is acceptable when it tests the same distinction in the application's domain. An empty template or undocumented expert understanding is insufficient evidence of actual vocabulary use.

The register records subject version, requirement identifier, applicability, evidence locator, observed result, assessor, date and unresolved limitation. Component results follow V100-026. One evidence item can support several requirements, but their results remain separate. Assessor disagreement identifies whether it concerns meaning, factual material, scope or the assessment method. Restricted evidence receives a scope statement; unavailable required examination evidence receives a not-assessed result rather than an inferred pass. Assessment of an allowed unknown-context declaration follows V100-025 and remains separate from assessment of the unresolved fact.

Annex B

(informative)

Worked vocabulary cases

B.1 Initial distinction cases

1. A clerk records that a request arrived late. An attributed entry record can support a reported recording time, subject to the relevant clock, integrity and acquisition-context checks. Whether the request itself arrived late requires identifying the receipt-time source, applicable deadline and inference. The record, target event and deadline assessment remain distinguishable.
2. A later witness report changes the assessment of the arrival time. That is a revision of the account. A later extension of the deadline changes a governing condition. A new definition of "arrival" changes the descriptive or institutional rule. One dossier can contain all three histories without conflating them.
3. Two administrations reuse an office name. An application follows their records under the same catalogue heading while recording replacement and disputed institutional continuity. Shared cataloguing does not decide Entity identity.
4. A new procedure reduces review time and makes some participants unable to contest an error. A generativity record can preserve both the increased processing capacity and the restricted capacity for correction; an ethical judgment states its own affected parties and criteria.

B.2 One agreement and several roles

A fictional agreement links a cooperative and a laboratory. It is a Relation for questions of commitments and access and is tracked as an Entity for continuity after personnel changes. Negotiation and amendment form a Process, signing is an Event, operative terms on a date form a State description and a reported access limit is a Property assignment. These descriptions need not compete for a single exclusive class.

Renewal creates a boundary question. The parties and title continue while terms change substantially. Participants can describe the same agreement, an archive can retain a new document and a legal analyst can ask a separate continuity question. The application retains the criteria and their grounds rather than deriving a universal identity resolution from the shared title. A technical edge that records only an active connection can support a current-status query while losing formation and dispute history.

B.3 Changing composition in an aggregate

A programme reports participation rates for two groups. Both groups improve in a later period, while the population contains a larger share of the initially lower-rate group. The pooled rate can decline despite each group's improvement. This is a stipulated comparison problem, not evidence about a real programme.

The Property description retains population, denominator, definitions, weights and periods. A question about the same people over time additionally needs identity linkage. A question about institutional composition can instead treat entry and exit as part of the process. The scalar alone does not establish which question is relevant or whether the outcome is fair.

B.4 Missing, withheld and inapplicable

One form records a zero reading, another says no measurement was performed, another withholds an existing value, and another concerns a subject for which the characteristic is inapplicable. A conversion maps every case to an empty cell. That table can have a limited use, but it cannot claim preservation of the distinctions or support a count of zero readings.

A finer vocabulary can recover an omitted value only where retained or newly obtained evidence supports it. Changing notation does not create missing observations. Authorized examination can use a protected source while a public view remains incomplete. The correspondence records the different routes and resulting limitations.

Annex C

(informative)

Foundation trace and drafting rationale

C.1 General

Page numbers below are one-based pages in the supplied PDFs. FM identifiers are those in `foundation_manuscripts/MANIFEST.md`. The definitions here are operational proposals rather than quotations or claims that the manuscripts prescribe this recording model.

Table C.1 – Foundation passages and operational decisions

Source	Preserved distinction and draft application
FM-004, §4.2, pp. 11–14; §4.6, pp. 43–45	Registers answer different questions; manifestation is broader than representation, and recognition need not precede relational reality. Basis for V100-002; no exclusive philosophical register schema.
FM-005, §5.4, pp. 28–31	Trace, target relation, and evidence differ; evidential force is target-relative. Basis for V100-003/004 and GR-200 evidence-role requirements.
FM-005, §5.17, pp. 141–142	Uncertainty concerns several dimensions and need not have one scalar measure. Basis for the uncertainty definition and GR-200.
FM-005, §5.20, pp. 168–174	New evidence, intervention, historical revision, and category revision differ. Basis for V100-006/007; three linked histories are an operational organizing proposal.
FM-007, p. 2; §7, pp. 26–29; §8, pp. 32–33	Roles overlap; identity criterion, lineage, participant incidence, and relation continuity require distinct information. Basis for V100-005/009/010 and Entity/Relation proposals.
FM-007, §9, pp. 37–38, 43; §12, pp. 56–57	Occurrence differs from effect; histories differ from endpoints and possible factorizations. Basis for Event/Process proposals.
FM-007, §10, pp. 43–44; §11, pp. 52–53, 56	Attribute domain/scale and State sufficiency are scoped. Basis for Property/State proposals, with Property/Attribute unresolved.
FM-003, §3.10.9, p. 115; §3.13, pp. 141–142	Generativity has no fixed normative sign; effects vary across subjects and time. Basis for V100-008, without a universal measure. Both Chapter 3 variants remain independently preserved.

The main alternatives were a complete philosophical definition, an exclusive six-class schema, or a limited operational vocabulary. This draft selects the third provisionally because initial cases need distinguishable claims and histories before a technical model can be justified. A programme decision record accompanies this drafting choice; adoption and technical realization remain separate decisions.

C.2 Additional analysis in edition 0.2

FM-007, sections 10.4–10.10, PDF pages 45–50, distinguishes partial definedness, overlapping classifications, scale interpretation, aggregate behavior and changing composition. V100-019/020 preserve these meanings without importing the formal constructions or equating Attribute with Property. The manuscript's arithmetic examples are stipulated constructions, not empirical validation of this vocabulary.

FM-007, sections 17.1–17.2, PDF pages 78–80, distinguishes within-regime consistency from cross-regime alignment and explains the inability of a coarse description to recover omitted distinctions by relabeling. V100-015/018 preserve correspondence limits without claiming that a fixed regime catalogue anticipates every future distinction.

FM-005, sections 5.4.4–5.4.8, PDF pages 32–35, distinguishes observation, inference, latency, hiddenness and negative evidential warrant. V100-016 distinguishes a target's claimed actuality from its inferential accessibility. Missing evidence is not proof of concealment, and inference is not a weaker kind of reality. Sections 5.18.1–5.18.5, pages 152–156, examine visibility, classification power and institutional legibility. The extension requirements make classifications inspectable without assuming that maximal visibility is desirable.

The provisional term Generativity return identifies a programme recording topic, not an asserted equivalence with a manuscript-defined quantity. FM-005, section 5.17.3, PDF page 145, discusses uncertainty in recirculation claims, including conversion or transfer, return pathways and effects on later generative conditions. That passage supports questions to record, while the terminology's wider definition, measurement and evaluative interpretation remain unresolved.

Annex D

(informative)

Unresolved issues and development evidence

D.1 General

- **OPEN — Property/Attribute.** Compare FM-007 with sustained programme usage and test conflicting value assignments, undefined values, and nominal scales before deciding equivalence, separation, or a terminology change.
- **OPEN — Claim representation.** Compare independently identified claims, attributed assertions within records, and hybrids using disagreement, revision, restricted access, and round-trip examples. This draft requires distinguishability, not a seventh ontology class.
- **OPEN — Role overlap and profiles.** Test overlapping Event/Process and Entity/Relation descriptions. No exclusive schema typing or full cross-role relation vocabulary has been adopted.
- **OPEN — Identity.** Domain-specific criteria and disputed linkage need examples beyond names and administrative identifiers; branching continuity does not have a universal resolution.
- **OPEN — Generativity and return.** Test possibility, foreclosure, contribution, and return pathways without presuming a universal metric or a normative entitlement.
- **OPEN — Source chronology.** Chapter 3 editorial precedence remains unresolved. This draft cites particular passages without declaring one variant authoritative over the other.

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GENERATIVITY STANDARDS PROGRAM

GR-110

Standards-track Working Draft

Version 0.3 2026-09-22

Generativity Recording Requirements

WORKING DRAFT FOR REVIEW

This document contains proposed provisions for technical and institutional review. It is not an adopted Standard or an operative governance instrument. Its scope, application conditions and publication status are specified in the text.

Prepared by the Generativity Standards Program. Reference to external publications does not imply endorsement by ISO, IEC, IEEE or any United Nations body.

Foreword

Version 0.3 records the bounded substantive review of the archived 0.2 package. This edition distinguishes dispute disposition from occurrence/modality in R110-012 and adds conditional recirculation-recording requirement R110-112 with an assessment route. The review matrix, synthetic assessments and unresolved readiness questions are documented in `docs/reviews/validation_0.2/README.md`. These activities do not constitute adoption or an independent institutional assessment.

This document specifies proposed requirements for generativity record packages and the practices that create, use, and maintain them. It is a preparatory Standards-track Working Draft. It is not an adopted Standard and does not establish that a formal standards project has been initiated.

Responsible editor: `UNASSIGNED`. Canonical source: `standards/GR-110-recording-requirements/GR-110.tex`. Intended readers are recording practitioners, participants in inquiry, record custodians, institutional users, implementers, and assessors.

Version 0.2 retained R110-001 through R110-034 and updated their dated draft dependency to GR-200 version 0.2. That edition developed operational planning, capture, attribution, alternatives, practical response, custody, presentation, and assessment. Normative annexes specify semantic information and assessment schedules. Informative annexes provide authored examples and a source-to-proposal explanation.

The proposed requirements are available for review and controlled exercises while programme governance develops. Their fulfillment concerns the stated recording practice and evidence. It does not certify factual truth, beneficial generativity, complete history, or external legal validity.

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Introduction

A final output can survive while the relations, judgments, alternatives, and conditions that made it possible become inaccessible. An account of a current result can also conceal mistaken assessments, changing categories, unrecognized contributions, or the loss of capacities elsewhere. This document addresses those problems through bounded and revisable recording.

A generativity package connects three distinguishable histories: changes in the situation being investigated; changes in evidence, interpretation, and judgment; and changes in categories, methods, or institutional recognition. A classification can enter the situation and alter access or action. Its practical effect does not establish that its description was warranted, and its later correction does not demonstrate repair of earlier consequences.

The recording objective is therefore more specific than accumulating observations. A reader needs to identify the asserted transformation, whose account it is, how earlier conditions are said to connect to it, which grounds support that connection, and what remains unavailable or disputed. A practice needs arrangements for proportionate collection, protection, challenge, correction, custody, and intelligible presentation.

The foundations support several forms of generative inquiry. A relation can enable, constrain, maintain, amplify, mediate, or stabilize an effect, and its role can change over time. A generative trajectory can cross several relations and carriers rather than follow one persistent object. The clauses below operationalize the recording of such accounts; they do not impose one causal theory, universal measurement scale, or exhaustive graph of possible futures.

1 Scope

1.1 Included subjects

This document specifies requirements for an identified generativity record package and the responsible recording practice. It covers purpose and boundary, material claims, record identity, time, generative accounts, contributions, alternatives, changes in distinctions, practical uptake, revision, protection, custody, and presentation.

The package contains the retained representation and its declared limits. The practice includes people or institutions, methods, assigned responsibility, collection and review actions, custody, and user-facing behavior. Full assessment of the declared scope examines both documentary material and applicable practice obligations. A package-only examination is a partial assessment under this edition; no reduced package-conformance profile is defined.

1.2 Excluded claims and implementations

The document does not require an exhaustive world history, unrestricted observation, a particular database, cryptographic mechanism, interchange format, common metric, or mandatory category-theoretic semantics. Narrative dossiers, tables, and technical systems can satisfy the same semantic obligations where the required distinctions and behavior remain inspectable.

It does not establish ownership, a compensation entitlement, a legal duty to disclose, or the authority of an external institution. Contextual legal and policy assertions are recorded with their grounds and status. Full GR-120, GR-130, GR-140, GR-150, GR-160, and GR-400 publications are not prerequisites for applying the bounded manual assessment in this draft.

2 Normative references

2.1 Dated draft dependencies

The following Standards-track Working Drafts supply provisions invoked by this document:

GR-100, Foundations and Vocabulary, version 0.3. `standards/GR-100-foundations-vocabulary/GR-100.tex`. The incorporated scope is Clause 3's terms, Clause 5's record-role meanings when used, and the result-category meanings in 8.3. This reference does not impose a separate claim of GR-100 vocabulary-application conformity.

GR-200, Epistemic Recording Framework, version 0.3. `standards/GR-200-epistemic-recording/GR-200.tex`. Provides the applicable requirements for the bounded epistemic record package required by R110-005, including package-level obligations.

These are draft dependencies, not adopted Standards. An assessment identifies their exact versions and the incorporated requirements. A later change requires dependency review.

2.2 Related documents

GR-210, Evidence, Interpretation, and Contestation, version 0.3, provides a complementary procedural draft. It is not a blanket dependency of this document. A claim to fulfill a GR-210 procedure requires a separate assessment. Programme governance controls publication development and adoption; it does not automatically supply the mandate of an institution using a package.

3 Terms and definitions

3.1 Generativity record package

An identified collection assembled for a stated inquiry or practical purpose, with a scope, inventory, responsible recording practice, attributable material claims, and history relevant to that purpose.

3.2 Recording practice

The responsible people or organization, methods, decisions, and custody arrangements used to assemble, assess, present, and maintain a package.

3.3 Material claim

An assertion relied on to explain a consequential relation, generative effect, decision, classification, assessment, or revision within the declared purpose. Materiality is determined by that reliance and the selection rationale; it is not a truth status.

3.4 Generative account

An attributed account of how conditions or relations enabled, maintained, transformed, or constrained subsequent capacities, relations, distinctions, constraints, or possibilities. This operational term permits recording an account whose substantive warrant remains disputed.

3.5 Generative contribution role

The asserted target-relative function of a relation, actor, or configuration in an account, such as enabling, triggering, mediating, amplifying, stabilizing, substituting, or constraining. Roles can overlap and change; they are not new record-ontology classes.

3.6 Generative carrier account

An account of a persisting or transmitted condition through which an earlier contribution is connected to a later effect, including any transformation of that condition. This is a recording expression informed by FM-005, Definition 5.100, rather than a new mandatory class.

3.7 Possibility-field account

A bounded account of the alternatives or pathways represented as accessible, constrained, opened, or foreclosed for specified subjects under stated conditions. It does not claim to enumerate the complete possibility field of reality.

3.8 Practical uptake

Reliance on an identified claim, classification, or assessment in a stated action or decision, distinguished from mere receipt or availability of the information.

3.9 Recording horizon

The period covered by collection or reconstruction. It can differ from the period over which a claimed effect is expected or assessed.

3.10 View

A selected or transformed presentation of package content for an identified purpose and audience, with declared relation to source versions and material limitations.

3.11 Declared limitation

An explicit account of a collection, knowledge, access, method, temporal, or assessment constraint. Declaring a limitation does not automatically satisfy an obligation requiring evidence that remains missing.

4 Planning and responsibility

4.1 Purpose, boundary, and selection

R110-001 A package shall identify its purpose, intended users, subject matter, boundary, relevant time horizon, recording practice and package version.

R110-002 The recording practice shall state the selection criteria for included material and identify known omissions material to the purpose, including unavailable perspectives, uncollected information and limits of reconstruction.

R110-003 The package shall distinguish an inventory of retained records from an assertion that the underlying history is complete. The existence of a record shall not be used as proof of its represented content.

R110-035 Before systematic capture or reconstruction, the recording practice shall identify the questions the package is intended to support, the decisions or uses anticipated, and the information needed to examine them. The collection plan shall distinguish necessary detail, conditional detail, and material excluded from collection with reasons.

R110-036 The plan shall identify temporal horizon and resolution, observational boundary and scale, included perspectives, source types, expected gaps, and relevant relations outside the boundary treated as context. A change of boundary or scale material to interpretation shall be versioned and explained.

R110-037 The practice shall assess feasible recording, assessment, protection, and participation effort for the declared purpose. If essential work exceeds available capacity, it shall narrow the scope, obtain capacity, or report an unmet requirement; resource limits shall not justify invented content or an unqualified assessment claim.

The selection plan makes the account usable and bounded. An inquiry into a maintenance collaboration can require the work that sustained access without documenting every interaction among its participants. Selection becomes misleading when exclusions material to the stated account disappear from view.

4.2 Responsible functions and operating conditions

R110-004 The recording practice shall assign responsibility for capture, assessment, custody, access decisions and correction, recording combined roles and relevant conflicts. An automated component shall not substitute for an unassigned responsibility.

R110-038 Each assigned function shall identify the responsible person or organization, accepted task, authority and access needed, relevant interests, and a contact or continuity arrangement. Where a function cannot be performed, the practice shall record the limitation and its consequence for current use or assessment.

R110-039 The recording plan shall identify when capture is contemporaneous, retrospective, automated, or assisted and how consequential selections or transformations will be checked. Automated output shall retain its relationship to source material and accountable review.

R110-040 A material expansion of purpose, audience, source collection, or practical use shall receive renewed scope and protection assessment before the affected activity begins. The package shall identify the change and distinguish earlier permission and evidence from authority for the new use.

R110-041 The practice shall maintain the package inventory, current responsible functions, known dependencies, and active review or correction routes through the declared maintenance period. A decision to stop maintenance shall identify its date, reason, custodial disposition, and consequences for users.

5 Capture, identity, and epistemic integration

5.1 Intake and trace preservation

R110-042 On incorporating material, the practice shall record its source, acquisition or creation time, received version or identifying characteristics, method of capture, relevant production context, and permitted use. Unverified source assertions shall remain attributed rather than represented as established provenance.

R110-043 A transcription, translation, summary, selection, annotation, or reconstruction shall identify the source material, responsible transformer or method, material changes, and known loss or uncertainty. A derived account shall remain distinguishable from its source.

R110-044 When several materials derive from a common source, the package shall retain known derivation relationships relevant to evidential independence. Multiple copies or repeated citations shall not be presented as independent corroboration without additional grounds.

R110-045 The practice shall identify collection or extraction errors that can materially affect interpretation, including temporal aggregation, omitted context, unresolved attribution, and unsupported precision. Correction of an extraction shall not silently alter the underlying source record.

5.2 Package and claim dependency

R110-005 The package shall identify its material claims and assessments as a bounded epistemic record package assessed against GR-200 Working Draft 0.3, including that draft's package-level obligations. It shall identify the assessed claim set, dependency versions, applicable requirements, evidence, exceptions and results; a claim-level check alone shall not establish fulfillment of the package dependency.

R110-046 The assessed material-claim set shall include claims relied on for generative connections, identity, alternatives, category change, and practical consequences, not only claims supported by convenient evidence. Exclusion of a relied-on claim shall be identified as a limitation of the assessment rather than omitted from the declared set.

R110-047 The package shall link each material claim and relevant assessment to the applicable GR-200 records and results. The dependency assessment shall cover all applicable obligations for that bounded epistemic package; successful individual claim checks shall not substitute for package-level evaluation.

5.3 Identity and temporal meaning

R110-006 Each retained record and version shall be distinguishable within the package, and a reference shall identify its intended target sufficiently for the declared use. A record identifier shall not itself establish identity of the represented person, event or relation.

R110-007 A continuity or identity judgment material to the trajectory shall identify its criterion, responsible source, supporting grounds and known dispute. Merger, succession and common labels shall not silently be treated as identity.

R110-008 The package shall distinguish the represented occurrence or validity time from observation, recording and later assessment times when their difference is relevant. Uncertain intervals and unsupported ordering shall remain explicit.

R110-009 Represented observations, actions, relations, states and properties shall retain the information needed to distinguish their operational roles. A relation with a material history, status or properties of its own shall be identifiable as a recordable subject.

R110-048 A disputed identification, apparent duplicate, split, merger, or succession shall retain the alternative interpretation and the decision or uncertainty governing linkage. The practice shall distinguish correction of a record identifier from revision of a judgment about the represented subject.

R110-049 The temporal account shall identify relevant ordering, interval, resolution, and uncertainty, including where observations leave gaps. A claimed continuous relation shall state its continuity criterion and evidence; continuity of a label, manifestation, or file shall not alone establish continuity of the relation.

R110-050 When a reconstruction uses categories or evidence unavailable to earlier actors, it shall identify that retrospective basis and retain the earlier terminology or a supported account of it where material. The reconstruction shall not attribute later knowledge or intended outcomes to earlier actors without grounds.

6 Generative accounts and attribution

6.1 Target and connection

R110-010 For each generative account, the package shall identify the target capacity, relation, constraint, distinction or possibility; the relevant actors or configuration; the comparison or earlier condition; and the temporal and contextual scope.

R110-011 The account shall state how the proposed enabling, maintaining, transforming or constraining contribution connects earlier conditions to the target, with grounds, method and limitations. Temporal precedence or a diagram edge alone shall not be presented as establishing that connection.

R110-012 An account shall distinguish the asserted occurrence or modality of an effect, such as realized, intended, possible or unrealized, from its epistemic basis, such as observed, reported, inferred or reconstructed, and from the assessment or dispute disposition. Unresolved actuality shall remain explicit. A realized past effect can be retrospectively inferred; its contribution attribution can remain disputed. The recording practice shall not manufacture an observed outcome where follow-up evidence is absent.

R110-014 When an enabling encounter, decision or judgment is material to the account, the package shall identify its represented role, relevant conditions and the claim connecting it to subsequent developments.

R110-051 A generative account shall distinguish the existence or occurrence claim about its target from the attribution claim connecting candidate contributors to that target. The role, boundary, scale, time horizon, and evidential limits of the attribution shall remain inspectable even when the target change is well supported.

R110-052 Where association, sequence, or co-occurrence is used as support, the account shall state that evidential role and assess material alternative explanations, such as selection, common conditions, reverse influence, or changing definitions, or identify their unresolved status. Association shall not be relabelled as a demonstrated mechanism.

R110-053 A mechanism account shall identify the intermediate changes proposed to carry the contribution, their connection to available evidence, and any unobserved or assumed link. Restating the final outcome as an intermediate step shall not be presented as additional evidence.

The meaning of a contribution depends on the target. A network can be associated with income while the stated generative question concerns access to knowledge or a new collaboration. The account identifies the level at which the asserted contribution operates. Different methods can provide different kinds of support without being reduced to one confidence number.

6.2 Alternative contributors and counterfactual reasoning

R110-054 When a counterfactual supports attribution, the account shall identify the focal change, connected conditions allowed to vary, background conditions provisionally held stable, target comparison, time horizon, evidence for plausibility, and material uncertainty. A modeled counterfactual shall remain distinguishable from an observed comparison.

R110-055 Where multiple or distributed contribution is material, the account shall identify the supported roles or organizational pattern, relevant complementarities, substitutions, or feedback, and the limits of allocating effects among participants. Failure to isolate a single contributor shall not force an unsupported sole attribution.

R110-056 A claim of emergent or configurational contribution shall identify the interaction, organization, or dependency said to matter and the evidence supporting its relevance to the target. The label emergent or systemic shall not replace the account of the proposed connection.

6.3 Carriers, delay, and long trajectories

R110-057 For a delayed contribution, the account shall identify the persisting or transmitted condition proposed to connect the earlier relation to the later effect, known transformations of that condition, intervening influences, and the limit of useful attribution. A long interval alone shall not establish either continuity or disconnection.

R110-058 A trajectory containing several generative links shall preserve link-specific contributors, target, grounds, modality, and uncertainty where these differ materially. Evidence supporting one link shall not automatically validate downstream links or the whole trajectory.

R110-059 Where available evidence ceases to support a downstream attribution, the account shall identify that boundary and classify further development as unassessed, conjectured, or separately supported as appropriate. A diagram or narrative shall not hide that change of status.

R110-060 A path-dependence or lock-in claim shall identify the sequence-sensitive condition said to alter later alternatives, its carrier or feedback, and grounds distinguishing historical dependence from persistence under current conditions. Claimed irreversibility shall state the relevant horizon and alternatives considered.

6.4 Branches and contributions

R110-013 Material participants and contributions shall be attributed with their basis and uncertainty. The recording practice shall provide a means to record disputed, collective, indirect or unknown contribution without forcing attribution to one actor.

R110-061 An account of branching shall distinguish opening or constraining a pathway, selecting a branch, and stabilizing a later outcome when those contributions differ. Earlier enabling conditions shall not receive the whole realized history's attribution solely because they preceded it.

R110-062 A contribution record shall distinguish descriptive attribution from acknowledgement, authorship, compensation, ownership, institutional credit, or legal responsibility. Any asserted entitlement or allocation shall identify its separate source, authority, evaluative basis, and disputed or operative status.

7 Alternatives, distinctions, maintenance, and loss

7.1 Alternative and possibility accounts

R110-015 A recorded alternative shall state whether it was considered at the time, inferred retrospectively, modeled or merely proposed, and identify the grounds for any claim of feasibility. Recorded alternatives shall not be presented as exhaustive or equally feasible without supporting grounds.

R110-063 A historical alternative shall identify whether it was evidenced as available to relevant actors at the time, proposed then but infeasible under identified conditions, or introduced retrospectively for analysis. A later technology, category, or institutional option shall not be represented as historically available without grounds.

R110-064 A possibility-field account shall identify the subjects or positions concerned, the selected pathways, the relevant conditions and horizon, and the change alleged in accessibility, cost, probability, or viability. Unenumerated possibilities and limits of comparison shall remain explicit; a bounded list shall not imply exhaustion.

R110-065 Where an option is represented as available, the account shall distinguish formal availability from practical access under material resources, authority, knowledge, timing, or participation conditions. A declared permission alone shall not establish that the affected person could exercise the option.

R110-066 A comparison of earlier and later possibilities shall state whether the compared categories, boundaries, and subjects remain sufficiently consistent for the claimed comparison. If the process generating change or the available distinctions changed, that change shall be represented rather than forced into an unchanged scale.

Alternatives are recorded for their relevance to the inquiry. No branch tree is required. A package can retain evidence of one abandoned option and explicitly state that other pathways were not reconstructed. A possibility claim is stronger than a statement that an observer imagined an option, and its grounds are recorded accordingly.

7.2 Categories and historical reinterpretation

R110-016 A material change in categories, available distinctions or methods shall identify the earlier and later formulation, the reason for change and its effect on interpretation. A new description shall not automatically be represented as a newly existing underlying object.

R110-067 A material classification or method change shall identify its responsible source, effective or asserted period, definitions or rules changed, and consequences for reading earlier records. A later harmonized dataset or view shall preserve a route to the distinctions lost or identify that loss.

R110-068 A retrospective interpretation shall distinguish correction of an earlier error, expansion using later evidence or categories, and subsequent transformation of the represented relation. Where more than one applies, the package shall preserve their separate grounds rather than choose one merely for a simpler history.

The same word can refer to changing institutional arrangements, and different words can describe related practices. A genealogy can therefore connect heterogeneous predecessors without claiming one continuous identity. The package identifies the type of historical account and the limits of the continuity or formation claim.

7.3 Maintenance, depletion, and restriction

R110-017 Known maintenance, depletion, restriction, exclusion or loss material to the declared generative account shall be recorded alongside creation or expansion, or have an explicit collection or protection limitation under R110-002 and R110-026. The account shall distinguish descriptive effects from their evaluation for particular people or values.

R110-069 Where maintaining a capacity or relation is material, the account shall identify the recurring work or conditions asserted to sustain it, the relevant period, and evidence or uncertainty about deterioration in their absence. Lack of a novel final output shall not be used to omit a supported maintenance contribution.

R110-070 A loss account shall distinguish loss in the represented situation from loss of records, visibility, access, institutional recognition, or interpretability. The package shall identify which kind is asserted, its basis and affected subject, without inferring one solely from another.

R110-071 An enabling or constraining effect that differs by participant, position, scale, or horizon shall be scoped accordingly. A short-term benefit shall not erase a recorded longer-term dependency or cost, and a loss to one participant shall not be concealed by aggregate expansion.

R110-072 A normative evaluation of maintained, created, or lost conditions shall identify the evaluator, relevant values, affected interests, grounds, and disagreement. Descriptive generativity and the desirability of its consequences shall remain distinguishable.

7.4 Generativity return

R110-018 Where generativity return is assessed or proposed, the package shall identify the asserted concept, intended recipients, scope, grounds and evaluative basis. Where it is not assessed, that limitation shall be stated without inventing a quantity or entitlement.

R110-073 A generativity-return account shall distinguish the proposed concept and evaluation from any observed transfer, practical response, or legally asserted entitlement. If a quantity is used, the account shall state its meaning, units or scale, calculation or judgment method, horizon, assumptions, and limits on comparability.

R110-112 When a return account asserts recirculation, the package shall distinguish the initial generation, conversion or transfer pathway, return pathway, and asserted effect on later generative conditions. For each stage and material connection it shall identify the claim, actuality or modality, supporting grounds and uncertainty. An unavailable link shall be marked unresolved with its assessment limit; it shall not be inferred solely from another stage. A proposed or completed transfer shall not by itself establish that returned value maintained or renewed generative capacity.

An account can state that generativity return was not assessed. The record of that limitation is assessed separately from any substantive claim about return. No universal distribution rule or monetary equivalent is prescribed.

8 Practical uptake, feedback, and revision

8.1 Decision and intervention accounts

R110-019 When a represented claim or classification informs a decision within scope, the package shall identify the claim version relied on, the decision, the asserted decision authority, its stated grounds and known subsequent response.

R110-074 A practical-uptake record shall distinguish availability or receipt of a claim from actual reliance, the decision communicated, and the action implemented. Each asserted step shall identify its

source and evidence or uncertainty; a delivery acknowledgement shall not establish that a judgment was accepted.

R110-075 When an intervention rationale is within scope, the package shall identify the immediate action, intended generative effect, target relations or conditions, relevant assumptions, beneficiaries and affected interests, and evidence expected to support or challenge the rationale. It shall identify the asserted authority rather than derive that authority from the recording Standard.

R110-076 Where monitoring or feedback is part of the assessed practice, the practice shall identify questions, observations, review points or triggers, responsible recipients, and the decisions that feedback can inform. A collection schedule without a route to consideration shall not be represented as an operative feedback arrangement.

The practical sequence depends on context. A retrospective archive need not operate the intervention it describes. Its package can record an institution's asserted action and the evidence available about it. A practice claiming to provide an operational feedback route needs evidence that the route works within its authority.

8.2 Learning and consequences

R110-077 The package shall distinguish evidence that an action was implemented as intended from evidence that the anticipated transformation followed. Unexpected, delayed, mixed, or unobserved effects shall retain those statuses rather than being treated as success or failure solely from implementation completion.

R110-078 A material feedback record shall identify the observation or testimony, its relation to the intervention rationale, the person or function considering it, and any maintained or revised action with reasons. Where the practice cannot observe consideration or action, that limit shall be reported.

R110-079 When feedback leads to a changed target, method, boundary, objective, or evaluative criterion, the package shall preserve the change and its rationale. Later success criteria shall not be presented as though they governed the original action unless that earlier status is evidenced.

R110-080 An account of withdrawal, reversal, or repair shall distinguish ending an activity, attempting to restore an earlier condition, and addressing residual consequences. It shall identify responsible authority, planned and performed actions, observed effects, and known limits; restoring a rule shall not alone establish restoration of the prior situation.

R110-081 Where a corrective decision has known downstream consequences within the declared scope, the practice shall record follow-up evidence or its absence, including whether affected access, participation, capacity, or dependence changed. A corrected description alone shall not be reported as completed practical repair.

8.3 Revision and challenge

R110-020 A revision shall identify its actor or responsible source, time, target, reason and affected records, distinguishing a change in the represented situation, evidence or interpretation, and descriptive regime. More than one reason can apply.

R110-021 The recording practice shall preserve the intelligible relationship between earlier and later accounts, subject to stated retention and access rules. It shall not retrospectively present earlier actors as possessing evidence or categories first available later.

R110-022 A correction shall identify dependent records or presentations known to the practice, actions taken to correct them and any limits on propagation. The practice shall not assert that uncontrolled external copies were corrected or deleted without evidence.

R110-023 The practice shall provide a declared route for questions, contested attribution and correction requests, identify the responsible recipient and maintain permitted request/disposition records. Availability of the route shall not imply a legal entitlement or a promise of agreement.

R110-082 The declared correction route shall explain how to identify the disputed material, contact the responsible function, request protected handling, and learn the status or disposition. The practice shall test the route within its claimed operating conditions and record failures and remedies.

R110-083 Conflicting correction requests shall remain separately attributable and linked to the affected versions. The practice shall record the responsible determination or unresolved disagreement and shall not silently overwrite one account merely because another was received later.

9 Protection, custody, and preservation

9.1 Authority and proportionate collection

R110-024 The recording practice shall declare the purpose and authority basis for collecting, retaining, accessing and disclosing material within the package, including the applicable policy or institutional context and unresolved constraints. It shall limit collected detail to that justified by the declared purpose.

R110-025 Access and retention decisions shall distinguish content, metadata, derived views and audit traces. Preservation of history shall not automatically require public disclosure or indefinite retention of sensitive material.

R110-084 Before collecting or disclosing sensitive material, the practice shall identify the intended use, actual authority or permission basis, audience, relevant restrictions, and feasible less intrusive information sufficient for the purpose. If the intended use lacks an established basis, that use shall not proceed merely to complete the package.

R110-085 Protection decisions shall consider whether identifiers, relationships, timing, summaries, or combinations of metadata disclose restricted identity, existence, or content. The resulting access arrangement shall distinguish material that can be retained, examined by authorized reviewers, or presented to a particular audience.

9.2 Unavailable information and retention

R110-026 Where material is unavailable, the package shall distinguish known non-collection, loss, destruction, restriction and an unknown reason to the extent that doing so is supported and permitted. It shall not disclose a protected fact merely to label an absence.

R110-086 An unavailable-information declaration shall state only what is supported and permitted, identify its effect on interpretation or assessment, and indicate a review or future-access route where one exists. A protected omission shall not be filled with a false factual explanation.

R110-087 The practice shall identify the custodian, retention period or event-based trigger, access-review point, and authorized disposition for material whose retention or disclosure is controlled. Expiry or withdrawal of access shall trigger review of affected claims, views, and assessment limitations.

R110-088 When interpretability depends on a vocabulary, method, software environment, codebook, or external resource, the package shall identify the relevant version and preservation or availability arrangement. A broken reference or obsolete tool shall be assessed for semantic loss rather than treated only as a display defect.

9.3 Transfer and migration

R110-027 A transfer, migration or custody change performed by the practice shall identify the source and destination versions or custodians, its authority, relevant transformation and known information loss. Unsupported finer distinctions shall not be invented during conversion.

R110-089 Before a transfer or migration, the responsible custodian shall identify the authorized source and destination, material and versions in scope, rights and restrictions to carry forward, transformation rules, expected losses, acceptance criteria, and responsibility if the operation fails.

R110-090 After a transfer or migration, the practice shall compare the resulting material against the declared acceptance criteria, including identity, attribution, versions, temporal distinctions, generative links, uncertainty, access restrictions, and known losses. A successful byte transfer shall not alone demonstrate preservation of meaning.

R110-091 An interrupted or unsuccessful custody operation shall retain a record of completed and incomplete steps, authoritative copies, protection status, recovery actions, and unresolved loss. The practice shall not claim that destination custody is complete before acceptance is evidenced.

9.4 Correction, restriction, and disposal

R110-028 An authorized correction, restriction, retention or disposal action shall have a scoped disposition and an accountable executor. The practice shall record permitted evidence of its result and known limitations without retaining prohibited content solely to prove deletion.

R110-092 An authorized restriction or disposal shall identify the affected content and derived views, permitted evidence of execution, known copies or dependents, and limits of control. The practice shall review public statements and assessment claims that relied on material no longer available, without retaining prohibited information merely to document the action.

10 Presentation and accessible examination

10.1 View identity and mediation

R110-029 A presentation supplied as part of the assessed practice shall identify its source package/version and disclose material selection, reconstruction, uncertainty, disagreement and restriction within the permitted audience. It shall distinguish an attributed claim, an assessment and an institutional determination.

R110-030 A public or reduced view shall not imply that it contains the entire retained package. A validation or provenance result shall state what was checked and shall not be presented as certification of substantive truth or normative legitimacy.

R110-093 Each supplied view shall identify its audience and purpose, source package and version, generation or preparation method, material selection and transformations, and update status. A cached or exported view shall not imply that it reflects later corrections without evidence of refresh.

R110-094 A view of a generative account shall distinguish the status of the asserted effect, the evidential basis for it, and the evaluation of its desirability. A visual edge, color, badge, or position shall not be the sole means of expressing a distinction necessary for interpretation.

R110-095 Navigation from a public or reduced view shall respect the access limits of linked evidence and metadata. Where a material link cannot be exposed, the view shall communicate the permitted limitation without suggesting that the source does not exist or that unrestricted inspection is available.

10.2 User tasks and support

R110-031 The practice shall provide enough accessible explanation for intended users to locate the grounds of a material claim and the relevant review route. A practical assessment shall record observed comprehension barriers and the alternatives or limitations offered.

R110-096 The practice shall assess whether intended users can identify a material claim and its source, distinguish assessment from institutional decision, find relevant uncertainty or alternatives, recognize revision and view limits, and locate the permitted challenge route. Assessment shall record tasks, users or representative role, observed barriers, assistance, and limits.

R110-097 Where a presentation fails a material intended task, the practice shall provide an accessible alternative, correct the presentation, narrow the supported use, or report an unresolved limitation. Successful file rendering or text extraction shall not be reported as demonstrated user comprehension.

11 Assessment and claims

11.1 Declaration and subject coverage

R110-032 A report shall identify the assessed subject, versions of this draft and its dependencies, purpose/profile, applicable requirements, assessor, method, evidence, results and unresolved limitations. Package-only results shall not be presented as assessment of unobserved practice.

R110-033 The report shall distinguish fulfilled, not fulfilled, not assessed and not applicable results for each requirement, with reasons for exclusions. A failed or unassessed applicable requirement shall prevent an unqualified claim that the declared scope satisfies this draft.

R110-034 The report shall distinguish structural or documentary checks from tests of understanding, evidential warrant and institutional performance. It shall not infer truth, complete historical recovery, beneficial generativity or legal validity from structural fulfillment.

R110-098 Before assessment, the assessor shall identify the package baseline, recording practice, purpose, period and environment, applicable requirements, incorporated GR-100 and GR-200 versions, protection limits, assessor competence and interests, and the methods in Annex B to be used. The declaration shall distinguish planned from completed assessment.

R110-099 An unqualified claim for the declared GR-110 scope shall require evidence for all applicable package and practice obligations, including the full applicable GR-200 package dependency. A successful documentary subset or absence of reported failures shall not establish that unobserved practice was performed.

R110-100 A package-only or otherwise partial assessment shall identify the exact assessed subset, methods and evidence, excluded practice claims, and dependency limitations. It shall not use an unqualified label suggesting that the complete recording practice or a reduced conformance profile was assessed.

11.2 Methods and result rules

R110-101 The assessor shall use requirement-level evidence and discriminating cases under Annex B. Where one identifier contains materially distinct obligations, component results shall be retained so that a fulfilled component does not conceal failure or non-assessment of another. A requirement shall be fulfilled only if every applicable component is fulfilled; any failed or unassessed applicable component shall prevent overall fulfillment of that requirement.

R110-102 Fulfillment shall require evidence of the stated obligation under its applicability condition. A missing required declaration shall be reported as not fulfilled; inability to examine whether a represented

action occurred shall be reported as not assessed unless adequate permitted evidence supports a result. Non-applicability shall identify the absent trigger.

R110-103 Where assessment uses sampling, the report shall identify the population, selection method, covered risks, excluded cases, and limits on extension of the findings. Cases selected only because they already appear complete shall not support a general claim about an unexamined practice.

R110-104 A dependency mismatch, unavailable required evidence, or unresolved interpretation affecting the result shall be recorded with the affected requirements and claim consequence. The assessor shall not substitute a newer dependency silently or count an unsupported exception as fulfillment.

11.3 Reassessment and change

R110-105 A material change to purpose, claim set, generative account, category, protection, custody, presentation, or dependency shall trigger review of affected assessment results. The new report shall identify what was reassessed, what remains supported by prior evidence, and what can no longer be claimed.

The assessment concerns the declared scope. It does not establish that the package contains every important historical fact or that every recorded interpretation is correct. A requirement to preserve uncertainty can be fulfilled while the underlying generative attribution remains contested.

Annex A

(normative)

Semantic information schedule

A.1 Application

R110-106 The recording practice shall provide the semantic information in Table A.1 when its stated trigger applies, by content in the package or a permitted reference to identified material. The schedule shall be implemented without treating its labels as mandatory serialization field names or ontology classes.

R110-107 For each scheduled information group, the package shall identify its applicable subject, version, source or responsible actor, temporal scope where relevant, access status, and relationship to the material claims it supports. Information shared across records may be referenced when the intended scope and target remain unambiguous.

A.2 Information groups

The table specifies semantic content rather than a database schema. An embedded document can supply several groups, but their meanings and responsible sources remain distinguishable.

Table A.1 – Semantic information and applicability

Group	Trigger and subject	Required meaning and relationships
Package context	Each package.	Identity/version; purpose and intended users; subject and boundary; horizon; inventory; selection and omissions; responsible practice; declared dependencies and assessment status.
Source and capture	Material incorporated or transformed.	Source and received form/version; acquisition or creation; capture method; production context; derivation; transformation and known loss; permitted use and verification limits.
Material claim	Reliance within the declared purpose.	Attributed assertion, target, scope and status; grounds, method, alternatives, uncertainty and revision through the applicable GR-200 package; link to the relied-on version.
Identity and time	Identity or timing material to interpretation.	Record/version identity separate from subject identity; continuity criterion and grounds; competing identification; occurrence, observation, capture and assessment times with supported resolution and uncertainty.
Generative account	A generative connection is represented.	Target; candidate configuration and contribution role; earlier or comparison condition; proposed link and grounds; scale/horizon; modality; alternative contributors; known unobserved links and limits.

Group	Trigger and subject	Required meaning and relationships
Return and recirculation	A return account is assessed or proposed; the four-stage detail applies when recirculation is asserted.	Concept, recipients, scope, evaluation and transfer or entitlement status; for recirculation, initial generation, conversion or transfer, return path, later-condition effect, and stage/link-specific modality, grounds and uncertainty under R110-112.
Carrier and branch	Delay, transmission, or branching is material.	Carrier or persisting condition and transformations; intervening influences; pathway opening, selection and stabilization where distinct; branch-specific evidence and uncertainty.
Alternative and possibility	Alternative or changed accessibility asserted.	Whose option; relevant period and conditions; contemporaneous, retrospective or modeled basis; feasibility grounds; changes in access, cost or viability; unexamined options and comparison limits.
Category or method change	A change alters interpretation.	Earlier/later formulations, author or authority, effective period, rationale, correspondence and loss; distinction among new knowledge, revised description and a changed situation.
Maintenance and loss	Material sustaining work or loss within scope.	Capacity or relation sustained/depleted; continuing conditions/work; affected subjects and horizon; kind and evidence of loss; permitted collection limits; evaluation separately attributed.
Practical uptake	Decision or action relies on represented material.	Relied-on version; receipt versus reliance; authority assertion; decision and reasons; intended versus implemented action; anticipated versus observed effects; feedback and disposition.
Revision and challenge	Correction, reinterpretation or request occurs.	Target and prior version; actor/time; reason; permitted request and reply; revised or maintained assessment; known dependents; notification/propagation limits; separate practical remedy.
Protection and custody	Each maintained package and controlled operation.	Purpose and authority basis; custodian; content/metadata/view controls; retention/review triggers; unavailable-information status; transfers, losses, disposal and permitted execution evidence.
View and assessment	A view or assessment is supplied.	Source baseline; audience and purpose; selection/mediation; limits and update status; assessor/method; applicable requirement and component results; dependency status; excluded claims.

A.3 Absence, uncertainty, and restrictions

R110-108 An absent scheduled element shall be distinguished as not applicable with a trigger-based reason, unknown, not collected, lost, destroyed, restricted, or otherwise unavailable only where that status is supported and permitted. An unavailable contextual factual value, including historical capture time or source-production context, may be represented by such a typed declaration identifying the responsible or attributing role, known reason, and effect on interpretation or assessment. Package and record references and versions, purpose and scope, accountable recording role, and relationship locators needed to identify asserted claims, contributions, assessments, and revisions shall not be replaced by unknown values. Required reasoning, criteria, and results of the package's own assessment shall remain explicit. Fulfillment of a contextual declaration obligation shall not establish the unavailable fact or fulfillment of an examination or action that could not be performed.

Annex B

(normative)

Requirement assessment schedule

B.1 Method and evidence register

R110-109 The assessor shall maintain a register for every applicable requirement, including R110-106 through R110-111, with subject/version, trigger, method, evidence locator, assessor and competence, component results, overall result, limitations, and needed action. The register shall use the discriminating assessment families in Table B.1 and identify any justified equivalent method.

Inspection examines the actual package and controlled records. A competent content review examines the grounds and distinctions asserted; it does not certify all historical truth. An observed task tests what the practice or user actually does under identified conditions. A lifecycle exercise uses authorized fixtures to assess access, revision, transfer, or disposal. Synthetic exercise results remain separate from evidence of live institutional action.

B.2 Assessment families

Table B.1 – Assessment families and discriminating outcomes

Requirements	Method and evidence	Outcome distinguishing fulfillment from failure
001–004, 035–041	Inspect scope, selection, inventory, accepted roles, resources, and maintenance record.	Boundary and omissions are explicit; no complete-history claim or automated substitute for missing responsibility.
042–045	Trace captured and derived material to its source and inspect transformations.	A summary and repeated copies remain distinguishable from the source and independent corroboration.
005, 046–047	Reconcile material-claim inventory with the complete applicable GR-200 package assessment.	Relied-on claims and package obligations are covered; isolated claim checks do not stand for the dependency.
006–009, 048–050	Compare disputed identity, an uncertain interval, and a historical category against their records.	Record identity, continuity judgment, time uncertainty and retrospective interpretation remain distinct.
010–012, 014, 051–056	Review a target and attributed contribution with an alternative explanation or unobserved link.	Occurrence, mechanism, association, counterfactual and model-based grounds retain their respective strength and limits.
057–060	Follow a delayed or multi-link account and examine a claimed persistence mechanism.	Uncertain carriers or downstream links remain uncertain; persistence alone does not establish lock-in.
013, 061–062	Examine collective/disputed attribution, branch contributions, and a separate credit or rights claim.	No forced sole attribution or automatic ownership/entitlement; branch formation and realization remain distinct.

Requirements	Method and evidence	Outcome distinguishing fulfillment from failure
015, 063–066	Compare a contemporaneous alternative and a retrospective proposal, including practical access.	Historical availability, imagination, permission and feasible access are not conflated.
016, 067–068	Reconstruct a change of category and an earlier account under its original information.	A revised description does not silently create a past object or erase the prior semantics.
017, 069–072	Review sustained capacity, record loss, and different effects across groups or horizons.	Maintenance remains visible; loss kinds and normative evaluations are separately grounded.
018, 073, 112	Inspect any return account and its measurement or entitlement basis. For a recirculation claim, remove evidence for its return path or later-capacity effect while leaving a transfer record.	Concept, transfer, evaluation and legal assertion remain distinct. An unsupported recirculation link remains unresolved; transfer alone does not demonstrate renewed capacity. Only the recirculation-specific obligation is inapplicable when no recirculation is asserted.
019, 074–081	Trace decision, implementation, intended effects, feedback and a corrective action.	Receipt is not reliance; implementation is not beneficial effect; record correction is not completed repair.
020–023, 082–083	Exercise the permitted challenge route and inspect linked revisions and requests.	Earlier grounds survive within retention limits; conflicting requests remain attributable; propagation claims have evidence.
024–026, 084–088	Inspect authority, purpose, permissions, protected views, retention and unavailable information.	Required distinctions remain interpretable without disclosing protected content or inventing an absence reason.
027–028, 089–092	Exercise an authorized migration or lifecycle action and compare source/destination meaning.	Loss, failed steps, access control, disposal evidence and uncontrolled copies are correctly reported.
029–031, 093–097	Perform stated reader tasks using the actual view and available assistance.	Users can locate grounds and challenge routes; untested comprehension and inaccessible features remain limitations.
032–034, 098–111	Inspect the scope, complete result register, dependencies, methods and change review.	Failed/unassessed obligations prevent an unqualified claim; package-only and synthetic evidence remain bounded.

B.3 Execution and result integrity

R110-110 An exercised assessment shall record initial conditions, input and output versions, relevant permissions, performed steps, expected discriminating outcome, observed result, interruptions, and limitations. A described fixture or expected outcome without execution shall be recorded as a planned test rather than observed fulfillment.

R110-111 The assessor shall state the requirement-level consequence of each material failed task, inconsistent record, unavailable evidence item, or unresolved dependency. A remedied result shall retain the earlier finding, corrective action, new evidence, and remaining limit; a favorable summary shall not conceal it.

Annex C

(informative)

Worked recording cases

C.1 Contested funding decision

This synthetic case concerns a public research fund that rejects an application after an AI-assisted summary treats missing calibration metadata as evidence that calibration did not occur. The community applicants later provide testimony and a restricted maintenance log. The package contains the initial claim and its grounds, the inference from missing information, the decision that relied on it, the challenge, authorized consideration of a supplied nonpersonal log excerpt, and the subsequent assessment. The described original log remains unavailable for examination in this fixture.

The revised factual assessment is distinct from the institution's decision whether to reconsider funding. A separate classification review examines whether the original scoring categories excluded relevant knowledge. The public view identifies permitted limits on the log without publishing protected content. A reader can distinguish the old judgment, current assessment, policy question, and pending practical response.

A documentary check can assess these distinctions in an authored package. Testing the practice additionally requires observing the contact route, authorized access, notifications, and reader tasks. The synthetic case does not establish that a real institution changed its decision or that interrupted research capacity was restored. The existing fixture is `examples/validation_0.2/p1-contested-decision.md`.

C.2 Maintenance, delay, and distributed contribution

A synthetic laboratory collaboration produces little new output during a year of instrument maintenance, training, and preserving shared access. A later discovery relies partly on those capacities. The account separates evidence that the maintenance occurred, its role in sustained capacity, the later discovery, and the attributed connection between them.

Training, functioning equipment, and retained procedures are possible carriers in the account. Their supported roles can differ, and the discovery can also depend on later collaborators or changed methods. No mandatory percentage allocation follows. An earlier contributor's loss of access remains visible even if the aggregate output increases. Recognition or compensation proposals require their own evaluative and institutional grounds.

C.3 An alternative that became visible later

An archive contains a proposal rejected under historical eligibility rules. Years later, a new category makes its significance easier to recognize. The reconstruction preserves the earlier categories and decision context, the later interpretive method, and evidence concerning options actually available at the earlier time.

The new account can be better supported without implying that the earlier actors possessed the later concept. An alternative technologically imaginable today is labelled retrospective unless period-specific evidence supports historical availability. A claim that the original choice caused lock-in needs evidence of changed transition conditions, such as accumulated dependencies or switching costs, rather than the persistence of the chosen arrangement alone.

C.4 Migration and loss of interpretation

A synthetic custodian exports a package into a format that preserves current claims but omits former versions and uncertainty in temporal ordering. The files transfer successfully. Assessment nevertheless identifies loss relevant to reconstruction and treats the destination as a reduced representation.

A repair can preserve the missing relationships in an accompanying dossier without requiring one prescribed schema. The migration record identifies the source, transformed representation, remaining loss, and accepted custody. If the earlier source cannot be retained under applicable permission, the package states the resulting limitation rather than implying lossless preservation.

Annex D

(informative)

Foundation interpretation and unresolved issues

D.1 Source-to-proposal relationship

FM-005 section 5.13, pp. 105–113, develops target-relative generative attribution through association, mechanism, counterfactual reasoning, multiple contribution, distributed organization, delay, branching, and emergence. R110-051–R110-062 translate this into attributable recording of a proposed connection and its limits. The standard does not turn every account into a warranted attribution merely because the required information is present.

FM-005 section 5.14, pp. 113–122, distinguishes relational continuity from chains of generative contribution and treats path dependence, genealogy, historical evidence, alternatives, and re-epistemization. R110-049–R110-050, R110-057–R110-060, and R110-063–R110-071 preserve those distinctions operationally. The term possibility-field account denotes a bounded representation; it does not redefine the broader theoretical possibility field.

FM-003 section 3.12, pp. 129–141, treats praxis through diagnosis, enabling and constraining conditions, intervention, downstream tracing, feedback, adaptation, withdrawal, reversal, and repair. R110-074–R110-081 record the corresponding distinctions where they occur within scope. The source's sequence is heuristic; this draft does not impose one intervention lifecycle on every archive or practice.

FM-005 section 5.17.3, p. 145, distinguishes uncertainties concerning initial generation, conversion or transfer, the return path, and effects on later generative conditions. R110-112 operationalizes these distinctions only when a recirculation claim is made. It does not define every generativity-return account as recirculation or establish a distributional entitlement. A planned transfer to a maintenance team can be recorded as proposed while both delivery and any later effect remain unassessed.

D.2 Open conceptual and implementation questions

OPEN ISSUE The programme has not established a universal measure of generativity or generativity return, a mandatory causal-identification method, or exhaustive minimum historical coverage. Purpose-specific burden and usefulness require pilot evidence.

OPEN ISSUE The relation of Property to the metamodel manuscript's Attribute and the chronology of the two Chapter 3 files remain unresolved. This draft retains operational terminology without claiming that the variants are identical or that one supersedes the other.

OPEN ISSUE No common serialization, permanent identifier service, certification scheme, or full presentation/access profile is selected here. Reusable implementation needs enter separate Specification work items; limited assessment does not acquire full conformance by naming a future profile.

OPEN ISSUE The required evidence for effective practical repair, independent implementation, and sustained human comprehension remains use-context dependent. An initial synthetic exercise can expose missing procedures but cannot demonstrate those outcomes generally.

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[3] FM-005. *Epistemology of Generative Relational Economics*, sections 5.13–5.14, pp. 105–122, directly examined for this edition. `foundation_manuscripts/GRE_Chapter_05_Complete_First_Draft.pdf`. Its formulations of attribution, contribution roles, carriers, trajectories, historical evidence, and re-epistemization inform the scoped operational proposals.

[4] FM-003. *Constitution and Research Programme of Generative Relational Economics*, section 3.12, pp. 129–141, directly examined for this edition. `foundation_manuscripts/GRE_Chapter_03.pdf`. FM-002 is the separately retained complete-first-draft variant; precedence is not inferred.

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GENERATIVITY STANDARDS PROGRAM

GR-200

Standards-track Working Draft

Version 0.3 2026-09-22

Epistemic Recording Framework

WORKING DRAFT FOR REVIEW

This document contains proposed provisions for technical and institutional review. It is not an adopted Standard or an operative governance instrument. Its scope, application conditions and publication status are specified in the text.

Prepared by the Generativity Standards Program. Reference to external publications does not imply endorsement by ISO, IEC, IEEE or any United Nations body.

Foreword

Version 0.3 records the bounded substantive review of the archived 0.2 package. Its requirement text is retained in this coordinated edition; updated references identify the companion 0.3 drafts. The review matrix, synthetic assessments and unresolved readiness questions are documented in `docs/reviews/validation_0.2/README.md`. These activities do not constitute adoption or an independent institutional assessment.

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This document is a standards-track Working Draft of the Generativity Standards Program. Its maturity is **PREPARATORY; PROVISIONAL**. It contains proposed requirements for review and experimental assessment, not an adopted Standard, a formally initiated project or an institutional or legal authorization. Governance adoption, editor appointment, work-item approval, review and final publication require separate recorded decisions.

Edition 0.2 develops the initial framework into a fuller requirements document. Existing identifiers E200-001 to E200-026 retain their meanings; additional requirements specify claim structure, evidential context, uncertainty, revision, mediated use and assessment. Annexes A and B are normative within the proposed draft. The remaining annexes and bibliography are informative. Historical edition 0.1 is preserved rather than rewritten.

The publication follows a structured requirements format with scope, dated references, numbered terms, operational requirements, conformance and annexes. It does not claim ISO, IEEE, ITU or United Nations approval or affiliation. Conceptual sources inform the distinctions; resemblance of publication structure does not establish conformance with another body's development procedure.

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Introduction

A representation can be authentic while its substantive content is mistaken. A classification can be applied consistently while failing to represent the situation relevant to a decision. A corrected record can improve current knowledge while leaving practical consequences of the earlier judgment unresolved. These are different problems, and a single verified-fact status cannot preserve their differences.

This document addresses the recording conditions for examining such problems. The epistemic record package links assertions, attributed sources, observations and reasoning, material, evidence roles, assessments, uncertainty, challenges and revisions. It supports inquiry into actual, possible, hypothetical and disputed targets without assigning all of them the same epistemic status. It records grounds for an assessment without prescribing one universal method of reaching substantive truth.

The programme's wider purpose concerns generativity: how relations and activity create, maintain, transform or restrict subsequent conditions and possibilities. The existence of a relation and an outcome does not establish the contribution linking them. Similarly, institutional uptake does not establish evidential warrant, and the ability to record a challenge does not establish effective access to review. Requirements for representation and requirements for institutional practice therefore remain connected but distinct.

The framework is deliberately independent of serialization. A small narrative dossier can distinguish claim versions and evidential roles through stable local references. A larger implementation can use structured objects or qualified statements. Choosing an encoding does not justify erasing an alternative, merging an unresolved identity or hiding an assumption. Specifications are developed when reusable implementation needs emerge from these requirements.

1 Scope

1.1 General

This draft defines the minimum information needed to examine who asserts what about a target, through which observations and reasoning, on which material, within what scope, with what uncertainty, and with what history of assessment and revision. Its organizing problem is the separation of a convincing or authentic representation from a warranted account of the represented situation.

The requirements concern a declared *epistemic record package*, which can include records, claim references, source locators, assessments, and protected components. The package can be textual, tabular, or implemented in software. This draft does not choose between claims as separate objects, attributed assertions within records, or a hybrid. A claim reference can be a local label and locator; it need not be a globally registered identifier.

GR-100 version 0.3 supplies the draft vocabulary. GR-110 adds requirements for generative trajectories and practical consequences. GR-210 is intended to govern the practice of assessment, challenge, and disposition. This document records those activities when present; it does not substitute a complete adjudication process, guarantee an appeal right, or set an evidential sufficiency threshold for every domain. GR-160 and GR-400 are intended to elaborate protection and institutional use. None of these drafts creates jurisdiction, a legal duty, or factual certainty.

2 Normative references

2.1 Dated draft reference

The following referenced document supplies this edition's operational meanings: Generativity Standards Program, *GR-100 — Foundations and Vocabulary*, Standards-track Working Draft, version 0.3, available at `standards/GR-100-foundations-vocabulary/GR-100.tex`. The incorporated scope is Clause 3's terms, Clause 5's record-role meanings when used, and the result-category meanings in 8.3. This reference does not impose a separate claim of GR-100 vocabulary-application conformity. It is a dated draft dependency, not an adopted Standard. If an incorporated meaning is unavailable or incompatible, the affected assessment is not assessed until the dependency is resolved. A later GR-100 edition does not silently change the meanings used here.

2.2 Other publications

There are no external normative references. GR-110 and GR-210 identify coordinated recording and procedural work, but their requirements are not imported into GR-200. A report claiming conformity to more than one publication identifies and assesses each dependency separately. Foundation manuscripts and external drafting models in the bibliography are informative.

3 Terms and definitions

3.1 General

The terms in GR-100 Working Draft 0.3 apply. The following terms specify their use for this document. These information structures are semantic recording units; they do not introduce new metaphysical classes or determine whether an implementation uses objects, wrappers or attributed statements.

3.2 Epistemic record package

An identified and versioned collection of claim content and linked context assembled for a declared inquiry, practical use and collection boundary, with an inventory or selection rule, responsible role and access scope.

3.3 Included claim

A claim designated as part of the assessed package, rather than merely occurring within an external source cited by it.

NOTE 1 Assertions attributed to another source remain assertions to be examined, not endorsements by the package owner.

3.4 Material information

Information capable of changing a reasonable examination of the declared claim, its warrant or its consequential use.

NOTE 2 Materiality is relative to the declared purpose; its selection rationale is inspectable and does not establish truth.

3.5 Claim reference

A designation that distinguishes an assertion and its version within the package.

NOTE 3 It supports links to evidence and assessment without itself establishing target identity or prescribing a globally registered identifier.

3.6 Material item

An identified source, portion, pattern or result proposed for use in an inquiry.

NOTE 4 It can be a trace, testimony, observation, record, comparison or intervention result. Its inclusion does not establish an accepted evidential role.

3.7 Evidence-role assignment

An attributed relationship between identified material and a specified claim, together with an assessment of relevance, limitations and alternatives.

NOTE 5 Supporting, challenging, qualifying and non-discriminating roles concern that relationship rather than an intrinsic status of the material.

3.8 Assessment record

An identified account of a question examined, the criteria and material used, the responsible assessor, timing, result, uncertainty and limitations.

NOTE 6 An assessment record can itself become a target of a later claim or challenge.

3.9 Dependency

A stated relationship through which a claim, assessment, representation or action relies on another identified item or version.

NOTE 7 Derivation, inferential reliance, shared-source dependence and practical uptake have different meanings and are identified separately where material.

3.10 Coverage statement

An account of the scope within which observation, collection, source examination or assessment was performed, including known omissions and exclusions.

NOTE 8 Coverage does not necessarily coincide with the scope of a substantive target claim.

3.11 Negative-evidence claim

A claim whose grounds include nonappearance of an expected trace.

NOTE 9 Its warrant depends on stated production, detection, coverage and preservation conditions; a missing value alone does not establish non-occurrence.

3.12 Transformation record

An account of a material change between a source representation and a resulting representation, identifying the input, output, operation, responsible role and known preservation or loss of meaning.

3.13 Released view

A representation selected from a package for a specified audience and purpose under stated access and disclosure conditions.

NOTE 10 Its completeness and inspectability are assessed against its declared boundary, not assumed from its source package.

3.14 Epistemic context

The attributed observations, methods, assumptions, evidential roles, uncertainty, perspective and temporal and descriptive scope required to interpret a claim.

NOTE 11 Shared context can apply to several claims when the inheritance and any exceptions are explicit.

4 Package declaration and recording boundary

4.1 General

The conformance subject is one named, versioned epistemic record package within a declared purpose, collection boundary, and access scope. Requirements apply to its included claims and assessments, with conditional requirements triggered by the relevant activity. An external source is not required to satisfy these rules merely because it is cited; the package's assertions about it and uses of it are within scope.

E200-001 The package shall declare its reference and version, responsible recording role, intended use, target and collection boundary, included claim set or selection rule, access scope, relevant descriptive regime, and the GR-200 draft version used. It shall identify exclusions and limits that materially affect interpretation.

E200-002 The package shall associate every requirement with an assessment result and an evidence locator. A claim of conformity to this draft shall identify its package boundary and applicable requirement set, and shall disclose failures, unassessed requirements, and restrictions that prevent assessment. It shall

not represent technical or recording conformity as proof of factual truth, evidential sufficiency, ethical acceptability, or legal validity.

An assessment result is fulfilled, not fulfilled, not assessed or not applicable with a reason. Only requirements whose stated trigger is absent can be marked not applicable. A package with failures or unassessed applicable requirements can report partial assessment, but not full conformity. This draft has no certification or accreditation scheme.

"Material" in this document means capable of changing a reasonable examination of the declared claim, its warrant, or its consequential use. The package's selection rule states how materiality was judged. Unknown, not collected, withheld, lost, and inapplicable can be explicit informational states where a value is unavailable. They disclose a limitation rather than establish the unavailable value or a substantive negative conclusion.

4.2 Semantic units and shared context

E200-027 The package shall provide the applicable information in Annex A for its declaration, included claims, material items, evidence-role assignments and assessments. Information supplied through shared context shall have an identifiable scope and version, with claim-specific exceptions explicit. A reference shall resolve within the declared assessment arrangement or carry an availability limitation.

These units need not be separate software objects. A table row can contain a claim and refer to shared acquisition context; a narrative passage can identify an assessment and its sources. E200-027 requires an inspectable association without reliance on undocumented assumptions. Reusing one context statement is acceptable when it actually applies to the linked claims. A package-wide uncertainty statement cannot conceal a material difference between a direct observation and a distant reconstruction.

External sources do not enter the assessed claim set merely because every sentence in them is quoted or stored. The package distinguishes the source material, the claim that the source contains a statement and any adopted substantive assertion. The resulting collection boundary is finite and declared. It is not a requirement to reproduce or assess every upstream publication, every possible objection or the entire history of an institution.

An assessment of this document can be recorded in a linked report outside the substantive claim set under examination. The report identifies the exact subject package and edition. Its statements about conformity do not automatically become evidence for the package's substantive claims.

5 Claim content, attribution and method

5.1 Claim identity and content

E200-003 Each included claim shall have a reference that distinguishes its content and version within the package, stated assertion content, an identifiable target or an explicit unresolved target description, and a link to its recording context. Different assertions or versions shall remain separately referenceable where their attribution, grounds, or disposition differ.

5.2 Attribution

E200-004 Each claim shall identify its represented originating actor or source and the role responsible for entering it into the package. Where these differ, the attribution chain shall distinguish origin from transcription, quotation, translation, summary, or adoption. Unknown, pseudonymous, restricted, or disputed attribution shall be explicit.

5.3 Modes and modality

E200-005 Each claim shall state its epistemic mode and relevant perspective: for example observation report, testimony, inference, interpretation, retrospective reconstruction, hypothesis, simulation, or normative or institutional judgment. Combined modes shall identify the distinct contributions rather than present inferred content as directly observed. A claim about an occurrence or possibility shall distinguish its asserted actuality or modality from its epistemic basis; retrospective inference can concern an actual occurrence.

5.4 Method and reasoning

E200-006 Each claim shall identify its acquisition or reasoning method, material premises and assumptions, relevant method version when one is used, and known transformations from source material to assertion. Where this information is unavailable, the package shall state the limit and shall not claim reproducibility or direct observation on that basis.

5.5 Boundary and scale

E200-007 Each claim shall state the boundary, scale or level of aggregation, contextual conditions, and temporal horizon relevant to its interpretation. It shall identify known omissions or selection conditions that materially limit generalization. A narrowed scope shall not be silently presented as a claim about a broader target.

5.6 Temporal scope

E200-008 Each claim shall distinguish target time from the times of observation or source acquisition, recording, and assessment where applicable. Time values shall carry their applicable meaning and known uncertainty or resolution. Unknown order shall remain distinguishable from asserted simultaneity and from recording order.

5.7 Target identity

E200-009 A claim that reidentifies a target across appearances shall identify the identity criterion, the appearances linked, the responsible attribution, and the evidential basis or stipulation. A proposed split, merger, succession, or disputed match shall not silently merge record identity, target identity, and lineage.

NOTE 1 A testimony can be preserved without claiming its reporter is infallible. Requiring attribution does not require public disclosure of a protected person's name. A role or pseudonymous reference, its protection status, and an accountable custody arrangement can provide the appropriate recording context.

5.8 Compound claims and qualifiers

E200-028 Where one expression contains assertions with materially different targets, attribution, temporal scope, modality or evidential grounds, the package shall distinguish the components and their qualifications sufficiently for separate assessment and revision. A conjunction or summary shall not silently transfer warrant from one component to another.

The expression "the meeting occurred and secured lasting cooperation" contains an occurrence claim and a claim about a later relational effect. Evidence for attendance might support the first while leaving the second unresolved. The components can remain in one document if their references and qualifications are distinguishable. The requirement does not demand logical atomization of every sentence; it applies where shared wording would otherwise conceal a material difference.

5.9 Relayed speech, quotation and translation

E200-029 Where a claim is quoted, translated, paraphrased or relayed, the package shall distinguish the attributed source expression from the recorder's rendition or interpretation, identify the available source context and material transformations, and state uncertainty about attribution or meaning. A quotation's presence shall not be treated as endorsement by its recorder.

A testimony can identify an experience available to a situated participant while leaving causes or other participants' intentions unresolved. A summary can be accurate for one question while omitting qualifications needed for another. Selection, transcription, translation and interpretation can each affect the path from source to assertion. The package records the relevant path instead of claiming that the reported wording is an unmediated view of the target.

5.10 Observation and acquisition context

E200-030 For an observation or measurement claim, the package shall identify the observer or acquisition system, observed feature, method, relevant instrument or procedure version, observation window and conditions materially affecting recognition, detection or recording. Known limitations in coverage, resolution or calibration shall be stated where relevant to the claim.

This requirement is proportional to the claim. A report that an inscription was seen can cite the observer and inspection context without manufacturing a quantitative measurement protocol. A measurement claim can require units, resolution and an instrument procedure. The package does not imply that a larger dataset removes selection effects or that an automated observation lacks an observer position.

5.11 Inference and reconstruction

E200-031 For a material inference or reconstruction, the package shall distinguish its asserted premises, adopted assumptions, inferential steps needed to examine the conclusion and material unresolved alternatives. An assumed premise shall not be represented as an observed input, and a mathematically possible history shall not be presented as an evidenced occurrence sequence without additional grounds.

An inference can be qualitative, historical, comparative, statistical, computational or mixed. The requirement is an inspectable connection between premises and conclusion, not a universal proof calculus. A researcher can identify a plausible contribution while remaining unable to establish causal sufficiency. A formal model can show consistency under its assumptions without establishing that its stipulated subjects and operations describe the actual case.

6 Material, evidence and uncertainty

6.1 Material identification

E200-010 For each material item invoked in support of, against, or to qualify a claim, the package shall identify the item or pattern, its relevant portion, source or acquisition path, and availability status. It shall distinguish original material, copies, derived representations, and generated material where those differences affect the claimed use.

6.2 Claim-relative evidential roles

E200-011 Each assigned evidential role shall link the material to a specified claim and identify the assessor or attributing source, assessment time, role, and rationale addressing relevance, reliability limitations, and material alternative explanations. An item with no assessment shall be marked unassessed rather than silently represented as accepted support.

The role can be supportive, challenging, qualifying, non-discriminating, or another defined relationship. A single item can support one claim and challenge another. The package need not impose a ranking across all evidence forms.

6.3 Dependence and corroboration

E200-012 Where multiple items are used together as evidence, the assessment shall identify known material derivation or dependence among them and the basis for any asserted independence. Repeated copies, summaries, or citations of one source shall not be presented as independent corroboration solely by their count.

6.4 Absence and non-occurrence

E200-013 A claim of absence or non-occurrence inferred from missing observations or records shall identify the expected observation or recording opportunity, coverage, detection or preservation limitations, and reasoning from the missing material to the claim. If those conditions are not established, the package shall preserve the weaker missingness statement and shall not treat it as established non-occurrence.

6.5 Uncertainty

E200-014 Each claim assessment shall describe material uncertainty and its location, including relevant alternatives, assumptions, identification limits, measurement limits, temporal gaps, or boundary and model limitations. A numerical confidence quantity, if used, shall state what it measures, its method and assumptions, and the scope of its interpretation.

6.6 Competing explanations

E200-015 The package shall record material competing claims or explanations known within its declared collection boundary, their attribution, their relationship to the target claim, and any recorded grounds for excluding or preferring them. If alternatives were not examined, this limitation shall be explicit; silence shall not be presented as evidence that no alternative exists.

An alternative need not receive equal evidential weight merely because it is recorded. Recording a disagreement does not mean that it remains unresolved after a reasoned assessment. The disposition and its grounds remain visible, and an attributed rejected interpretation can remain historically consequential.

6.7 Formation, selection and survival of material

E200-032 Where the production, selection, custody or survival of material affects an assigned evidential role, the assessment shall record the relevant known conditions and gaps, including selective preservation or inaccessible channels. A hypothesis of concealment shall have stated grounds and shall not be inferred solely from missing evidence.

An archive contains what was produced, captured, retained, made accessible and recognized as relevant. Failure at any stage can alter the evidential field. A missing complaint has different implications when a reporting route was usable, when it was dangerous to use, or when submissions were not retained. The package records what is known about those conditions rather than assigning one universal evidential weight to silence.

6.8 Transformation and derived material

E200-033 A material transformation relied on in an assessment shall identify its source and output versions, operation, responsible role and known effects on meaning or inspectability. Extraction, redaction, normalization, deduplication, imputation and generation shall remain distinguishable where their differences affect the claim. Supplied or inferred values shall not be represented as original observations.

A copy can preserve substantive content while changing its custody context. A redaction can protect a person while removing context important to interpretation. A transcript can make a recording searchable while introducing uncertain wording. None of these operations is inherently disqualifying. Their role and limits need to be visible to the assessment that relies on them.

6.9 Combination, aggregation and independence

E200-034 Where a claim relies on combined or aggregated material, the assessment shall state the included units, inclusion and exclusion rules, relevant denominators or weights, and known changes of composition. A claim about independent corroboration, stable population or comparable periods shall identify its basis rather than follow solely from a count, common label or shared format.

Several individually weak traces can jointly constrain a claim when their production paths differ in relevant ways. The opposite is also possible: many records can reproduce the same source, coding rule or institutional selection effect. Neither volume nor diversity of file formats establishes independent evidential pathways. Known dependence remains visible even when its precise quantitative effect cannot be estimated.

6.10 Comparability of uncertainty statements

E200-035 A comparison, aggregation or transfer of confidence quantities or qualitative grades shall state the meanings, assessed claims, scopes, methods and assumptions that support comparability. Incomparable dimensions shall not be silently combined into a universal score. Strong warrant in one dimension shall not erase a material unresolved limitation in another.

Confidence in an occurrence can exceed confidence in a causal attribution or long-term consequence. A numeric model score can concern a prediction conditional on its training and observation regime, while an assessor's confidence concerns a broader institutional claim. Shared numerical range does not establish shared meaning. A package can retain dimensional qualitative assessments without inventing probabilities or forcing all disagreements onto one scale.

6.11 Alternatives and limits of examination

E200-036 The assessment shall distinguish an alternative examined and rejected with grounds, an alternative retained as plausible, and an alternative not examined. Where a conclusion depends materially on boundary, scale, population, method or descriptive-regime choice, the assessment shall identify that dependence and any comparison actually performed. An unperformed sensitivity or alternative analysis shall not be described as completed.

Alternatives can compete for the same explanatory role or concern different parts of a composite process. A rule, network and resource condition can each contribute without being interchangeable explanations. Recording them does not require equal weighting or an exhaustive catalogue. It requires the package to disclose the comparison it actually makes and where a claim exceeds that comparison.

7 Assessment, revision and practical use

7.1 Assessment questions and criteria

E200-016 Each assessment or determination shall identify its question, responsible assessor or decision role, criteria, material examined, result, date, limitations, and relationship to the assessed claim versions. Provenance/authenticity, factual warrant, institutional acceptance, normative evaluation, legal determination, and technical validation shall remain distinguishable assessment functions.

7.2 Substantive revision

E200-017 A substantive revision shall link the prior and revised claim or assessment versions and record who revised it, when, why, and which content or scope changed. The reasons shall distinguish target change, evidence or assessment change, and descriptive-regime change, allowing combined reasons. Historical access shall preserve earlier meaning to the declared retention and protection extent; any unavailable earlier content shall have an explicit reconstruction limitation.

7.3 Descriptive-regime change

E200-018 A change of descriptive regime shall identify the prior and new definitions or methods, grounds for change, affected claim set, and any mapping or transformation used. It shall identify known non-comparability, lost distinctions, or unresolvable mappings; finer classifications shall not be reconstructed from insufficient earlier material as if evidenced.

7.4 Dependent records and actions

E200-019 For a revised claim with known dependent assessments, claims, or consequential uses within the package boundary, the package shall identify those dependencies and record whether each was reviewed, updated, left unchanged with reason, or remains pending or unreachable. It shall not claim that external recipients or institutions have corrected their actions without evidence of that correction.

7.5 Practical uptake

E200-020 Where the package records practical uptake of a claim, it shall distinguish the claim, its assessment, the institutional or other action, the actor responsible, and the asserted basis for acting. Recorded consequences and proposed remedies shall remain separately attributable from the original grounds and intended effects.

7.6 Challenge and disposition records

E200-021 For a challenge received within the package's declared collection boundary, the package shall record the challenged claim version, challenger or protected source reference, grounds and submitted material, receipt context, and current status. A disposition shall record the responsible role, response, reasons, date, unresolved disagreement, and resulting changes or the reason for no change. A challenge without disposition shall remain visibly pending or otherwise explicitly unresolved.

This clause addresses the record of a challenge. Routes for submission, notification, review independence, timeliness, appeal and remedy are procedural matters addressed in the coordinated GR-210 draft and relevant institutional profiles. Their effectiveness requires separate assessment. Merely supplying challenge fields does not demonstrate that a person can effectively contest a decision.

7.7 Criteria, status and temporal validity of an assessment

E200-037 An assessment shall identify the version and scope of its criteria and distinguish the date of examination, the evidential state examined and any stated period or condition of applicability. A later change of criteria or available evidence shall not silently change the recorded meaning of an earlier result.

Supported, rejected, qualified, unresolved and not examined have different meanings when applied to a claim. A procedural status such as closed concerns the case process rather than the claim's truth. An institution's acceptance can authorize an internal action while the underlying evidential assessment remains qualified. The package records these distinctions instead of using one status field as a substitute for them.

7.8 Version identity and concurrent interpretation

E200-038 Where more than one revision or interpretation of the same earlier item is retained, the package shall identify their predecessor relationships, responsible sources and whether a preferred current version has been designated within a stated scope. It shall preserve material unresolved branches and shall not treat latest recording time alone as evidential precedence.

Version history can branch. Two reviewers can correct different parts of a description, or disagree about the interpretation of the same material. A later administrative designation can select one version for use without establishing that every competing claim has been factually disproved. The designation, its authority and its grounds remain separately identifiable.

An editorial correction that preserves meaning can be recorded as such. A changed target, evidential ground, qualification, criterion or scope requires the substantive revision context of E200-017. Replacing an artifact for formatting does not automatically create a new historical occurrence or erase the earlier asserted content.

7.9 Intervention and reflexive effects

E200-039 Where intervention, publication, observation or classification is claimed to have changed the target situation, the package shall distinguish pre-change observations, the intervention or uptake, subsequent observations and the claim connecting them. An improvement in observation shall not automatically be represented as creation of a new relation, and an intervention-produced change shall not automatically be used as evidence of the earlier unchanged situation.

Discovery and creation can coexist. A new reporting route can reveal previously unrecorded practice and alter that practice by making it visible. A revised eligibility category can change both available distinctions and subsequent access. The package can record combined reasons while preserving their different temporal and evidential bases. It does not require a counterfactual causal experiment where none exists; it records the stated method and limits of attribution.

8 Mediation, protection and layered assertions

8.1 Computational mediation

E200-022 Where computational mediation materially affects a claim's observation, classification, inference, reconstruction, or presentation, the package shall identify the system and available version, its task, supplied source material or its controlled reference, material transformations, output used, and the role responsible for uptake or review. Unavailable system details and resulting limits shall be stated. Generated output shall remain distinguishable from independent source evidence.

This requirement includes rules, statistical models, sensor processing, database transformations, and generative systems when material to the claim. It does not require exhaustive logs of unrelated operations

or disclosure of private credentials. A vendor confidence score does not automatically measure the warranted confidence in the package's substantive claim.

8.2 Protected material

E200-023 Where claim context or evidential material is restricted, the package shall identify the restriction and its asserted basis, responsible custodian or accountable role, assessment consequence, and any available route for authorized examination or challenge. A released view shall identify material omissions at a level permitted by the declared protection arrangement and shall not describe unavailable evidence as independently examined.

If even acknowledging an item is restricted, the released view can describe its assessed scope without exposing item-level existence. The protected package still needs an accountable restriction record. This clause supplies neither permission to disclose nor a legal retention rule. Where a reviewer cannot assess a required component, E200-002 requires an unassessed result; a protection reason does not turn missing verification into a pass.

8.3 Normative and ethical assertions

E200-024 A normative or ethical assertion shall identify the evaluative question, attributed evaluator, stated criteria or values, affected parties and scope, and material acknowledged tradeoffs or disagreements. It shall remain distinguishable from the descriptive claims on which it relies and shall not treat a claimed generative effect as inherently desirable.

8.4 Legal and jurisprudential assertions

E200-025 A legal or jurisprudential assertion shall identify the asserted legal concept, source or rule relied upon, relevant institutional or jurisdictional context, attributed authority, temporal applicability, and procedural status, or explicitly state which are unresolved. It shall distinguish a descriptive legal analysis, party allegation, institutional determination, model rule, and policy proposal where applicable. Recording the assertion shall not be represented as creating or confirming its legal effect.

8.5 Selected and transformed packages

E200-026 When a package is selected, summarized, exported, or transformed and the resulting package is claimed to conform to this draft, it shall preserve the attribution, claim-version relationships, epistemic qualifications, material disagreement, and access/reconstruction limits required within the resulting declared boundary. Omitted or transformed content and the resulting limits shall be identified; a partial view shall not imply completeness of the source package.

This is an implementation-neutral requirement on the resulting package. Format negotiation, transport, identifiers, validation vocabulary, and machine-readable exchange behavior belong in Specifications prompted by the demonstrated need.

8.6 Computational observation and inferred completion

E200-040 Where computational processing affects evidential coverage, identity, category assignment or missing values, the package shall identify the relevant selection, linkage, classification and completion operations and their known limitations. A generated or imputed relation shall not be presented as an independently observed relation solely because it appears in a structured output.

The term machine-mediated includes a rule-based pipeline or database transformation as well as a learned model. A system can record extensive interactions while excluding people or activities outside its infras-

tructure. A link-prediction result can be a useful candidate for inquiry while remaining an inference. An embedding similarity is not itself evidence that two people collaborated or that two records concern one target.

8.7 Reproduction and availability claims

E200-041 A claim that a material computational result is reproducible or independently reviewable shall identify the available inputs, system or method version, relevant configuration and output, and the procedure supporting that claim. Unavailable internals, changing services, inaccessible data or nondeterministic behavior shall be disclosed where they limit the asserted reproduction or examination.

This requirement does not demand secret credentials, unrelated conversation logs or an invented explanation of a model's internal reasoning. It requires a truthful account of what can be inspected and repeated. A person can review a generated summary against its cited documents without reconstructing every internal operation, but that limited review is described as such. Reproducing the same output does not by itself establish its factual warrant.

8.8 Protected context and accountability

E200-042 Where protected references or substitutes are used, the package shall state the examination they permit, the accountable custody or review role, and their known limits for source identification, context and challenge. A custodian's assurance, an assessor's direct examination and an unavailable source shall remain distinguishable.

Restricted evidence can be handled through an authorized reviewer, an excerpt or a statement of examined scope. Those arrangements can support different questions. A public summary cannot claim full independent inspectability when its readers cannot examine a decisive source. The protected package need not reveal a source's identity to every audience; the restriction and the resulting assessment limitation remain accountable within the authorized arrangement.

8.9 Loss of access and historical reconstruction

E200-043 Where deletion, restriction, loss or a failed reference materially affects later examination of a retained claim, the package shall record the known change, its scope, responsible role or explicit unknown, and the resulting assessment or reconstruction limit. Evidence of a permitted disposal action shall not retain prohibited content solely to prove its removal.

Historical assessment and present inspectability can diverge. An assessor might have examined a source that is no longer available to a later reader. The historical result can remain recorded with the evidence then cited, while the later reader's ability to reassess it is limited. Neither automatic erasure of the earlier examination nor an unsupported assertion of continuing inspectability follows.

8.10 Evaluative scope and policy proposals

E200-044 Where an ethical or policy assessment compares effects across people, groups or periods, it shall identify the compared effects, evaluative criteria, aggregation or tradeoff method if any, and material effects left outside the comparison. A recommendatory institutional or policy proposal shall remain distinguishable from an adopted requirement, an authorized decision and a descriptive finding.

The same intervention can expand one group's capacity while reducing another's access to review. An assessment can favor the intervention under stated values while preserving the adversely affected group's account. Describing a generative effect does not settle its normative sign. A proposal addressed to an international organization also requires a stated intended institution and mandate context when those affect its recommendation; technical recording conformity does not confer that mandate.

9 Conformance

9.1 General

The conformance subject is one declared epistemic record package at a fixed edition, purpose and boundary. This document specifies recording requirements, not proof that every described activity occurred or that an institution's procedure was fair. A package can faithfully record an unsupported or rejected claim when its attribution, status and grounds are clear. Whether a substantive inference is warranted remains an assessment question with its own scope.

9.2 Applicable requirements and information schedules

E200-045 A conformity assessment shall use the semantic schedules in Annex A and the checks in Annex B, documenting the applicable requirements, evidence, assessor, date, result and limitations. Each requirement shall receive a result; an omitted field or unavailable source shall not be treated as an absent trigger for a requirement whose subject is present.

E200-049 Where one requirement groups obligations whose results can differ materially, the assessment shall record the result and evidence for each such component. The requirement shall be fulfilled only if every applicable component is fulfilled. A failed or unassessed component shall remain visible in the requirement-level and overall package result.

General package requirements apply to every assessed package. Claim requirements apply to every included claim. Requirements concerning measurements, legal assertions, machine mediation, transformations, restrictions, revisions or practical uptake apply when those features occur within scope. A package without a legal assertion can mark E200-025 not applicable. A legal allegation lacking a known jurisdiction instead invokes that requirement and records the jurisdiction as unresolved.

9.3 Extent of examination

E200-046 The assessment shall state the extent of examination, including any sampling, inaccessible components and checks performed only automatically. A sampled or partial assessment shall not be represented as exhaustive examination of the package. An unqualified conformity claim shall require a supported fulfilled result for every applicable requirement throughout the declared subject.

Automatic checks can verify presence, reference integrity or structural combinations. They cannot alone establish appropriate inference, meaningful scope, adequacy of an explanation or the source of institutional authority. A larger assessment can use justified sampling to discover defects, but its report remains explicit about the claim that the sample supports. Narrowing the subject to examined cases does not justify describing the result as institutional assurance.

9.4 Result categories and reassessment

The result categories are fulfilled, not fulfilled, not assessed and not applicable with a reason. They have the meanings stated in GR-100, 8.3. A blocked review receives a limitation and an unassessed result; an authorized restriction is not itself evidence of fulfillment of an unexamined requirement.

E200-047 A change to an assessed package, its claimed scope or an applicable dated dependency shall identify the prior assessment, affected requirements and evidence, and any reassessment performed or pending. Previous results shall not silently transfer to materially changed claims, methods, access conditions or transformations.

A report identifies whether it concerns the retained protected package, a released view or both. A view can receive its own bounded assessment if it preserves the requirements applicable to that view and does not

imply access to withheld material. Where a required component cannot be examined, its result remains not assessed. No certification, accreditation or legal evidentiary status is created by these categories.

Annex A

(normative)

Semantic information schedules

A.1 General

This annex specifies the semantic information required by E200-027. It does not prescribe a serialization, field name, datatype or new ontology class. Information can be directly recorded or supplied by a stable contextual reference whose meaning and applicable edition are inspectable. E200-048 distinguishes mandatory structural information from unavailable contextual factual values and identifies the assessment consequence of the latter.

E200-048 The package shall supply its reference and version, declared purpose and boundary, included claim references and content, target designations, accountable recording role, and relationship locators needed to identify each asserted evidence role, assessment or revision. These structural components shall not be replaced by an unknown value. A required contextual factual value that is unavailable may be represented by a typed unknown, uncollected, lost, disputed or restricted declaration identifying the responsible or attributing role, known reason and assessment limit. Such a declaration shall not establish the unavailable fact, replace required reasoning or criteria for the package's own assessment, or produce a fulfilled result for an examination that could not be performed.

An unresolved target designation states what the claim concerns or the identification question under examination, as allowed by E200-003. It is not an invented identity. A protected actor or material can have a controlled reference whose disclosure scope is stated. The structural requirement is an identifiable relationship in the authorized arrangement, not publication of protected identifying information.

For the tables below, unknown contextual values include the actual source person's identity, target time, instrument details, an upstream actor's method, external legal context or unavailable historical content where these cannot be established. The package's own declared assessment method, criterion, inference and result describe what its assessor actually used or determined. An unperformed evidential examination is recorded as not examined; fulfillment of the duty to disclose that state remains separate from any claim that the examination occurred. A known omission of required structural content or assessment reasoning is a recording defect rather than an unknown-context exception.

A.2 Package, claim and material information

Table A.1 – Core semantic information and its governing requirements

Component	Required information when the component is present	Governing requirements
Package	Reference and version; purpose; recording responsibility; target and collection boundaries; included claims or selection rule; access scope; descriptive regime; exclusions; assessment results.	E200-001/002/027/045.
Claim	Distinguishable content/version and target; origin and recording attribution; epistemic mode and relevant modality; method; material assumptions; scope; temporal context; identified unavailable context.	E200-003–008/028–031.

Component	Required information when the component is present	Governing requirements
Identity assertion	Appearances linked; stated criterion; responsible attribution; grounds or explicit stipulation; material dispute; distinction from lineage and record references.	E200-009.
Material item	Reference or controlled locator; relevant portion or identified pattern; source/acquisition path; availability; distinction between original, copy and derived or generated representation.	E200-010/032/033.
Evidence-role assignment	Material and claim-version links; assessor/source; time; evidential role; relevance rationale; reliability limits; material alternatives and known dependence.	E200-011/012/034.
Assessment	Question; assessor or decision role; criteria and version; material examined; result; date; claim versions; uncertainty and limitations; available alternative analysis.	E200-014–016/035–037.

A.3 Conditional information

Table A.2 – Information activated by conditional recording subjects

Trigger	Information required for the triggered subject	Governing requirements
Negative evidence	Expected trace opportunity; production, detection, coverage and preservation conditions; inference and limitations.	E200-013/032.
Revision	Prior/resulting versions; responsible source; time and reasons; changed content/scope; history limits; known dependents and disposition.	E200-017–019/038.
Regime change	Earlier/new definitions or methods; reasons; affected claims; mapping used; non-comparability or lost distinctions.	E200-018.
Practical uptake	Relied-on claim/version; assessment; action and actor; asserted authority or grounds; intended effects; separately attributed consequences or remedy.	E200-020/039.
Challenge	Challenged version; protected or open source attribution; grounds/material; receipt context; status; disposition responsibility, reasons and resulting changes.	E200-021.
Machine mediation	System and available version; task; inputs and outputs used; material operations; uptake/review role; unavailable detail; limits on claimed reproduction.	E200-022/040/041.

Trigger	Information required for the triggered subject	Governing requirements
Protected or lost material	Restriction or loss; asserted basis; accountable role; examination route where available; effect on assessment and later reconstruction.	E200-023/042/043.
Ethical or policy assessment	Evaluative question; attribution; values/criteria; affected parties; comparisons and tradeoffs; limits; recommendatory or operative status.	E200-024/044.
Legal assertion	Legal concept; asserted source; institutional/jurisdictional context; authority; temporal applicability and procedural status, including explicit unresolved components.	E200-025.
Transformed view	Source/resulting versions; selection/transformation; retained attribution, qualification and history; omitted content and limitations; declared audience and boundary.	E200-026/033.

A.4 Link interpretation and unavailable context

A claim reference identifies the asserted version, not merely a mutable latest view. A material reference identifies the portion used where that distinction affects the inference. A criteria reference identifies the governing edition. A shared-context reference identifies which claims inherit it and which exceptions apply. An ambiguous reference does not provide an inspectable link merely because it opens a document.

If the package cannot determine a material value, it records whether the value is unknown, not collected, not applicable, disputed, lost or restricted to the extent supported and permitted. A reason recorded by another source remains attributed to that source. This annex does not require the package to accept an assertion of completeness or authority merely because a custodian supplied it.

Annex B

(normative)

Assessment schedule

B.1 General

This normative schedule specifies the minimum evidence methods for assessing this draft. They specify discriminating checks and failure cases; this draft does not claim these cases have been implemented or passed. Each applicable requirement needs its own result even where several use the same dossier. Human review is necessary for meaning, rationale, and sufficiency of disclosure; structural field validation alone is inadequate.

Table B.1 – Epistemic recording assessment schedule

Requirement	Required evidence and discriminating check
E200-001	Inspect package declaration and selected claim inventory. Check that a consequential excluded record is disclosed by the collection rule or limitation.
E200-002	Inspect result ledger and evidence locators. An inaccessible required component is not assessed; a syntax pass is not labeled a true fact.
E200-003	Retrieve two versions and two conflicting claims concerning Q. Their content and targets remain distinguishable.
E200-004	Follow testimony through a translator or summarizer. Originating source and recorder remain separate, including protected attribution.
E200-005	Inspect C1. Its late-arrival inference is not presented as direct observation merely because L1 was directly read.
E200-006	Recover the entry-time assumption and method for C1. A missing method produces a stated limit, not a reproducibility claim.
E200-007	Compare a single intake desk's coverage with an institution-wide assertion. A known unobserved delivery route remains a limitation.
E200-008	Recover receipt, acquisition, entry, and review times or their explicit uncertainty; out-of-order recording does not reorder events.
E200-009	Examine an organizational replacement using a reused name. An identity criterion and separate lineage prevent automatic merger.
E200-010	Locate the relevant L1 entry and R2 image or controlled locators; derived transcript and original are distinguished.
E200-011	Recover L1's separate evidential roles for entry time and delivery time, including rationale and assessor.
E200-012	Present three copies derived from L1. Assessment detects shared origin instead of counting three independent observations.
E200-013	Remove the log for one delivery channel. No receipt found remains distinct from evidence that no request arrived.
E200-014	Inspect uncertainty about queue delay and a confidence quantity if used. Its measured quantity and assumptions are explicit.
E200-015	Recover C2 and reasons for its disposition. If no alternative search occurred, the absence of search remains visible.
E200-016	Compare log authenticity check, receipt-time assessment, and D1 decision. Their questions, roles, criteria, and results are distinct.

Requirement	Required evidence and discriminating check
E200-017	Retrieve C1 versions and changed grounds. Target change, correction, and category change produce different stated reasons.
E200-018	Apply a category split to records lacking the finer information. Mapping records non-recoverability rather than invented categories.
E200-019	Follow C1 to D1. Pending action review is distinguishable from completed correction and from an unreachable external use.
E200-020	Recover D1, the claimed authority for action, and separately attributed consequences. No automatic remedy is inferred.
E200-021	Trace CH1 receipt through pending and disposed states. A closed status without response, responsible role, and reasons fails.
E200-022	Add a machine summary that invents a link. Recover input, system/version where available, output used, uptake role, and correction.
E200-023	Compare protected dossier and released view. Restriction basis and accountable route are recorded without unauthorized disclosure or a false independent-review claim.
E200-024	Inspect an assessment that exclusion was unfair. Criteria, affected parties, and descriptive premises are distinguishable.
E200-025	Inspect an allegation of unlawful exclusion. Asserted source, jurisdiction, authority, and procedural status are stated or unresolved; no legal effect follows from technical compliance.
E200-026	Examine a textual summary or exported dossier. Correction, dissent, attribution, scope, and protection limitations survive or omissions are explicit.
E200-027	Compare supplied semantic components with Annex A. Resolve shared context and exceptions without inferring undocumented values.
E200-028	Inspect a compound occurrence-and-effect claim. Separate components can receive different assessments and revisions.
E200-029	Follow a translated or relayed statement to its available source context; distinguish quoted content from the recorder's interpretation.
E200-030	Inspect an observation's window, method, observer and detection limits; a broader claim does not acquire unobserved coverage.
E200-031	Recover premises, assumptions and consequential inferential steps; a stipulated process is not mislabeled an observed history.
E200-032	Examine selective preservation and any concealment hypothesis. Missing evidence alone does not establish concealment.
E200-033	Trace an extraction, redaction or imputation to its source and effect; a completed value remains distinguishable from observation.
E200-034	Inspect aggregate populations, denominators, weights and changed composition; repeated or recoded items do not become independent observations.
E200-035	Compare confidence statements across targets or methods; unsupported commensuration and hidden unresolved dimensions are detected.
E200-036	Distinguish rejected, retained and unexamined alternatives; an unperformed sensitivity analysis is not described as completed.
E200-037	Reconstruct assessment criteria and evidence at the time; later rules do not silently change an earlier result.

Requirement	Required evidence and discriminating check
E200-038	Follow two revision branches. Latest entry order alone does not establish evidential precedence or erase disagreement.
E200-039	Separate pre-intervention evidence, intervention, later evidence and effect attribution; discovery differs from creation.
E200-040	Inspect generated links, imputed values and computational selection; structured output is not treated as independent observation.
E200-041	Test a stated reproduction or inspection claim against available inputs, method and configuration; unavailable detail limits the result.
E200-042	Compare custodian assurance, direct authorized examination and unavailable source; their scopes remain distinct.
E200-043	Inspect a formerly accessible source after loss or restriction; the historical assessment and current access limit remain distinguishable.
E200-044	Recover affected parties, evaluative comparisons and omitted effects; a recommendation is not reported as an adopted rule.
E200-045	Check every requirement's result and evidence against both normative annexes; absence of required information is not a missing trigger.
E200-046	Inspect coverage, sampling and automatic checks; partial examination does not acquire an exhaustive claim.
E200-047	Compare a revised package with its prior assessment; affected results are reassessed or explicitly pending.
E200-048	Inspect unknown-context declarations alongside mandatory references/content and reasoning; a missing structural component or unperformed examination does not acquire a fulfilled result.
E200-049	Inspect a grouped obligation with mixed component results; an unassessed or failed component remains visible and prevents overall fulfillment.

B.2 Assessment sequence and retained result

The assessor fixes the package edition, access arrangement and claim inventory before applying the schedule. The assessor identifies present conditional subjects, locates the Annex A information and examines the semantic checks in Table B.1. The result register records the requirement, trigger, evidence locator, observed result, assessor, date and limitation. A domain-equivalent case can test the same distinction when the package does not concern the illustrative delivery case.

One material item can support several checks, but every applicable requirement receives a separate result and materially distinct component results follow E200-049. A counterexample establishes a defect only within the tested scope; a passing case does not establish universal institutional performance. If assessor disagreement concerns the meaning of a claim, its material, criteria or scope, the report identifies that point rather than averaging incompatible conclusions into a numerical result.

Annex C

(informative)

Worked epistemic cases

C.1 A late-recorded delivery

This invented case tests recording distinctions. It supplies no claim about an actual institution or applicable law.

Target. Whether request Q arrived before the deadline specified in a synthetic institution's internal rule R1. The asserted rule and whether it applies are separate claims.

C1 version 1. Clerk A reports that Q arrived after the deadline, inferred from entry log L1. Target time is the claimed receipt time; recording time is the later creation of C1. The method assumes entry time matches receipt time.

Evidence use. L1 supports that an entry occurred at the recorded time. Reviewer B records that its support for receipt time depends on the untested assumption about queue delay. Three copies of L1 are not independent corroboration.

Alternative C2. A protected participant reports earlier delivery; a receipt image R2 is available to an authorized reviewer. The public view identifies restricted evidence and the scope of examination without naming the participant.

Action D1. The institution records exclusion of Q using C1 and R1. This is an attributed institutional act. Its occurrence, justification, and any claimed legal effect remain separate.

Challenge CH1. The participant challenges C1 and provides R2. The record includes the challenged version and receipt time of the challenge; a pending challenge is not displayed as a completed review.

C1 version 2. Review establishes that the entry occurred later than the claimed delivery. The assessed receipt time changes; the entry event does not. The revision links its grounds to R2 and records the continuing uncertainty. C1 version 1 and D1 remain identifiable historical records.

Dependency review. D1 is marked for review. Until a later action is evidenced, correction of C1 is not displayed as restoration of Q's participation. The record can identify consequences of the interval of exclusion separately.

Regime change. If the institution later defines arrival by a different channel, the change of rule/category has its own effective interval. It does not silently recode earlier evidence or establish that earlier actors used the new meaning.

C.2 Generated relationship and shared-source dependence

A fictional analysis receives three documents: an intake entry, its automated summary and a report that cites the summary. The summary adds a claim that two named organizations coordinated their decisions. The intake entry only records that messages were exchanged. The package keeps the communication occurrence, the inferred coordination and the later report as distinct claims.

The three documents share a derivation path. Their number does not supply independent corroboration. The generated relation has a source and method reference, but that provenance does not establish its content. A reviewer can reject the unsupported coordination inference while retaining evidence of the messages. A later independent account could change the assessment; its independence and target relevance would still need examination.

If a public graph displays only the generated edge, the reduced view needs its inferential qualification and relevant limitation. A caption that describes the edge as observed would lose the distinction. No universal

graph schema is needed to expose this failure; a reader can compare the graph's statement with the source material and assessment.

C.3 Reclassification, intervention and later evidence

A fictional institution broadens its participation category after reviewing evidence that earlier records omitted some forms of contribution. Existing archived material supports reclassification of some earlier cases, while others lack the necessary detail. The new category also changes later access to institutional resources.

The dossier retains three linked changes. The category changed; knowledge of some earlier contributions changed through re-examination; and later resource access changed through practical uptake. The unresolved earlier cases do not acquire a finer classification merely because the vocabulary now provides one. Nor does increased later participation prove that identical opportunities were available earlier.

An ethical assessment can favor the new arrangement while recording its additional reporting burden and effects on different groups. A policy proposal can recommend wider adoption without claiming institutional authority to impose it. The package records these positions and their criteria separately from evidence concerning participation and from the decision that implemented the change.

Annex D

(informative)

Source trace and drafting rationale

D.1 General

References are to the supplied local PDFs indexed in `foundation_manuscripts/MANIFEST.md`; page numbers are one-based PDF pages. Source passages provide conceptual grounds, not adopted requirements. No external compatibility or legal claim is made.

Table D.1 – Foundation passages and recording requirements

Source	Operational proposal and reason
FM-004, §4.2, pp. 11–14; §4.6, pp. 43–45	E200-003–008 distinguish target, manifestation, representation, and observation conditions. A single undifferentiated fact field cannot preserve these questions.
FM-005, §5.4, pp. 28–31	E200-010–013 assign evidence roles relative to claims and preserve trace paths, alternatives, and dependence. Material presence alone does not establish relevance or independent corroboration.
FM-005, §5.17, pp. 141–142	E200-014/015 preserve dimensional uncertainty and alternatives. A single mandatory confidence score was rejected for this draft because methods and uncertainty sources differ.
FM-007, §7, pp. 26–29	E200-009 separates record references, identity criteria, and lineage, permitting unresolved matches. Administrative identifier equality is insufficient as a universal criterion.
FM-005, §5.20, pp. 168–174	E200-017–020 distinguish evidential, intervention-related, historical, and category revisions, and the historical effects of an earlier representation. Silent overwrite loses those distinctions.
FM-005, §5.19, pp. 160–161, 168	E200-021–023 make machine mediation and contestability inspectable while allowing differentiated access. A declaration that “AI was used” omits material epistemic conditions.
FM-003, §3.10.9, p. 115; §3.13, pp. 141–142	E200-024 separates generative attribution from ethical evaluation and records affected parties and criteria. No universal beneficialness or commensuration is assumed.
Programme Brief, §3A; repository jurisprudential discipline	E200-025 preserves the asserted basis and status of legal claims. This is a recording boundary proposed by the programme, not a legal conclusion derived from a manuscript.

The selected direction is an inspectable claim package with attributed relationships and scoped evidence. Alternatives included a single verified-fact flag, a mandatory new ontology class for every assertion, and a fully specified adjudication process inside this document. The first loses distinctions; the second prematurely fixes implementation architecture; the third conflicts with the planned separation of epistemic representation from GR-210 procedures. The present choice leaves representation and procedural elaboration open while producing requirements that a small synthetic dossier can test.

D.2 Additional foundation analysis for edition 0.2

FM-005, sections 5.4.4–5.4.8, PDF pages 32–35, distinguishes observation, inference, latency, hiddenness and negative evidence. E200-030–032 require an inspectable observational and inferential path and do not infer concealment from silence. Sections 5.17.3–5.17.8, pages 145–150, distinguish generative linkage, boundary, scale, time, model and competing-explanation uncertainty. E200-034–036 preserve those dimensions without a compulsory scalar score.

FM-005, sections 5.18.1–5.18.5, PDF pages 152–156, explains why visibility and institutional legibility are uneven and why greater visibility can itself cause exposure. E200-042/043 separate accountable examination from unrestricted publication. These recording duties do not claim to complete the manuscript's broader account of epistemic justice.

FM-005, section 5.19, PDF pages 162–164, distinguishes computational observation, classification, inference and generated representation. E200-033/040/041 preserve transformations and limits on inspection. A generated description can aid inquiry without becoming an independent source of authority.

FM-007, section 10, PDF pages 45–50, distinguishes partial attributes, numerical scales and changing composition; section 17, pages 78–80, distinguishes regime alignment and recovery of omitted information. E200-034–038 adapt these distinctions to inspectable records without importing a formal model or declaring Property equivalent to Attribute.

D.3 External drafting models

The ISO model document and ITU-T author's guide inform the organization of scope, dated references, terms, clauses and normative or informative annexes. The United Nations National Quality Assurance Frameworks Manual provides a useful comparison for distinguishing institutional conditions, processes and outputs in a quality framework. Here, package recording, assessment performance and institutional effects remain separate subjects. No UN statistical quality indicator or external conformance rule is incorporated through this comparison.

Annex E

(informative)

Unresolved issues and specification needs

E.1 General

- **OPEN — Representation.** Whether claim identity is implemented through objects, qualified statements, wrappers, or hybrids requires disagreement, revision, protection, and exchange cases before a Specification decision.
- **OPEN — Burden.** Initial review needs to measure time and participant burden as well as field completeness. Shared context can reduce duplication; E200-027 addresses the preservation of claim-specific exceptions.
- **OPEN — Evidence assessment granularity.** The minimum useful rationale varies across testimony, measurement, historical interpretation, and routine record entries. Domain profiles need cases and relevant expertise.
- **OPEN — Challenge procedure.** The effective operation of submission routes, standing, accessible participation, impartial assessment, notification, timing, appeals and repair in GR-210 and institutional profiles needs evidence from actual practice. E200-021 records results without establishing that these practices exist or work.
- **OPEN — Retention and restriction conflicts.** Historical reconstruction, deletion, protection, and procedural examination can conflict. Named institutional and jurisdictional profiles need explicit review; this draft imposes no universal retention period or disclosure priority.
- **OPEN — Technical needs.** Independently addressable versions, evidence-role links, dependency notifications, missingness states, controlled locators, and loss-aware transformations are candidate inputs to GR-SPEC-120/130/200. No encoding or transport protocol is adopted here.
- **OPEN — Conformance practice.** The matrix is a review design, not a completed validator or certification programme. Independent reviewers need to test whether the same package yields reproducible assessments and whether affected participants can recover its meaning.

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GENERATIVITY STANDARDS PROGRAM

GR-210

Standards-track Working Draft

Version 0.3 2026-09-22

Evidence, Interpretation, and Contestation

WORKING DRAFT FOR REVIEW

This document contains proposed provisions for technical and institutional review. It is not an adopted Standard or an operative governance instrument. Its scope, application conditions and publication status are specified in the text.

Prepared by the Generativity Standards Program. Reference to external publications does not imply endorsement by ISO, IEC, IEEE or any United Nations body.

Foreword

Version 0.3 records the bounded substantive review of the archived 0.2 package. This edition clarifies the limited GR-100 vocabulary dependency while retaining the full applicable GR-200 package dependency. The review matrix, synthetic assessments and unresolved readiness questions are documented in `docs/reviews/validation_0.2/README.md`. These activities do not constitute adoption or an independent institutional assessment.

Responsible editor: `UNASSIGNED`. Canonical source: `standards/GR-210-evidence-interpretation/GR-210.tex`. Intended readers are procedure operators, affected people, reviewers and assessors.

This is a **PROVISIONAL Standards-track Working Draft**. It is not adopted, and preparation does not formally initiate a standards project, authorize an institutional procedure, or establish a legal entitlement. Its requirements are proposals for review and experimental assessment. Draft 0.2 preserves the meaning of C210-001 through C210-032 and extends the procedure declaration, case handling, protection, and assessment schedules. Draft 0.1 remains historical material.

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Introduction

An account can be authentic, widely repeated, or institutionally accepted and still lack adequate grounds for its substantive conclusion. A person affected by that account also needs a usable route to question it. This document connects the examination of evidence with the practical organization of receipt, response, review, revision, and action. It keeps those functions distinct so that a successful correction of text is not mistaken for a completed remedy and an inclusive procedure is not mistaken for proof of truth.

The foundation manuscripts distinguish trace from evidence, evidential adequacy from epistemic justice, and current knowledge of the past from the past and its historical representations. They also identify unequal capacities to produce, preserve, interpret, and contest evidence. The procedures proposed here operationalize a bounded part of those concerns. They do not claim to exhaust the philosophical concepts or prescribe a single institutional model.

The procedure can be operated with documents and accountable people before a machine protocol is needed. Technical infrastructure becomes useful when case correlation, controlled exchange, version tracking, notification, or concurrent action requires interoperable behavior. Such infrastructure remains subordinate to declared authority and protection. A complete state log cannot establish that a reviewer actually considered the grounds or that an affected person could use the route.

1 Scope

1.1 General

This document proposes requirements for a bounded procedure through which people can question an attributed account, introduce evidence or an alternative interpretation, obtain a reasoned disposition and seek further review. Its subjects are the procedure operated by a named organization or recording practice and the associated case record.

An evidential assessment, a procedural disposition, an institutional action and an externally competent legal finding remain distinct. This draft provides no universal tribunal, evidentiary ranking or legal right to review. A conforming procedure can conclude that the available evidence does not resolve the dispute.

The scope includes a procedure declaration, accessible receipt, case scoping, reviewer assignment, evidential and interpretive examination, participation, reasoned disposition, notification, further review, correction propagation, practical response, closure, and protected retention. It excludes a universal evidentiary ranking, mandatory probability scale, cross-jurisdiction legal remedy, and a claim that procedural conformity proves the underlying facts. Institutional profiles determine the contextual service periods and authority within these boundaries.

2 Normative references

2.1 Dated draft dependencies

For experimental assessment against this edition, GR-100, *Foundations and Vocabulary*, Working Draft 0.3, supplies the terms in Clause 3, the record-role meanings in Clause 5 when used, and the assessment-result meanings in 8.3; this reference does not impose a separate claim of GR-100 vocabulary-application conformity. GR-200, *Epistemic Recording Framework*, Working Draft 0.3, supplies the package and claim requirements invoked by C210-030. The source locations are `standards/GR-100-foundations-vocabulary/GR-100.tex` and `standards/GR-200-epistemic-recording/GR-200.tex`. Both are draft dependencies, not adopted Standards. All applicable GR-200 requirements remain applicable to the bounded claim package; a field-level check does not satisfy package-level obligations.

A dependency revision requires review of affected procedure declarations, claim packages, and assessment results. GR-110 concerns the broader generativity recording package and is a related informative publication here, not a blanket additional conformance dependency. Full GR-300/310/400 profiles remain in development. Directives Part 1 governs the programme's own development procedure after adoption; its periods are not universal periods for institutions using GR-210.

No external legal instrument or United Nations publication is a normative dependency of this edition. Comparative sources in the bibliography inform drafting and assessment architecture without importing institutional powers or policy commitments.

3 Terms and definitions

3.1 Operational procedure terms

The following terms narrow the procedural use in this document without redefining the broader GR concepts supplied by GR-100.

Operator The accountable organization, person, or arrangement that declares and provides the procedure within its stated authority.

Case A distinguishable collection of issues, submissions, review actions, dispositions, and follow-up concerning identified records or decisions.

Case record The retained representation of a case, including its boundaries, versions, access scope, and known missing material. Its existence does not prove that every represented action occurred.

Issue A question capable of receiving a scoped response, such as whether a date is wrong, evidence supports a claim, a category is adequate, or the declared procedure was followed.

Reviewer The assigned person or accountable review function that examines specified issues within declared competence and authority.

Disposition The reasoned procedural outcome for an issue or case. It can maintain a judgment, support revision, record unresolved evidence, refer the matter, or close a procedure without settling the substantive question.

Practical response An authorized or proposed action following review, distinct from recording the disposition and from evidence that the action was completed.

Further review Reconsideration, a procedural appeal, or another declared examination of a previous handling or disposition, with the route's authority and independence stated.

Material grounds Evidence, assumptions, criteria, or reasons capable of changing a reasonable assessment of the issue, its disposition, or its consequential use within the declared scope.

Case state A procedural status indicating completed and pending handling. It is not a truth value, a probability, or an institutional judgment on the underlying claim.

4 Procedure declaration

4.1 General

C210-001 The operator shall publish or otherwise provide an accessible procedure declaration identifying its purpose, eligible users, covered records or decisions, responsible roles, asserted authority, submission routes and exclusions.

C210-002 The declaration shall distinguish technical correction, evidential disagreement, procedural complaint, ethical or conduct complaint and an asserted legal claim, identifying their available handling routes and limits of authority.

C210-003 The operator shall declare response and review periods, their start events, permitted extensions, notice arrangements and the route available when a period is exceeded. The chosen periods shall be justified for the institutional context and affected users.

C210-004 The operator shall declare the information needed to submit a case, the support or alternatives available to users and how restricted evidence or protected identities can be handled. A demand for unnecessary public disclosure shall not be a condition of receipt.

NOTE 1 No universal period is selected here. The programme's own standards-development comments and appeals are governed by Directives Part 1 if adopted; an institution using records has its own declared procedure and legal context.

4.2 Declared authority and service conditions

C210-033 The declaration shall have an identifier, version, effective interval, accountable owner, and accessible change history. It shall identify the normative dependencies and any institutional profile applied, the intended users and languages, and the procedure functions actually available. A named but unstaffed function shall be identified as unavailable rather than presented as an operative review route.

C210-034 For each kind of issue, the declaration shall identify who can receive it, examine evidence, determine a disposition, authorize action, and conduct further review. It shall distinguish an operator's internal policy from a claimed external legal mandate and identify the source, scope, and uncertainty of the latter. Receipt by one function shall not transfer authority belonging to another.

C210-035 The operator shall maintain the service schedule in Annex A, including receipt, acknowledgement, clarification, review, reply, disposition, notification, further-review requests, action follow-up, and closure. The schedule shall identify clock starts, responsible roles, expected periods or deadlines, permitted pauses and extensions, and escalation when service cannot be provided.

C210-036 The operator shall make submission and further-review routes available without requiring a person to accept the challenged account, withdraw an unrelated complaint, or expose unnecessary protected information. Any eligibility limitation, fee, identity requirement, representative arrangement, or technological prerequisite shall have a declared purpose, authority, proportionality rationale, and available alternative or challenge route.

C210-037 Before changing the procedure, the operator shall assess effects on open cases, participation, protection, and remedies. The change notice shall state the new version, effective date, reasons, transition treatment, and how affected users can question the change. A later rule shall not be applied silently to make an earlier handling appear compliant.

C210-038 A profile shall identify its institutional setting, covered actions, authority limits, service periods, available resources, review competence, protection basis, and assessment scope. It shall identify any requirement not met rather than claim full GR-210 fulfillment through a profile that silently removes an applicable obligation.

C210-039 The operator shall assess whether its declared channels and staffing can support the expected cases and urgency. Material capacity gaps shall produce a documented mitigation, narrower service declaration, referral arrangement, or postponement with notice. A backlog shall not be concealed by classifying unexamined submissions as resolved.

NOTE 2 An institution can distinguish a clerical correction desk from a merits-review panel and an external legal forum. A single contact can assist routing, but that convenience does not make it competent to decide each type of question. A profile's named institution is part of the authority claim to verify, not evidence of authority by itself.

5 Receipt and scoping

5.1 General

C210-005 On receiving a submission, the operator shall create a distinguishable case reference and record receipt time, the target record or decision and version if available, the asserted issue and the submitter's attribution or protected-contact arrangement. Receipt shall not be reported as agreement with the submission.

C210-006 The operator shall acknowledge receipt through the declared route or record why acknowledgment is not possible. The response shall explain the next step, expected timing and any missing information needed for further action.

C210-007 Where a case is out of scope, incomplete, duplicated or directed to the wrong recipient, the operator shall record that procedural reason and any available correction or referral route. That outcome shall not be represented as factual refutation.

C210-008 Any restriction on repetitive or abusive submissions shall use declared criteria, record the reason and preserve a route to challenge the restriction. The operator shall not classify a submission as abusive solely because it criticizes an authoritative account or repeats an unresolved material concern.

5.2 Intake, triage, and issue separation

C210-040 The operator shall accept enough information to identify a concern without requiring the submitter to supply a complete evidentiary case or technically correct amendment at receipt. If the target or issue is unclear, the operator shall seek clarification and offer the declared assistance before closing for incompleteness, unless contact is unavailable or a stated protection constraint prevents it.

C210-041 Triage shall identify immediate protection or irreversible-consequence risks, the covered question, required routing, known deadlines, and whether temporary preservation or action review is available within the operator's authority. Triage shall not be presented as a concluded evidential finding. Any urgent measure shall have a responsible actor, scope, reason, review point, and notice appropriate to protection needs.

C210-042 A submission containing several kinds of issue shall be divided into distinguishable questions with linked handling routes and a coordinating contact. A referral shall identify what is sent, on what authority, to whom, and whether receipt or acceptance has been confirmed. The operator shall not describe sending a referral as evidence that the recipient has assumed the case.

C210-043 The intake record shall preserve the submitted meaning and relevant original formulation within protection limits. Translation, transcription, summarization, or assisted reformulation shall identify its responsible role, method, version relationship, and material uncertainty. The submitter shall have a practicable opportunity to correct a material misunderstanding through the permitted contact arrangement.

C210-044 A duplicate-case decision shall identify the related case and explain which issues are shared and which remain distinct. Consolidation shall retain separate attribution, protection preferences, and individual practical consequences where material. A previous disposition shall not automatically dispose of new evidence or a newly identified defect in the previous handling.

C210-045 A request for further information shall specify the missing information, why it matters, who is expected to supply it, available assistance or alternatives, the response period, and the effect of nonresponse. The operator shall not shift responsibility for evidence within its own declared control to a person who lacks access without explaining and addressing that access problem.

C210-046 A case placed on hold shall identify the reason, affected work, responsible owner, next review date, and clock treatment. A hold shall not remove the case from pending-work reporting or imply acceptance, rejection, or abandonment. The operator shall reassess the hold at the stated review point and notify permitted recipients of a material change.

C210-047 When a submitter withdraws a request, the operator shall record its scope, distinguish withdrawal of participation from withdrawal of an evidential assertion, and explain any continuing handling under a separate declared responsibility. Withdrawal shall not be described as proof that the original claim was false or that the person agreed with the challenged decision.

C210-048 Case transitions shall conform to the semantic controls in Annex B. The operator shall record the previous and new state, trigger, responsible actor, time, reason, and next action. Local status labels may differ if their mapping preserves the distinctions between receipt, review, disposition, action pending, and closure.

6 Review responsibilities and participation

6.1 General

C210-009 Before substantive review, the operator shall identify the reviewer or review function, relevant competence, relation to the contested account and conflicts of interest. Material conflicts shall be handled through recusal, reassignment or a disclosed limitation with an appropriate further-review route.

C210-010 The reviewer shall identify the questions within the case, the relevant claim versions, evidence available, known limitations and decision criteria. Factual, normative, procedural and legal questions shall remain distinguishable.

C210-011 Affected parties shall be given an opportunity to respond to material grounds used in the disposition through a procedure consistent with protection and applicable institutional constraints. Where direct disclosure is restricted, the operator shall explain the permitted alternative and its limits.

C210-012 The operator shall record participation barriers known to affect the case, assistance or adjustments offered and material perspectives that could not be obtained. Absence of a response shall not automatically be represented as consent or admission.

NOTE 1 A reviewer cannot promise that every perspective will be available. The proposed obligation is to expose the evidential and procedural consequence of a material gap.

6.2 Assignment, competence, and meaningful response

C210-049 The reviewer assignment shall state the questions delegated, relevant domain competence or situated knowledge, decision limits, availability, and accepted responsibility. Where several reviewers supply different expertise, the record shall identify who integrates findings and who is accountable for the disposition. Unavailable competence shall narrow the finding or trigger additional review, referral, or deferral.

C210-050 The operator shall provide a route to raise a conflict concern and assign its assessment to a person not deciding a complaint about their own interest. The conflict disposition shall identify the concern, relevant evidence, management action, and effect on the case. Disclosure alone shall not be represented as independent handling.

C210-051 An author of the challenged account may explain its sources or participate in a disclosed initial reconsideration, but shall not be described as an independent reviewer of that account. A material unresolved conflict shall not support an unqualified independent-review claim; the available further-review arrangement and its limits shall remain explicit.

C210-052 Before a consequential disposition, the operator shall give affected parties notice of the questions, material grounds proposed for reliance, applicable criteria, response route, and response period to the extent permitted by protection. A later-added material ground shall receive a further response opportunity unless a declared urgent measure requires temporary action with prompt subsequent review.

C210-053 An opportunity to respond shall be assessed in relation to actual access, language, disability, resources, time, and the form of the material. The operator shall record requested adjustments, its response, and unresolved barriers. Merely making a complex dossier available shall not establish that an affected person could meaningfully address the proposed grounds.

C210-054 Where direct participation is unsafe or impracticable, the operator shall assess the declared alternatives, including protected contact, assisted submission, representative participation, or controlled independent examination. The record shall identify the chosen arrangement, its authority and limitations, and any material perspective it cannot provide. Representation shall not be inferred without a basis.

C210-055 A reviewer shall assess testimony in relation to the source's access, claim scope, method, and material limitations rather than institutional status alone. Relevant experience and technical expertise shall remain distinguishable. Giving a person an opportunity to speak shall not be reported as showing that their grounds influenced the decision unless the disposition records how they were considered.

C210-056 If the reviewer and decision authority are different, the authority shall identify the review findings received, any departure from them, the grounds and competence for that departure, and the

additional response opportunity required by new material grounds. A managerial instruction shall not silently replace an evidential assessment while retaining the reviewer's attribution.

C210-057 The operator shall provide a protected route to report retaliation or interference linked to participation and shall record available protective responses within its authority. Such a report shall remain distinct from the factual merits of the original case. A person shall not have to publish the protected allegation to obtain triage or an explanation of the available route.

7 Evidence and interpretation

7.1 General

C210-013 An assessment shall identify the claim under examination, the evidence relied on, how that material bears on the claim, relevant method and assumptions, and known counterevidence or materially plausible alternatives.

C210-014 The reviewer shall distinguish the authenticity or integrity of a source from the warrant it provides for a particular claim. A signed assertion shall not receive an unqualified truth status merely because its signature validates.

C210-015 A conclusion based on missing evidence shall identify the expected trace-production, observation or preservation conditions supporting that inference. Where those conditions are not established, absence of the record shall remain distinguishable from non-occurrence.

C210-016 The assessment shall state uncertainty and its scope without inventing a common probability scale for heterogeneous judgments. Disagreement among assessors shall be attributed and retained where material and permitted.

C210-017 Where a category, method or institutional rule is challenged, the reviewer shall distinguish whether it was applied correctly from whether its adequacy or legitimacy is itself under review. A correct application shall not by itself dispose of a challenge to the rule.

C210-018 A material computational or AI-assisted contribution to the review shall be identified with the inputs or sources available for inspection, its role, relevant limitations and responsible human or institutional uptake. An inaccessible internal process shall not be replaced by an invented explanation.

7.2 Evidence plan and material examination

C210-058 The reviewer shall maintain an issue-to-evidence plan identifying the question, claim versions, relevant criteria, material available, material sought, expected access, alternatives to examine, and known gaps. A change in the plan that materially affects the scope or burden of review shall be recorded and communicated to permitted affected participants.

C210-059 An evidence item used in a disposition shall have a locator or controlled reference, source attribution, acquisition context, relevant version, and any known transformation or custody limitation material to the inference. An unavailable original shall be distinguished from an examined copy, excerpt, testimony about the item, or generated reconstruction.

C210-060 For each material item, the assessment shall state its role relative to the specified claim: support, challenge, qualification, non-discrimination, or another explained relationship. The reviewer shall not give the item a universal reliability status that silently transfers across different claims, times, or contexts. A role assigned by a party shall remain distinguishable from the reviewer's assessment.

C210-061 Where several items are treated as corroboration, the reviewer shall examine known derivation and dependence material to that claim. Copies, summaries, translations, model outputs, and repeated

citations of one source shall not count as independent observations solely because they are separately stored or differently worded. Any asserted independence shall have a stated basis and limits.

C210-062 The reviewer shall identify material alternatives that fit the accessible evidence and state why an alternative is retained, weakened, rejected, or outside the assessed scope. An alternative need not receive equal weight merely because a party proposes it. Failure to examine alternatives shall remain a limitation rather than be reported as evidence that none exists.

C210-063 When an identity, temporal order, measurement, classification, or causal link is contested, the review shall identify the relevant criterion or method and assumptions. Agreement on a record identifier, timestamp, endpoint, or category label shall not by itself resolve the corresponding underlying identity, chronology, trajectory, or causal question.

C210-064 An assessment of a generative contribution shall state the capacity, relation, distinction, constraint, or possibility at issue, the comparison condition, temporal horizon, proposed connection, and evidential limits. A change following an intervention shall be examined for whether it reveals an earlier condition, creates a new condition, or combines both; later observation shall not silently become direct evidence of the earlier configuration.

C210-065 If a rule or category is challenged, the operator shall separate the case-specific application question from the rule-review question and identify the competent recipient for each. A referral of the rule question shall leave its status visible. Rejection under the existing rule shall not be represented as a finding that the rule is adequate, fair, or legally valid.

C210-066 A change in evaluative criteria during review shall identify the earlier and revised criteria, authority, reasons, affected issues, and transition effects. The operator shall provide a response opportunity where the change materially affects a party's case. Historical acts shall retain the criteria actually relied on at the time, even when the present assessment uses a later framework.

C210-067 A numerical score, confidence estimate, or model recommendation used materially in review shall identify what it measures, relevant inputs, method and version where available, assumptions, uncertainty, and role in the decision. A threshold chosen for operational action shall remain distinguishable from an estimate of factual warrant. Unavailable technical details shall qualify the assessment rather than be fabricated.

C210-068 The reviewer shall document the planned examination actually performed, material steps not performed, reasons, and effects on the conclusion. An evidence request sent, an access permission obtained, or a tool available shall not be reported as an examination completed. A finding shall remain bounded by the material and methods actually used.

8 Disposition and practical response

8.1 General

C210-019 The disposition shall state the questions decided, findings and their scope, evidence and reasons, responsible decision function, decision time, remaining disagreement and matters outside its authority.

C210-020 The disposition shall distinguish correction of a record, changed evidential assessment, maintained judgment, changed institutional action, inability to decide and procedural closure. Procedural closure shall not imply epistemic agreement.

C210-021 Where the procedure supports a remedy or practical response, the disposition shall identify the proposed or authorized action, its responsible executor, scope, timing and evidence needed to establish completion. Recording a proposed action shall not establish that it occurred.

C210-022 The operator shall notify the submitter and other relevant recipients through the declared, permitted routes, explain any further-review route and record delivery or known failure. Public notices shall respect the case's disclosure limits.

C210-023 A material correction shall be linked to the earlier account and known dependent views or decisions. The operator shall record which corrections or notices were performed and which downstream effects remain unresolved.

NOTE 1 A corrected classification can leave lost opportunities, costs or harm unremedied. The procedure records the distinction rather than declaring repair complete because a field changed.

8.2 Reasons, notification, and action tracking

C210-069 Each disposition shall address every scoped material issue or state why it remains deferred, referred, withdrawn, or unresolved. The record shall distinguish the parties' positions, the reviewer's assessment, the authorized determination, and any minority or competing assessment retained within protection limits. A single closed-case label shall not conceal different outcomes for different issues.

C210-070 A maintained judgment shall explain why the challenge does not warrant the requested change, including treatment of material contrary grounds. An inability-to-decide disposition shall identify the limiting evidence, authority, or method and any conditions for further review. Neither outcome shall rely solely on institutional acceptance of the original account.

C210-071 An action plan shall distinguish proposed, authorized, assigned, initiated, completed, verified, failed, and no-longer-pursued actions where those differences are material. It shall identify the executor, authority, affected records or persons, due or review date, completion evidence, and route when execution fails. A reviewer lacking implementation authority shall identify the required decision recipient rather than promise completion.

C210-072 When immediate action is taken before full review, the operator shall record the urgency, authority, limited purpose, expected consequences, duration or review point, notice limits, and later examination required. The temporary action shall not be presented as a final evidential finding or remove the remaining opportunity to challenge material grounds.

C210-073 The notification record shall identify the permitted recipient, route, exact disposition or summary version, dispatch time, known delivery status, and any protected information withheld. The operator shall distinguish dispatch, delivery, receipt acknowledged, and substantive response. A delivery failure material to a review opportunity shall trigger the declared alternative or timing correction.

C210-074 A notice of disposition shall give an accessible account of the outcome, material reasons and limitations, action status, further-review route, relevant deadline and starting event, and assistance available. If the full record cannot be shared, the notice shall explain the permitted way to examine or challenge the grounds without overstating the completeness of the summary.

C210-075 Correction planning shall identify known dependent claims, assessments, records, presentations, and decisions within the operator's control or declared notification relationships. For each, the operator shall record correction performed, review pending, no change with reason, notification sent, unreachable recipient, or another explained status. It shall not assert universal propagation beyond the evidenced boundary.

C210-076 A correction shall preserve a distinguishable relationship between the prior and revised account, its reason and authority, and the time of each formulation, subject to protection and retention. The corrected view shall not present earlier decision makers as having used evidence or categories acquired later. A removed sensitive detail shall not be retained in the public history solely to illustrate the correction.

C210-077 A consequential action or remedy shall be evaluated separately from record correction. The follow-up shall identify the intended practical change, evidence of what occurred, unresolved costs or losses, affected perspectives obtained, and limits on causal attribution. An apology, amended field, or scheduled meeting shall not be recorded as restoration of an opportunity without supporting evidence.

C210-078 A case closure shall identify which issues are disposed, which actions remain pending, who owns continuing follow-up, and the conditions for reopening. Where the declared procedure requires action verification before closure, unavailable verification shall prevent that closure claim. Administrative closure shall not erase outstanding obligations, remaining disagreement, or unavailable evidence.

C210-079 If a disposition is itself corrected, the operator shall identify the earlier disposition and notice versions, the error, authority for correction, affected deadlines or actions, and renewed notifications or response opportunities. A substantive change shall receive the review warranted by its effect, rather than be hidden as a typographic correction.

9 Further review, reopening and continuity

9.1 General

C210-024 The procedure shall provide a declared route to request reconsideration of a material error, new evidence or procedural failure, with its scope, competent recipient and limitations. A reviewer of their own contested action shall not be described as independent.

C210-025 A reopened case shall identify the earlier disposition, trigger, changed evidence or criteria, reviewer and new outcome. Later interpretation shall not silently replace the record of what was known or decided earlier.

C210-026 If the operator lacks competence, authority or resources to complete a material step, it shall record the limitation and notify permitted recipients of the available alternative, postponement or closure basis. Passage of time alone shall not establish a finding on the substantive claim.

9.2 Reconsideration, procedural appeal, and reopening

C210-080 The declaration shall distinguish reconsideration of evidence or judgment, review of procedural failure, conduct handling, and an external legal route where one is asserted. It shall state who can request each route, the grounds and scope, responsible recipient, available remedies, timing, and independence arrangements. Routing assistance shall preserve the submitted concern rather than require technical knowledge of the operator's organization.

C210-081 A further-review request shall receive a linked reference, acknowledgement, admissibility decision with reasons, reviewer assignment, timetable, and notice of any effect on action or closure. A refusal to admit the request shall not be represented as substantive refutation and shall identify any remaining challenge route or explicit limit.

C210-082 A person who made the challenged decision shall not be described as independent when reviewing it. An independent-review claim shall identify the reviewer's separation from the disputed handling and relevant interests. If the declared independent function is unavailable, the operator shall disclose the limitation and refrain from claiming that an independent appeal occurred.

C210-083 The further-review authority shall assess whether disputed action needs a stay, temporary qualification, preservation measure, or other protection within its mandate. The decision shall identify urgency, consequences for affected parties, duration or review point, and reasons. Requesting review shall not be assumed either to stop every action or to leave every action unaffected.

C210-084 Further review shall identify the record and criteria reviewed, new material admitted, opportunities for response, questions determined, reasons, remedy, and implementation responsibility. A procedural reviewer acting outside authority to decide factual merits shall remit the appropriate question rather than relabel a procedural finding as a final factual conclusion.

C210-085 Where a remedy requires renewed notice, evidence examination, reassignment, reconsideration, or action, the operator shall record completion evidence before asserting the remedy fulfilled. The renewed disposition shall link the earlier decision and further-review grounds. Repeating the earlier conclusion without performing the required remedy shall not constitute compliance with the review outcome.

C210-086 A reopening assessment shall distinguish newly available evidence, a material error, changed target conditions, changed categories or criteria, procedural defect, and unimplemented remedy. It shall state whether these grounds affect the past assessment, current action, or both. A later event shall not automatically prove that an earlier claim was mistaken under the evidence then available.

C210-087 A reopened case shall preserve the earlier scope, evidence state, disposition, and consequential uses to the permitted extent and identify the new review boundary. New and prior issues may be linked or separated when the reason is recorded. Reopening shall not silently reset an overdue action or delete the history of a missed response.

C210-088 When a service period is exceeded, the operator shall record the missed event, cause, effect, notice, revised target or authorized extension, and available escalation. An extension shall identify who authorized it and why it is consistent with the declared procedure. Repeated extensions shall trigger capacity review and a reasoned alternative, rather than indefinite pending status without accountability.

C210-089 A handover, operator closure, or loss of a responsible function shall identify open cases, pending actions, permitted successor access, affected notices, and continuity limits. Transfer shall require a stated authority and custody record. Where no successor can accept responsibility, users shall receive the available permitted explanation and alternatives; an unavailable service shall not continue to be advertised as operational.

10 Protection and retention

10.1 General

C210-027 The operator shall specify access, retention, correction and disposal arrangements for submissions, evidence, reviewer notes, dispositions and notifications. Content and audit metadata shall be considered separately; history preservation shall not justify retaining prohibited sensitive material.

C210-028 Disclosure, redaction, access withdrawal or disposal affecting a case shall identify its authority, scope, executor and permitted evidence of the action. The operator shall state known limits concerning copies outside its control.

C210-029 A public summary shall distinguish the accessible grounds from material that cannot be disclosed, where that distinction is itself permitted. It shall not claim full independent inspectability when a material evidential restriction prevents it.

10.2 Differentiated access and protected case handling

C210-090 The operator shall distinguish submission content, identity and contact information, evidence, internal working material, disposition, public summary, and audit information in its access and retention schedule. Access shall correspond to an identified purpose and authority. Permission to examine one component shall not be presumed to authorize onward publication or unrestricted reuse of the case.

C210-091 Before relying on protected grounds for a consequential adverse disposition, the reviewer shall assess whether affected parties can receive a sufficient account or a credible authorized alternative examination. If protection prevents fair examination of a material issue, the operator shall narrow the finding, defer it, or state the unresolved limitation rather than claim fully contestable determination.

C210-092 A controlled view shall identify its source case and disposition version, intended audience, material selection or transformation, and permitted limitations. If acknowledging a particular item's existence is restricted, the view shall state its scope at a safe level without exposing that existence. The protected accountability record shall remain available only within its authorized boundary.

C210-093 A suspected unauthorized disclosure, misdirected notification, or compromise of protected evidence shall receive recorded triage, containment within authority, affected-case assessment, permitted notice, and review of whether the evidence or procedure remains usable. Correction of the public copy shall not be described as recall of copies beyond the operator's control.

C210-094 A retention or disposal decision shall assess ongoing review, action, and reconstruction needs against the applicable protection basis, authority, and schedule. The record shall state what is retained or disposed of, when, by whom, and the permitted verification method. It shall not retain prohibited content merely because a review might theoretically occur in the future.

C210-095 An assessor denied access to material required for an applicable finding shall state the resulting limitation. A protected assessment by another authorized competent person may be cited with its scope and independence limits, but shall not be represented as the first assessor's direct examination. Confidentiality shall not convert an unassessed obligation into fulfillment.

11 Conformance and assessment

11.1 General

C210-030 A conformance report shall identify the procedure or case record assessed, operator, institutional context, this draft and dependency versions, applicable requirements, reviewer relationship, evidence and results. It shall identify the case's material claims as a bounded GR-200 Working Draft 0.3 package and report its applicable requirement results, including package-level obligations. A case-record assessment alone shall not establish that unobserved procedural steps occurred.

C210-031 Each applicable requirement shall receive a supported result of fulfilled, not fulfilled or not assessed; a not-applicable result shall give its trigger-based reason. An unqualified claim of fulfillment shall not omit a failed or unassessed applicable requirement.

C210-032 A procedure assessment shall include an ordinary case and relevant failure cases concerning conflict, unavailable evidence, missed timing, restricted disclosure and correction propagation. A case-record-only assessment shall identify the supplied case and the procedural behavior it cannot establish. Reported success shall be limited to the cases and conditions actually exercised.

This edition defines no reduced case-record conformance profile. A case-only report is a partial documentary assessment. Performance obligations remain not assessed when only their records were examined; not applicable requires an absent stated trigger. A procedure claim covers all applicable requirements and the declared GR-200 package dependency. The multi-case rehearsal obligation in C210-032 is explicitly conditional on procedure assessment.

11.2 Assessment plan, results, and limitations

C210-096 Before assessment, the assessor shall define the procedure version, operator and institutional scope, period observed, cases selected, relevant failure conditions, methods, evidence access, and inde-

pendence or author involvement. A sample of cases shall have an explicit selection rationale and limit; a favorable sample shall not be generalized to unexamined settings without supporting grounds.

C210-097 The assessment register shall give each applicable requirement its own result, evidence locator, method, assessor, and unresolved action, distinguishing documentary adequacy from actual performance where both are required. A grouped test may support several results only when its evidence supports each obligation separately.

C210-098 A procedure assessment shall use the minimum coverage schedule in Annex C and justify any additional failure cases arising from the declared context. A synthetic exercise shall identify fictional actors and unperformed external actions. A demonstration of software behavior shall not establish competent human review, meaningful participation, legal authority, or practical remedy.

C210-099 Assessment shall include an intended user's attempt to locate the route, identify the issue, understand the notice and reasons, and determine the next available action under permitted conditions. The report shall record assistance, barriers, failures, and participant relationship to the design. Author familiarity shall not be reported as independent evidence of ordinary-user comprehension.

C210-100 An assessment finding that results in a corrected procedure, case record, or implementation shall identify the changed version, affected requirements, corrective action, and reassessment scope. Results for unchanged material may be reused only with a recorded reason that the change does not invalidate the evidence. A prior pass shall not automatically transfer across a material change.

C210-101 A public assessment summary shall identify the assessed scope, dependency versions, methods, failures and unassessed requirements, protected-evidence limitations, and whether actions were observed or merely documented. It shall not use a certificate, badge, or concise status to imply factual truth, institutional legitimacy, or full procedure fulfillment beyond the evidence.

Annex A

(normative)

Procedure declaration and service schedule

A.1 General

This schedule specifies the information needed to operate and assess the declared procedure. It does not set universal numerical deadlines. The operator supplies actual values, their justification, and the corresponding authority under C210-003/035. An unspecified period is an incomplete declaration, not an unlimited permission to delay.

C210-102 For every applicable service event in Table A.1, the schedule shall specify the responsible role, starting event, period or deadline, notification, allowed pause or extension, and escalation recipient. If institutional constraints impose a different controlling deadline, the declaration shall identify the asserted source and conflict treatment. A service extension shall not be represented as altering an external deadline beyond the operator's authority.

Table A.1 – Procedure declaration and service-event schedule

Event or arrangement	Required declared treatment
Receipt and acknowledgement	Submission routes; minimum intake content; time of receipt; distinction between receipt and agreement; acknowledgement channel and alternative when contact fails.
Clarification and scoping	Assistance; information requested and purpose; response period; inactivity treatment; routing of separate issues; decision on scope with reasons.
Urgent triage	Risks assessed; available temporary protection; authority; duration or review point; notice and later examination; limits on irreversible action.
Review assignment	Accepted reviewer role; competence; conflicts and challenge route; substitute or unavailable-capacity treatment; intended completion or status-update events.
Grounds and reply	Material grounds disclosed or authorized alternative; response period; adjustments; treatment of new material; consequence of failed notice.
Disposition and notice	Decision responsibility; required reasons; delivery arrangements; action plan; notice of further-review scope, deadline, and starting event.
Further review and reopening	Permitted grounds; recipient; independence; admissibility and response events; stay decision; remedy; new-evidence and closure rules.
Action and closure	Executor; due and review points; verification; dependent corrections; remaining action ownership; closure criteria and later contact.
Protection and continuity	Access categories; retention and disposal basis; incident handling; handover authority; limitations when evidence or operators become unavailable.

Annex B

(normative)

Case-state and transition controls

B.1 General

The states below define procedural meaning rather than mandatory serialized values. A procedure can use local terminology or several parallel issue tracks if the mapping remains explicit. State changes concern handling, while claim assessments and institutional actions have separate versions and statuses.

C210-103 A transition shall identify the prerequisite evidence, authorizing role, permitted notification, and continuing work in Table B.1. Skipping a named state shall be permitted only when its underlying obligations are either fulfilled together with another step or inapplicable for a recorded reason. A state label alone shall not serve as evidence that its prerequisite action occurred.

C210-104 Where a case contains multiple issue or action tracks, the overall state shall identify unresolved tracks and their owners. Disposition of one question shall not close another without an explicit reason. Reopening or remitting an issue shall preserve the earlier disposition and its procedural context while identifying the newly pending work.

Table B.1 – Semantic case states and transition conditions

State	Evidence and permitted transition	Meaning not established by the state
Received	Distinguishable submission and receipt time; move to clarification, scoping, or urgent triage with an accountable owner.	Agreement with the assertion or completeness of evidence.
Awaiting clarification	Specific missing information, support, response opportunity, and review point; proceed on receipt or give a reasoned scope or closure disposition.	Falsity, abuse, or abandonment inferred solely from delay.
Scoped / assigned	Questions, target versions, authority, reviewer and conflicts identified; proceed to material examination or a reasoned referral.	Jurisdiction outside the declared mandate or independent review by title alone.
Under review	Examination plan and performed work; material grounds and reply opportunity; pauses remain recorded with review dates.	That every source is authentic or every planned check has occurred.
Awaiting response	Specified grounds and usable response route; proceed after the declared opportunity, addressing barriers and newly raised issues.	Consent, admission, or waiver inferred from nonresponse.
Disposed	Reasoned issue outcomes, limitations, action and further-review notice; proceed to action, review, or permitted closure.	Action completion, truth certification, or agreement by the submitter.

State	Evidence and permitted transition	Meaning not established by the state
Action pending	Authorized executor, action and review point, dependency and verification record; close or escalate under declared criteria.	Remedy completed because it was ordered or scheduled.
Closed / withdrawn	Recorded basis, disposed and unresolved issues, continuing follow-up and reopening route; later reopen with a linked trigger.	Erasure of remaining disagreement, past consequences, or obligations owned elsewhere.
Reopened / remitted	Earlier outcome, trigger, scope, assigned reviewer, and required remedy identified; return to the affected review step.	Retrospective disappearance of the earlier decision or evidence state.

Annex C

(normative)

Minimum procedure-assessment coverage

C.1 General

This schedule applies to a procedure assessment under C210-032/098. For a case-record-only assessment it identifies behavior that the supplied record cannot establish; it does not turn unobserved performance into a not-applicable result. Cases can combine several conditions when each relevant obligation is separately examined.

C210-105 The procedure assessment shall cover each applicable condition in Table C.1, record the input and expected behavior, observe the action claimed, and retain permitted outcome evidence. It shall identify conditions not exercised and their effect on the assessment claim. A fulfilled result shall not be assigned merely because a specimen record contains the expected fields.

Table C.1 – Minimum assessment conditions and discriminating evidence

Condition	Required assessment focus
Ordinary material challenge	Exercise accessible receipt through reasons, notification and stated next action. Trace claim versions and GR-200 package results. Distinguish completed handling from a template showing intended steps.
Conflict or missing competence	Raise an assignment concern; inspect its independently handled assessment, reassignment or limitation, and effect on progression. A title alone does not prove independence.
Unavailable or dependent evidence	Supply a missing original and several derived copies. Observe scope qualification and treatment of dependence rather than invented verification or independent corroboration.
Missed timing or failed notice	Cross a declared target or introduce a delivery failure. Verify status, extension or escalation, renewed opportunity where needed, and absence of deemed substantive agreement.
Restricted material	Compare authorized and permitted reduced views. Check meaningful response alternatives, audit access, and the stated limit where examination cannot be provided.
Category or rule challenge	Separate application from adequacy or authority; trace referral and its acceptance status. Correct application does not alone dispose of a challenge to the rule.
Correction and practical action	Follow a revised assessment to known dependencies and an executor. Distinguish notification, correction, action completion, verification, and unresolved loss.
Further review and reopening	Exercise a procedural or evidential request, stay decision where relevant, reasoned outcome and remedy, and reopening on a distinct trigger. Preserve prior meanings and time boundaries.

Annex D

(informative)

Worked cases and interpretation

D.1 Missing attachment and changed classification

The following case elaborates the synthetic dossier in `examples/validation_0.2/p1-contested-decision.md`. None of its actors, notices, decisions, or remedies represents a live institution. A fictional research fund rejects a water-monitoring application after a generated summary states that the equipment was never calibrated. Its intake extract shows only that a calibration attachment was absent. A technician later supplies testimony and a maintenance-log excerpt, while the protected original contains contact details.

Intake creates a case with three questions: whether calibration occurred, whether the application met the existing documentary rule, and whether that rule gives appropriate recognition to maintenance evidence. The first requires claim-relative assessment. The second requires application of the declared rule version. The third is referred to the function authorized to review the rule. None of these operations alone determines a legal claim or an award of funding.

The reviewer distinguishes the absent attachment from non-occurrence, the generated summary from source evidence, and the log excerpt from independent examination of its original. Testimony and a log can share a source; their number does not establish independence. The protected original receives controlled handling with a safe account of the grounds available for response. If the reviewer cannot examine calibration quality or instrument identity, the disposition preserves those limits even while revising the overbroad statement that no calibration occurred.

The record correction links the old and revised claims. A later rule change records its own effective interval rather than making the earlier decision appear to have used the new rule. Scheduling a renewed eligibility review creates an action-pending state, not an award or restoration of lost training opportunities. Practical follow-up investigates the reported interruption, the scope of attribution, and the actual effect of any later response.

D.2 Protected grounds and unavailable independent review

In a second synthetic case, a person disputes an adverse classification based partly on restricted testimony. The operator cannot safely disclose the witness's identity. It provides a redacted account of the material allegation and explores controlled examination by an independent reviewer. The distinction between protection and warrant matters: hiding an identity does not establish the allegation, while the need to test an allegation does not itself authorize publication of the identity.

Suppose the only available reviewer authored the classification. They can explain their original sources and conduct a disclosed reconsideration, but the operator cannot label that work independent. If a credible alternative examination cannot be arranged, the disposition identifies the unresolved procedural and evidential limits. A narrow temporary protective action can be separately considered within actual authority; it does not convert the disputed allegation into a final finding.

The relevant assessment results remain granular. A documented restriction basis can fulfill a documentary obligation. An unperformed independent review remains not assessed. A case record describing a desired notice does not establish delivery or a meaningful response opportunity. The case can close administratively under declared limits without claiming that the underlying factual disagreement has been resolved.

D.3 Outage, deadline, and later reopening

A third synthetic case concerns a challenge received during a service outage. The original timestamp and failed acknowledgement remain recorded. An extension notice identifies the operational cause, responsible role, revised target and escalation route. If a separate institutional deadline applies, the operator states its asserted source and whether it has authority to alter it; a service notice is not treated as changing external law.

Later material reveals that the original classification depended on a mistaken identity link. Reopening identifies this evidential trigger and the affected past assessment, while preserving the decision and its consequences during the intervening period. The remedy includes checking known dependent views and actions. An unreachable external recipient is recorded as unreachable rather than silently treated as corrected.

Annex E

(informative)

Source rationale and unresolved profile decisions

E.1 Operational interpretation

The synthetic funding case accompanying GR-110 supplies a common example. The procedure's record requirements can be implemented manually before a network protocol is needed. A later Specification would define message correlation, delivery, authorization, concurrent revision and failure semantics in response to demonstrated requirements.

The initial operational direction is recorded in ADR-0004. This expanded procedure remains a programme proposal, not a claim that the foundation manuscripts prescribe these case states, deadlines, or institutional functions. Chapter 5 treats evidence as a role relative to an epistemic target and distinguishes just participation from evidential adequacy. Those distinctions motivate separate assessment of access, method, warrant, disposition, and consequences. The record preserves both a supported conclusion and the limits of the procedure that produced it. For the expansion decision and alternatives, see `decisions/ADR-0005-expanded-drafts-and-source-models.md`. The comparison record is `docs/references/drafting_models.md`.

The choice of explicit schedules follows the need to make a procedure exercisable by someone other than its author. Alternatives include a general right-to-comment statement, a fixed software workflow, or a single universal adjudication model. The first leaves response and remedy underspecified; the other two impose technical or institutional commitments beyond this draft's scope. The selected approach fixes inspectable obligations while profiles specify contextual authority and service arrangements.

The United Nations National Quality Assurance Frameworks Manual provides an informative comparison for separating institutional capacity, process quality, and output quality. Here, the operator and authority declaration, observed review behavior, and resulting case record receive distinct assessment evidence. This translation is a programme design choice; it does not assert that an official-statistics framework creates rights or governs the review procedure. ISO's model document and ITU-T drafting guidance inform publication structure rather than the evidential meaning of a finding.

OPEN ISSUE Service periods, independence arrangements, proof of authority, available remedies, costs and admissible disclosure depend on the institution and require a scoped profile. A synthetic procedure cannot establish their validity in a live jurisdiction.

OPEN ISSUE Abuse handling, protection of vulnerable participants, meaningful access under low resources and the burden of keeping case histories require review with affected users before live deployment.

OPEN ISSUE No reduced profile, universal evidential threshold, legal admissibility rule, or machine protocol is adopted. Domain-specific proof standards, representative arrangements, protected disclosure mechanisms, and independently feasible remedies require their own competent review and recorded authority.

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Documentary Appendices: Programme Documents and Application Guides

Generativity Standards Program

Source freeze: 30 September 2026

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1 Documentary reading edition

This volume reproduces project Markdown documents frozen on 30 September 2026. Original classes, maturity declarations and unresolved questions remain applicable. The original files, links and machine-readable resources are retained in the accompanying source archive. Images are represented here by their descriptions; the archive and research-paper figures preserve the available image material. Earlier citations in these historical texts have not been independently reverified for this reproduction.

2 AGENTS

Original source: `AGENTS.md`.
Original source SHA-256: `dbd19a7bbe98f68337274234181a24a747d843a31680b01b6e148d4cb1f6d2f2`.

2.1 AGENTS.md

This file governs AI-assisted and human-assisted vibe development of the Generativity Standards Program.

2.1.1 1. Mission

Contributors and agents shall help develop a rigorous, inspectable, extensible standards family for recording and presenting generativity without collapsing philosophical theory, mathematical semantics, archival practice, and implementation into a single layer.

2.1.2 1A. Required orientation

Before making a substantive change to the standards programme, read `PROGRAMME_BRIEF.md`.
Use it to maintain consistency about:

- why the standards programme exists;
- what is and is not being standardized;
- how governance, standards, manuals, technical reports, and foundation manuscripts relate;
- the intended development lifecycle;
- the distinction between GR theoretical foundations and operational standardization.

If a proposed change conflicts with the programme brief, do not silently overwrite the brief. Record the issue and determine whether the proposal or the brief should be revised.

2.1.3 2. Architectural invariants

2.1.4 2A. Foundation manuscript discipline

The directory `foundation_manuscripts/` is the primary project-local corpus for recovering GR concepts, terminology, notation, and conceptual history.
When a task materially depends on GR theory, agents should consult relevant foundation manuscripts before:

- defining or redefining a GR concept;
- introducing a new ontology class;
- changing terminology or notation;
- claiming compatibility with earlier GR work;
- writing theoretical background for a standard;
- resolving an apparent contradiction between standards documents.

2.1.5 Source hierarchy

Use the following precedence:

1. governance directives for standards-development procedure;
2. published normative standards for conformance;
3. accepted ADRs for repository architecture;
4. foundation manuscripts for interpretation of GR theory;
5. active drafts and planning documents;
6. examples and exploratory notes.

This hierarchy separates **normative authority** from **conceptual source authority**.

2.1.6 Consistency workflow

For a substantive GR concept:

1. identify relevant foundation manuscripts;
2. extract the manuscript's actual terminology, definitions, notation, and scope;
3. note whether later manuscripts revise or qualify earlier ones;
4. compare the proposed standards text with those sources;
5. preserve unresolved differences explicitly;
6. create an ADR when the standards programme intentionally narrows, operationalizes, or departs from a foundation formulation;
7. update `foundation_manuscripts/MANIFEST.md` when a manuscript is newly added or newly recognized as foundational.

2.1.7 Conflict handling

Do not silently reconcile manuscripts.

If two foundation manuscripts differ:

- preserve both formulations;
- record the tension;
- determine whether the difference is historical development, domain-specific variation, or unresolved disagreement;
- add the issue to `docs/planning/open_questions.md` when necessary;
- avoid converting one interpretation into normative text until a decision is recorded.

2.1.8 Historical consistency

Do not rewrite older GR formulations to make them appear consistent with later ones.

The standards programme should preserve conceptual evolution and make revision traceable.

2.1.9 Terminological stability

When a term already has a sustained meaning in foundation manuscripts, prefer that terminology unless a standards-specific operational definition is needed.

If a narrower operational definition is introduced:

- name the scope explicitly;
- state that the standards use is operational;
- avoid implying that the standards definition exhausts the GR concept.

Preserve these distinctions unless a recorded decision explicitly changes them:

2.1.10 2.1 Metamodel vs record ontology

The deep metamodel concerns:

- constraint;
- change;
- structure;
- difference.

The operational record ontology currently contains:

- Entity;
- State;
- Event;
- Process;
- Relation;
- Property.

Do not describe the six record classes as ultimate constituents of reality.

2.1.11 2.2 Formal substrate vs semantic record

Where the underlying metamodel uses weak notions such as a carrier of states or mechanisms, do not identify them one-to-one with richer archival concepts without argument.

Examples:

- formal change is not automatically a recorded Event;
- a mechanism is not automatically a recorded Process;
- a weak metamodel state is not automatically a semantically articulated record State.

2.1.12 2.3 Standard vs manual vs technical report

- **Standard:** normative and testable where possible.
- **Manual:** practical guidance and examples.
- **Technical Report:** theory, comparison, exploration, mathematical development, or material not ready for normativity.

Agents must move material to the appropriate document class rather than forcing everything into a standard.

2.1.13 2B. Multilayer conceptual discipline

Do not treat ontology as sufficient for the Generativity Standards Program.

When relevant, distinguish at least:

- metamodel;
- record ontology;
- epistemic representation;
- normative/ethical assessment;
- jurisprudential/legal status;
- institutional governance;
- political-economy context;
- technical implementation.

Examples:

- “Event E occurred” is an event-level representation.
- “Observer A reports E” is epistemic.
- “E was unjust” is normative.
- “E violated legal duty D” is jurisprudential/legal.
- “Institution I must retain a record of E under procedure P” is institutional/legal.
- “E is serialized as JSON-LD object X” is technical.

Do not collapse these statements into one field or one level of authority.

2.1.14 Epistemic discipline

When developing recording requirements, ask:

- what is observed;
- by whom or what;
- through which method;
- with what evidence;
- under which perspective;
- with what uncertainty;
- whether the statement is direct, inferred, interpreted, attributed, or retrospective;
- whether competing interpretations exist.

2.1.15 Jurisprudential discipline

Do not imply that a technical standard automatically creates legal rights, duties, liability, admissibility, or jurisdiction.

Legal and jurisprudential proposals should identify:

- the legal concept at issue;
- the institutional or jurisdictional context;
- procedural implications;
- unresolved conflicts;
- whether the text is descriptive analysis, a model rule, or a policy proposal.

2.1.16 2C. Standards and policy-proposal separation

The repository supports both:

1. technical/organizational standards; and
2. policy proposals, including proposals for international organizations.

Agents should keep these publication classes distinct.

A standard may define interoperable requirements.

A policy proposal may recommend institutional adoption, pilots, governance arrangements, capacity-building, or legal/policy experimentation.

For international-organization proposals:

- identify the intended organization or class of organizations;
- respect differences in mandate and authority;
- distinguish descriptive facts from recommendations;
- provide more than one institutional option when reasonable;
- identify implementation risks and safeguards;
- avoid presenting one political choice as inherently required by the technical standard.

2.1.17 2D. Publication-class discipline

Always distinguish among **Specifications**, **Standards**, and **International Political / Policy Proposals**.

2.1.18 Specification

Use for technically precise implementable material that has not necessarily passed the full standards-adoption process.

A Specification may contain normative technical language without being a Standard.

2.1.19 Standard

Use only for material formally adopted through the programme's standards-development procedure.

Do not call a draft, implementation model, schema, or experimental technical document a Standard merely because it is detailed.

2.1.20 International Policy / Institutional Proposal

Use for policy, governance, legal, or institutional options addressed to international organizations or other transnational public-interest actors.

Such proposals are recommendatory. They do not define conformance unless they separately reference an adopted Standard.

2.1.21 Cross-class rules

- A Specification may mature into a Standard only through an explicit promotion decision.
- A Standard may be cited by a Policy Proposal.
- A Policy Proposal may identify a new need for standardization, but it should not directly rewrite technical conformance requirements.
- Every publication should declare its class and maturity status near the beginning.
- When uncertain, classify conservatively and record the question in `docs/planning/open_questions.md`.

See `docs/framework/publication_taxonomy.md`.

2.1.22 2E. Standards-first development rule

The default development order is **Standard first, Specification when needed**.

Begin by defining the normative problem:

- purpose;
- scope;
- terminology;
- requirements;
- conformance expectations;
- institutional, epistemic, ethical, and legal constraints.

When a requirement depends on reusable technical infrastructure, create a Specification work item.

Use this pattern:

Standard Working Draft → identified infrastructure need → Specification → pilot → feedback to Standard

Do not interpret "Standards-first" as requiring a Standard to be finalized before specifications begin. They may co-evolve until the Standard reaches adoption.

Prefer to keep implementation details out of the Standard unless they are genuinely necessary for interoperability or conformance.

2.1.23 3. Normative language

Reserve:

- **shall** for requirements;
- **should** for recommendations;
- **may** for permissions;
- **can** for possibility or capability.

Do not use normative language casually in background or planning documents.

2.1.24 4. Traceability

For every substantive design decision:

1. record the issue;
2. identify alternatives;
3. state the selected direction;
4. record rationale;
5. identify affected documents.

Use `decisions/` for Architecture Decision Records (ADRs).

Do not erase superseded reasoning. Mark it as superseded and link to the new decision.

2.1.25 5. Uncertainty discipline

When a concept is not settled, label it explicitly:

- `OPEN`
- `PROVISIONAL`
- `EXPERIMENTAL`
- `DEFERRED`

Do not convert an unresolved philosophical position into a definitive standard clause.

2.1.26 6. Source discipline

Foundation manuscripts are especially important sources for GR-specific content. Agents should ground GR claims in them rather than reconstructing GR from general model knowledge or from memory alone.

When developing from external standards, papers, or attached source material:

- preserve source terminology accurately;
- distinguish source-derived material from new proposals;
- verify external references before incorporating them into normative or scholarly text;
- do not invent compatibility claims.

2.1.27 7. Ontology discipline

When defining Entity, State, Event, Process, Relation, or Property, each definition should eventually include:

- definition;
- admissibility conditions;
- identity criterion;
- temporal behavior;
- allowed relations to other classes;
- required metadata;
- optional metadata;
- examples;
- counterexamples;
- unresolved edge cases.

Relations must remain first-class recordable objects when their own states, properties, or histories matter.

2.1.28 8. Generativity-specific concerns

The standards family should be able to represent, where appropriate:

- generative conditions;
- contingent encounters;
- branches and alternatives;
- recognition and judgment;
- revision and reinterpretation;
- changes in available distinctions;
- changes in the possibility field;
- enabling and constraining relations;
- contribution and relational provenance;
- generativity return;
- uncertainty, absence, restriction, and loss.

Do not assume that final outputs are sufficient evidence of the process that generated them.

2.1.29 9. Category theory

Category theory is a candidate formal semantics, not a mandatory user-facing ontology.
Agents may explore:

- categories;
- spans and cospans;
- profunctors;
- double categories;
- fibrations/indexed categories;
- functorial observables;
- temporal and versioned structures.

Such proposals belong first in `technical_reports/` unless and until they are stable enough to constrain the information model.

2.1.30 10. Editing style

Prefer:

- explicit structural role at the beginning of sections;
- precise terminology;
- low ambiguity;
- restrained claims;
- short normative clauses;
- examples separated from requirements.

Avoid:

- rhetorical overstatement;
- unnecessary equivalence claims;
- vague words such as “everything,” “always,” or “all” unless logically required;
- replacing historical drafts with cleaned-up narratives.

2.1.31 11. Repository workflow

When making a substantive change:

1. update the relevant document;
2. update `CHANGELOG.md`;
3. create or update an ADR if the change affects architecture;
4. preserve unresolved questions in `docs/planning/open_questions.md`;
5. keep file numbering and publication codes stable.

2.1.32 12. Initial priority

The first priority is not GR-110 itself. It is the standards-development infrastructure:

1. Standards Programme Charter;
2. Directives Part 1;
3. Directives Part 2;
4. Technical Committee Charter;
5. New Work Item Proposal template;
6. Public Review and Comment procedure;
7. IP / ethics / conflict-of-interest policy;
8. Maintenance and versioning procedure.

Only after this governance layer is coherent should GR-100 and GR-110 be treated as formal standards projects.

3 CHANGELOG

Original source: `CHANGELOG.md`.
Original source SHA-256: `1ce87ae62317301dab7cc47dc3d66be5a406898c8b695719843a9828a7ec0cb4`.

3.1 Changelog

3.1.1 0.17 — Reproducible synthetic demonstration and application galleries

- Added the fictional River Commons inquiry to the generalized application: 31 records across all six operational roles, five Events, scoped and competing accounts, six retained materials, retrospective recording and a preserved chronology correction across seven project revisions.
- Added an authenticated API seeder with a separate synthetic account, ignored credentials, staged transaction recovery and checks for role coverage, historical contradiction and cut selection independent of recording history.
- Captured ten actual desktop and mobile interface views and documented their narrative, visible filtering and reproduction. Added gallery sections to the programme, infrastructure, generalized application and web application READMEs; parent repositories retain synchronized preview copies for submodule-safe image rendering.
- Expanded the demo's visualized-spacetime walkthrough: promoted event order, two explicitly labeled ontology cuts and subject trajectories into all four README galleries. Reframed both topology captures to retain the actual selected event frontier and contrast trial access with revised access at the same Git revision.
- Verified the populated demonstration, byte-identical material downloads and read-only screenshot workflow against the local application; an isolated reproduction check recovered an interrupted registration and preserved the complete history on rerun. Results are recorded in the application verification guide. The demonstration is informative synthetic material, not a real-world pilot or an assertion of Standard conformance; academia's native protocol and application remain unchanged.

3.1.2 0.16 — Experimental event order and spacetime topology

- Grounded the requested topology-at-event-cut view in actual foundation manuscript passages, preserving the distinction between occurrence, recording revision, event boundary, continuity, and causal-generative attribution. Recorded the selected alternatives and limits in ADR-0011 and the event-spacetime design.
- Added proposed temporal requirements to the current Markdown GR-120/140 Working Drafts, preserving existing IDs and historical TeX editions. Added experimental GR-SPEC-121 and additive references in GR-SPEC-120/130; no Standard adoption is asserted.
- Specified required version 1 event-order and temporal-extent modules under the existing 0.2 protocol, explicit predecessor-closed cuts, scoped trajectory grouping, active topology and retained contradiction/unknown-scope diagnostics. No automatic conversion of existing records or academia's native protocol is implied.
- Defined a read-only, authorized and revision-pinned spacetime GET/POST binding with bounded selections and anti-forgery protection. Module changes retain the existing accountable Git transaction path; recording order does not become target chronology.
- Implemented the common projection in package 0.3.0 and the generalized application's Spacetime and Time & trajectory controls. Styled the native file chooser and corrected draft, retry and concurrent-qualification preservation issues found during browser review.
- Verified 178 non-browser tests and seven browser tests across focused runs, including a final topology-overlap correction. Refreshed the local preview on 2026-09-27 and confirmed both existing project heads unchanged; see the implementation review. Academia's source and native protocol remain unchanged.
- Recorded Q-45–48 for alternative chronology accounts, interval semantics, subject continuity/effect modeling and participant comprehension. Verification results belong in the separate implementation review; these design changes do not by themselves establish successful checks, factual warrant or whole-programme conformance.

3.1.3 0.15 — Hosted source repository configuration

- Configured the four user-supplied GitHub remotes, replaced local submodule URLs with hosted URLs, and updated repository READMEs and the recursive-clone/development guide.
- Selected the user's Windows SSH identity in repository-local configuration; private key contents remain outside source control. Existing host verification remains enabled.
- Integrated academia's existing remote contributor-attribution commit into the migrated MIT repository, preserving both development histories and the earlier frozen source snapshots.
- Retained the application-to-infrastructure-to-programme publication order and separated source publication from private runtime records. Repository governance, CI and release policies remain open under Q-44.
- Published all four `main` branches and verified their remote references, nested commit pointers and a fresh GitHub recursive clone with 372 matching source files. See the hosted publication record.

3.1.4 0.14 — Independent repositories, nested submodules and MIT licensing

- Established the programme root, infrastructure and two applications as four independently committed Git repositories. Infrastructure pins both application repositories as submodules; the programme pins infrastructure. The enclosing repository's index and references remain unchanged.
- Preserved academia's original source history as actual ancestry and retained its original history bundle. New relocation, documentation and licensing changes are subsequent commits; private record repositories remain outside source history.
- Added boundary-local ignore rules, byte-preserving attributes, comprehensive repository READMEs, a submodule development/publication guide and a read-only structure checker. Local relative URLs support the present workspace; hosted remotes remain deferred at the user's direction.
- Applied the requested MIT grant to project-controlled content, added contributor attribution at each repository boundary and in distributable Python packages, aligned package metadata, and retained third-party and historical notices with explicit scope notes.
- Recorded ADR-0010, Q-44 and independent repository/recursive-clone verification. No application record schema, record bytes, account data or accepted record-history heads were changed.

3.1.5 0.13 — Application infrastructure consolidation

- Accepted ADR-0009 and established common packages plus independently runnable generalized and academia applications under `applicative_infrastructure/`; programme publications remain canonical at the root.
- Relocated the generalized application and record-protocol package, extracted the unchanged Git store into its own tested package, and introduced explicit runtime paths and separate reproducible Python environments.
- Imported academia source with its verified complete Git history bundle, per-file provenance, original README and licensing notices. Preserved native GRRP semantics and kept the original checkout untouched; semantic adapters remain deferred.
- Preserved the existing four accounts, three project repositories, record files and academia key material. Created private pre-migration backups, verified SQLite data and record inventories, and retained the generalized legacy project format without automatic conversion.
- Added setup and launch tools for separate ports 8000/8001, updated active documentation links and recorded migration verification, independent audit and remaining deployment questions. Old generalized source directories are retired into ignored operator backups after verification.
- Verified 128 generalized/common tests including browser journeys; 208 academia Python tests with one platform-specific skip; 91 academia TypeScript tests; production build; isolated deep-path record creation; and both live entry points. Inherited academia npm dependency advisories are recorded for separate maintenance.

3.1.6 0.12 — Experimental record graphs, atomic transactions and retained modules

- Reviewed the current GR manuscripts and the earlier academia application's actual source. Recorded current-manuscript precedence, conceptual mappings, implementation gaps and the separate academia migration boundary; no academia source was copied or modified.
- Added ADR-0008 and a detailed design separating semantic record graphs, Git revision history and local display state. Relations remain records with role-indexed incidences; repeated, unary, cyclic, parallel and higher-order participation is supported within the experimental profile.
- Developed bounded GR-120/130/140/160 Working Drafts for the identified requirements, preserving existing outlines and the coordinated nine-document TeX edition 0.3. Added implementable experimental GR-SPEC-120/130; no Standard adoption or independent interoperability certification is asserted.
- Added an application-independent Python protocol package, packaged JSON Schema, fixtures and CLI validation. Added overlapping roles, versioned modules, whole-candidate validation, RFC 8785 request digests, explicit legacy migration and preservation of opaque optional content.
- Implemented atomic Git transactions for records, modules, receipts and verified file bytes; durable retry recognition, conditional publication, pinned historical reads, bounded batch loading, supported-material ZIP exports and streamed files/history bundles.
- Added interactive graph/list views, visual selection and connection, multi-participant Relation forms, atomic connected-record creation, conditional notes/files/history panels, local layout, visible filters, historical project views and draft-preserving conflict review.
- Extended protocol, real-Git, API and browser checks. Recorded the current limits and unresolved cross-project references, governed erasure, independent custody, accessibility evaluation and academia identity/record preservation work.

3.1.7 0.11 — Experimental Git-backed web workspace

- Added a runnable Flask/Waitress web application with registration, login, logout, private projects and a responsive recording interface.
- Added one bare Git repository per project, structured JSON records, attributed revisions with reasons, historical views, current-snapshot exports and full-history bundles. Compare-and-swap publication prevents silent concurrent overwrites.
- Kept accounts, password hashes, expiring sessions and project authorization in SQLite outside project history; added CSRF, browser-security headers, authentication rate limits and input validation.
- Added API, real-Git and browser verification, reproducible runtime dependencies and local operation instructions.
- Recorded the implementation decision in ADR-0007, exact draft traceability and explicit feature/conformance limits in the application design, and Q-34–37 for collaboration, retention/recovery, richer epistemics and actual contestation. No Standard adoption or whole-practice conformance is asserted.

3.1.8 0.10 — Substantive validation and traced Working Draft 0.3

- Preserved the 0.2 source, tool and review baseline with hashes and copied its generated PDFs/reports before revision.
- Reviewed all 753 baseline requirement identifiers through 116 explicit topical groups, with actual foundation-manuscript passages, operational narrowing, findings and unresolved questions. Added a reproducible per-ID review matrix without treating editorial coverage as conformance.
- Added new P0/v2 and P1/v2 fixtures while preserving the original examples. Executed 18 ballot arithmetic/input cases; all matched the authored expectations. Added 208 P1 assessment rows that separate 54 selected documentary components from 154 whole-requirement coverage results.
- Prepared coordinated Working Draft 0.3: clarified invalid/unresolved ballot accounting, general versus conditional metamodel assessment, effect modality versus dispute dispo-

sition, and GR-210's vocabulary dependency. Added conditional recirculation requirement R110-112 with source rationale, semantic information and a discriminating assessment route.
- Retained the unresolved P1 retention arrangement and unperformed institutional actions explicitly; corrected a premature failure classification when its decision trigger was not established. Added readiness/burden evidence gaps and future measurement design; no participant effort, real procedural success or adoption is invented.
- Added ADR-0006, revision regression cases, Q-31–33, validation tooling, baseline-selectable change comparison, archive-integrity checks, and current publication/navigation updates.

3.1.9 0.9 — Expanded formal Working Drafts and ISO/IEEE/UN source models

- Expanded all nine governance and GR-100/110/200/210 documents to coordinated Working Draft 0.2, with detailed procedures, definitions, application conditions, semantic schedules, assessment obligations and worked examples.
- Added formal Foreword/Introduction, Scope, Normative references, numbered Terms and definitions, decimal clause hierarchy, captioned tables, labelled normative/informative annexes and bibliographies using a shared restrained TeX layout.
- Compared verified ISO publication models, accessible IEEE rules, ITU drafting guidance and UN statistical quality guidance. Recorded actual source access, unsuccessful downloads, and the successfully cached UN NQAF manual without importing external institutional authority or claiming compatibility.
- Preserved the complete 0.1 source/build-tool snapshot with hashes, retained all original requirement identifiers and added a reproducible text change register. Updated dated technical dependencies to 0.2; corrected the ethics acknowledgement/deadline ambiguity through explicit revision.
- Expanded independent-review capacity gates, ethics case handling and reconsideration, information/evidence methods, generative trajectory recording, and correction/maintenance procedures. Internal conduct criteria and proportionality remain proposed choices.
- Extended artifact checks for formal structure, local cross-references, archive integrity and historical ID retention. Added a new review record, ADR-0005 and Q-27–30; preserved earlier review and fixture scope as historical evidence.
- Updated publication navigation, development status, source register and project index. No adoption, appointment, licensing grant, real pilot success or international partnership is represented by these changes.

3.1.10 0.8 — Initial substantive working drafts and TeX publication package

- Developed five governance Working Drafts: Programme Charter, Directives Parts 1 and 2, GR/TC 1 Charter, and ethics/conflict/contribution-rights policy. They cover founding authority, appointments, review, consensus/ballots, appeals, maintenance, rights, records and separate publication-class routes.
- Developed preparatory GR-100, GR-110, GR-200 and GR-210 texts with stable requirement identifiers, bounded conformance subjects, source rationale, assessment methods and unresolved questions. No governance, committee, work item, Specification or Standard is represented as adopted by these edits.
- Separated claimed occurrence/modality from epistemic mode; required material maintenance/loss recording; made GR-200 package dependencies explicit; distinguished partial documentary assessment from observed institutional performance.
- Added shared TeX presentation, a nine-document manifest, WSL/LuaLaTeX build tooling with hashes and reports, PDF requirement-coverage checks and publication navigation. Generated build artifacts are ignored in source control.
- Added synthetic governance and contested-decision fixtures, an unsigned founding-agreement template, a requirement-assessment template, and expanded NWIP/comment/disposition templates without inventing operational evidence or signatures.
- Added Proposed ADR-0004, cross-document review evidence and Q-21–26. Preserved earlier Markdown outlines as historical planning material linked to the developed drafts.

- Updated programme navigation, Programme Brief development status and the project index. Governance adoption, actual appointments and rights terms, domain review, accessibility targets and live pilot evidence remain open.

3.1.11 0.7 — Comprehensive epistemic and practical development planning

- Reframed the programme brief and README around the confirmed motivation: symbolic crisis, warranted recognition, contestation, revision and practical action.
- Added a PROVISIONAL comprehensive plan connecting objectives, the existing publication portfolio, substantive domain work, dependencies, conformance subjects, milestone evidence and an immediate work queue.
- Added a comparative study of ISO/IEC, IEEE and WTO standards-development approaches, with official sources, access/edition limits and explicit local adaptation proposals.
- Added a cross-domain programme for epistemology, archives, jurisprudence, ethics, institutional governance, public policy, political economy and implementation, preserving their different sources of authority.
- Added a draft GR/NWIP-001, governance/pilot planning, protocol/Specification planning, and a verified candidate technical standards landscape. These do not adopt Standards or approve work items.
- Clarified that protocols describe behavior within Specifications or Standards and are not a separate publication authority class.
- Indexed the seven local foundation manuscripts and added source-to-operational-proposal traceability with unresolved terminology, version and formal-scope differences preserved.
- Added Proposed ADR-0003 with alternatives and rationale; retained accepted ADR-0002 as the governing Standards-first decision.
- Marked the earlier preliminary plan as historical and preserved its text, identifying its superseded specification-first wording.
- Added prioritized open questions and updated publication taxonomy, Specification-track guidance and project navigation.
- Added explicit publication-class and non-adoption labels to the existing standards-track and Specification placeholders without changing their identifiers.

3.1.12 0.6 — Standards-first, specifications-on-demand

- Added ADR-0002 establishing Standards as the default starting point.
- Clarified that Specifications are created when Standard requirements reveal reusable technical or infrastructure needs.
- Added the co-evolution loop: Standard WD → Specification → Pilot → Standard revision.
- Updated AGENTS, publication taxonomy, programme brief, preliminary plan, and README.

3.1.13 0.5 — Publication-class separation

- Added a formal taxonomy distinguishing Specifications, Standards, and International Political / Policy Proposals.
- Added `docs/framework/publication_taxonomy.md`.
- Added a new `specifications/` track with preliminary GR-SPEC placeholders.
- Added GR-IPP / GR-IIP identifiers for international policy and institutional proposals.
- Updated `AGENTS.md`, `PROGRAMME_BRIEF.md`, README, planning, open questions, and policy-proposal guidance.
- Clarified that technical precision, standards adoption, and political/institutional recommendation are different forms of authority.

3.1.14 0.4 — Multilayer architecture and policy-proposal track

- Expanded the programme beyond ontology to include epistemics, normativity, jurisprudence, governance, political economy, and implementation.
- Added `docs/framework/multilayer_architecture.md`.

- Added epistemic and jurisprudential background documents.
- Added provisional GR-200/210 epistemic standards, GR-300/310 jurisprudential standards, and GR-400 governance standard.
- Added a separate `policy_proposals/` publication track with an international-organizations folder and policy-brief template.
- Updated `PROGRAMME_BRIEF.md`, `AGENTS.md`, planning, README, and open questions to maintain the distinction between standards and policy proposals.

3.1.15 0.3 — Programme-level Why / What / How brief

- Added root-level `PROGRAMME_BRIEF.md` as the first-read orientation for contributors and reviewers.
- Added explicit Why, What, and How sections covering historical motivation, AI-era context, GR foundations, standards scope, document family, development lifecycle, source discipline, traceability, and pilot-driven implementation.
- Updated `README.md` to point new readers to the programme brief.
- Updated `AGENTS.md` so agents must consult the programme brief before substantive development.
- Linked the preliminary plan to the new brief.

3.1.16 0.2 — Foundation corpus and contextual background

- Added `foundation_manuscripts/` with a source-corpus README and manifest template.
- Added `docs/background/GR_background.md`.
- Added `docs/background/era_background.md`.
- Expanded `AGENTS.md` with foundation-manuscript consultation, source hierarchy, conflict handling, historical consistency, and terminology rules.
- Updated preliminary planning and open questions for manuscript-to-standard traceability.

3.1.17 0.1 — Initial project scaffold

- Created governance, standards, manual, technical-report, template, schema, example, and decision directories.
- Added preliminary background and planning documents.
- Added `AGENTS.md` for AI-assisted vibe development.
- Added provisional publication family and lifecycle.
- Added starter templates for new work items, comments, and architecture decisions.

4 CONTRIBUTING

Original source: `CONTRIBUTING.md`.
Original source SHA-256: `c86bf381512f428d92b523d034ca39f2ca5b1b7add2cc23546c21ffc39457d01`.

4.1 Contributing

This repository is in early standards-design mode.
Before proposing normative text:

1. identify the target publication;
2. check whether the issue is conceptual, procedural, normative, or implementation-specific;
3. add unresolved matters to `docs/planning/open_questions.md`;
4. create an ADR for architecture-level decisions;
5. preserve dissenting or superseded reasoning rather than rewriting history.

Public contribution and consensus procedures will be formalized in Directives Part 1.

4.1.1 Contribution terms and attribution

This repository's project-authored material is offered under the MIT licence, within the scope described in LICENSE.md. By intentionally submitting original work for incorporation, you offer that contribution under those terms while retaining your copyright. State your authority to contribute material on behalf of another rights holder, and identify third-party material and its licence separately. Submission for discussion alone is not an assignment of ownership or permission to redistribute material outside the terms you state.

Include your preferred name or organization and a brief contribution description in CONTRIBUTORS.md when your contribution is incorporated. Existing notices and contributors' attribution are preserved. AI tools can be acknowledged as tools; they are not added as copyright holders.

Application changes belong in the corresponding application repository; shared packages and launch tools belong in `applicative_infrastructure`. Each repository carries its own licence, contributor list and contribution guidance. The programme's draft ethics and IP policy remains a separate governance work item; the MIT grant does not imply its formal adoption.

5 CONTRIBUTORS

Original source: `CONTRIBUTORS.md`.

Original source SHA-256: `804303cad8053868d5c19e769a6ba55b24e583d418730bce11eca5c0c65fdee8`.

5.1 Contributors

Copyright (c) 2026 the contributors listed in this file, for their respective contributions.

Contributor	Recorded contribution
Wanhong Huang	GR foundation manuscripts, programme conception and direction, standards and application design.

Application contributors are also credited in the corresponding submodule contributor files. The foundation manuscript manifest records author attribution for the source corpus.

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6 LICENSE

Original source: `LICENSE.md`.

Original source SHA-256: `2a99e50c99ca72263b1fce18765149614ed59f5544b836e8acea21a5d39010d0`.

6.1 Licensing scope

Effective date: 2026-09-22. **Licence:** MIT. **Authority:** explicit project-owner instruction to license the four project repositories under MIT and credit their contributors.

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Material	Current terms
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7 PROGRAMME BRIEF

Original source: `PROGRAMME_BRIEF.md`.
Original source SHA-256: `2b591eab10c23cbdacffa2cab5e525f0af7766446f207680ff0d2f7cb847d3a8`.

7.1 Programme Brief

7.1.1 Why, What, and How We Develop the Generativity Standards

Status: Preliminary programme brief
Version: 0.5
Document class: Informative programme-level background

7.1.2 1. Purpose of this brief

This document gives a concise orientation to the Generativity Standards Program.
It answers three questions:

1. **Why** is a standards programme needed?
2. **What** is being standardized?
3. **How** will the standards be developed, reviewed, published, and maintained?

It is intended to be the first document read by new contributors, reviewers, collaborating organizations, and AI agents before they enter the more detailed governance, theoretical, or technical documents.

7.1.3 2. Why

7.1.4 2.0 Symbolic crisis, recognition, and practical action

The programme's organizing motivation is the symbolic crisis: instability in the connections among symbolic representations, their referents, institutional classifications, and practical trust. GRE Chapter 1, section 1.14, develops this diagnosis. It includes fabricated representations as well as sincere but outdated, partial, or inadequate categories. It does not imply that every representation has become unreliable.

The programme develops epistemic and practical infrastructure through which people and institutions can recognize reality, investigate factual claims, examine their grounds, contest interpretations, revise judgments and action, and preserve the trajectories through which knowledge and future possibilities develop. Archival loss and AI provenance are important components of this broader problem.

Reality, manifestation, representation, evidential warrant, institutional acceptance, and normative legitimacy remain distinguishable. Reality can precede recognition; records and classifications can also enter social relations and change what happens later. Technical conformance, authentic provenance, or institutional acceptance does not by itself establish that a substantive claim is true.

The infrastructure consequently concerns both what changes and how it becomes knowable and actionable. It also concerns who can produce evidence, challenge a classification, obtain review, and participate in shaping the conditions of future generation.

Source interpretation and proposed operational translations are recorded in the foundation traceability map. The current development proposal is the comprehensive plan.

7.1.5 2.1 The historical problem

Contemporary knowledge production increasingly leaves behind abundant outputs while preserving much less information about how those outputs became possible.

A paper may survive while the following disappear:

- the encounters that redirected the inquiry;
- the relations that enabled the work;

- the alternatives that were considered and abandoned;
- the changes in judgment that occurred over time;
- the conditions under which an idea became recognizable;
- the capacities that were created, weakened, or lost;
- the role of human, institutional, computational, and environmental contributors.

A final artifact therefore often preserves substantially less than the generative history from which it emerged.

7.1.6 2.2 The AI-era problem

AI-assisted work intensifies this problem.

A simple statement such as “AI was used” does not reveal:

- what role the AI system played;
- which materials were supplied to it;
- which outputs were selected or rejected;
- how human judgment interacted with machine-generated material;
- which later ideas depended on earlier AI-mediated encounters;
- how the trajectory changed through repeated interaction.

As automated and agentic systems become increasingly involved in research, education, policy, design, and administration, conventional provenance records may be too coarse to preserve the relevant history of generation.

7.1.7 2.3 The generativity problem

The programme is motivated by a broader GR concern: the history of a process includes more than its manifested outputs.

Of particular interest are changes in:

- available distinctions;
- relational structures;
- constraints;
- possible continuations;
- interpretive frames;
- generative capacities.

A process may produce a modest output while opening an important future trajectory. Another may produce a highly valued output while exhausting the conditions that made future generation possible.

For this reason, output history and generativity history should not be treated as equivalent.

7.1.8 2.4 The archival problem

Future observers may need to do more than retrieve an artifact.

They may need to ask:

- How did this become possible?
- Which relations mattered?
- What was known or believed at the time?
- Which alternatives were visible then?
- Which later interpretations rewrote the earlier history?
- Which possibilities remained unrealized?
- Which records are absent, restricted, lost, or destroyed?

A durable standards programme can help preserve enough structured information for later reconstruction, reinterpretation, contestation, and continuation.

7.1.9 3. What

7.1.10 3.1 Object of standardization

The programme develops standards for the recording, preservation, exchange, presentation, assessment, contestation, and revision of **generativity-related records**, and for their accountable use in inquiry and practical action.

The programme does not attempt to standardize a complete metaphysics of reality.

It develops an operational framework through which generative histories and the grounds of claims about them can be recorded in a consistent, inspectable, and interoperable form. It distinguishes changes in the situation under inquiry, changes in evidence and judgment, and changes in categories or methods of recognition.

7.1.11 3.2 Conceptual architecture

Within the wider multilayer architecture, a foundational distinction separates the following two levels.

7.1.12 Deep metamodel

The GR background emphasizes four highly abstract dimensions:

- Constraint
- Change
- Structure
- Difference

These belong to the foundational theoretical layer.

7.1.13 Operational record ontology

The standards programme currently explores six operational record classes:

- Entity
- State
- Event
- Process
- Relation
- Property

These are candidate standardized forms for recording.
They are not assumed to be ultimate ontological kinds.

7.1.14 3.3 What a generativity record may need to preserve

Depending on the profile and use case, a record may include:

- entities and participants;
- states and state changes;
- events and processes;
- relations;
- properties and observations;
- temporal information;
- provenance;
- perspective;
- epistemic status and uncertainty;
- generative conditions;
- contingent encounters;
- decisions and judgments;
- alternatives and unrealized branches;
- enabling and constraining relations;

- later reinterpretations;
- changes in available distinctions;
- changes in future possibilities;
- generativity return;
- access, privacy, restriction, and retention metadata.

7.1.15 3.4 Standards family

The programme is intended to produce a family of coordinated documents rather than one monolithic standard.

The provisional family includes:

- **GR-100 — Foundations and Vocabulary**
- **GR-110 — Generativity Recording Requirements**
- **GR-120 — Generativity Information Model**
- **GR-130 — Generativity Interchange Specification**
- **GR-140 — Generativity Presentation Requirements**
- **GR-150 — Conformance and Validation**
- **GR-160 — Preservation, Privacy, Access, and Retention**
- **GR-200 — Epistemic Recording Framework**
- **GR-210 — Evidence, Interpretation, and Contestation**
- **GR-300 — Jurisprudential Interface**
- **GR-310 — Rights, Duties, and Procedural Profiles**
- **GR-400 — Governance and Institutional Use**

These identifiers currently name preliminary standards-track projects, not adopted Standards. Their proposed coordinated scopes and dependencies appear in the comprehensive plan. Existing GR-120/130 project titles are retained; their requirements are distinguished from the implementable details in GR-SPEC-120/130. GR-SPEC-200 supports epistemic representation where draft requirements establish the need.

Supporting publications include:

- manuals;
- implementation guides;
- technical reports;
- schemas;
- validation artifacts;
- worked examples.

7.1.16 3.5 Normative and non-normative layers

The programme deliberately separates:

- **normative standards**, which define requirements, recommendations, permissions, and conformance;
- **manuals**, which provide practical guidance;
- **technical reports**, which develop theory, mathematical semantics, comparison, and experimental ideas;
- **foundation manuscripts**, which preserve GR conceptual history and source material.

This separation allows the standards to remain operational without losing contact with their theoretical foundations.

7.1.17 3A. Beyond ontology: epistemic, normative, legal, and institutional dimensions

The programme does not assume that a sufficiently detailed ontology alone can produce an adequate generativity record.

A mature framework must also specify how records are:

- known;
- evidenced;
- interpreted;
- contested;
- normatively evaluated;
- legally recognized;
- institutionally used;
- politically and economically situated.

Accordingly, the programme now treats ontology, epistemics, normativity, jurisprudence, governance, political economy, and technical implementation as interacting but distinguishable layers.

See `docs/framework/multilayer_architecture.md`.

7.1.18 3B. Dual outputs: standards and policy proposals

The programme may produce two coordinated families of public outputs:

1. **standards and technical infrastructure**, concerned with interoperable requirements, models, profiles, and conformance; and
2. **policy and institutional proposals**, concerned with how international organizations and other institutions may pilot, adopt, govern, or build capacity around these infrastructures.

Policy proposals are not themselves standards, and standards do not by themselves settle political or legal choices.

7.1.19 3C. Publication classes

The programme distinguishes three principal public-output families:

1. **Specifications** — technically precise and implementable documents that may be experimental, candidate, or stable without yet being formal Standards.
2. **Standards** — formally adopted normative publications with programme-level conformance authority.
3. **International Political / Policy Proposals** — recommendatory institutional or policy publications directed to international organizations or other transnational actors.

This distinction prevents technical precision, formal standardization, and political/institutional recommendation from being treated as the same kind of authority.

See `docs/framework/publication_taxonomy.md`.

7.1.20 4. How

7.1.21 Protocols within publication classes

A protocol describes behavior: participants, interactions, states, transitions, outcomes and failures. Protocols are technical subjects documented in Specifications or, after formal adoption, Standards. They do not create a separate publication authority class. Institutional review procedures and machine-to-machine protocols can support the same purpose while requiring different implementation and assessment methods.

7.1.22 Comparative and cross-domain development

The programme studies ISO/IEC and IEEE standards-development approaches, ITU technical publication practice, and relevant UN-system quality and institutional frameworks to inform its own proportionate procedures. The comparative study distinguishes source practices, proposed adaptations and unresolved governance choices. The drafting-model study records verified ISO, IEEE, ITU and UN sources, their different functions, and access limitations. This work does not imply affiliation, accreditation or compliance with those organizations' procedures.

The cross-domain programme connects the mission to epistemology, archival practice, jurisprudence, ethics, institutional governance, public policy, political economy and implementation. These domains contribute substantive work and review throughout development; they are not reduced to metadata fields or a final compliance check.

7.1.23 4A. Standards-first development

The default programme logic begins with the Standard.

The Standard identifies what a conforming practice should achieve. If those requirements create a need for shared technical infrastructure, the programme develops one or more Specifications.

This yields a recurring development loop:

Standard Working Draft → Specification need → Specification → pilot → revision of the Standard

The Standard and Specification may therefore co-evolve before publication.

7.1.24 4.1 Develop the standards programme before the standards

The programme first establishes the rules by which standards are created.

The initial governance layer includes:

- Standards Programme Charter;
- Directives Part 1 — Procedures for Development and Maintenance;
- Directives Part 2 — Structure and Drafting Rules;
- Technical Committee Charter;
- public review procedure;
- consensus and decision policy;
- conflict-of-interest and ethics policy;
- intellectual property policy;
- maintenance and versioning procedure;
- records and transparency policy.

This creates a defined process through which later GR standards can claim procedural consistency.

Validation-revised preparatory version 0.3 texts for this governance layer and GR-100/110/200/210 are available in the working-draft package. Versions 0.1 and 0.2 remain archived. The substantive validation cycle covers the 753 baseline identifiers through explicit review groups, new synthetic P0/P1 fixtures, bounded component assessments and executed ballot arithmetic. It identifies supported corrections without establishing governance adoption, institutional performance or legal authority. Readiness and burden evidence remains necessary before those claims.

7.1.25 4.2 Development lifecycle

The provisional standards lifecycle is:

Stage	Status
00	Preliminary
10	Proposal
20	Working Draft
30	Committee Draft
40	Public Review Draft
50	Final Approval Draft
60	Published Standard
90	Review / Revision / Withdrawal

The process is intended to remain lighter than ISO while preserving comparable principles of traceability, review, versioning, and maintenance.

7.1.26 4.3 Evidence and source discipline

The programme distinguishes several kinds of authority.

- Governance directives govern the standards-development process.
- Published standards govern conformance.
- Accepted ADRs govern project architecture.
- Foundation manuscripts provide source authority for GR concepts.
- Working drafts and planning documents remain provisional.

Agents and contributors should not silently convert a theoretical statement into a normative requirement.

Where a standard intentionally narrows or operationalizes a broader GR concept, the divergence should be explicit and traceable.

7.1.27 4.4 Foundation manuscript workflow

The folder `foundation_manuscripts/` serves as the project-local GR source corpus.

When relevant manuscripts are added, contributors should:

1. index them in `foundation_manuscripts/MANIFEST.md`;
2. identify important concepts and notation;
3. record historical changes and tensions;
4. map relevant ideas to candidate standards clauses;
5. preserve disagreements and revisions;
6. create an ADR when a standards-specific interpretation materially departs from the source corpus.

7.1.28 4.5 Issue and decision traceability

Substantive changes should leave a visible record.

The preferred pattern is:

$$\text{Issue} \rightarrow \text{Alternatives} \rightarrow \text{Decision} \rightarrow \text{Rationale} \rightarrow \text{Affected documents}$$

Architecture-level decisions are recorded as ADRs.

Public-review comments should likewise record:

$$\text{Comment} \rightarrow \text{Disposition} \rightarrow \text{Rationale} \rightarrow \text{Resulting change}$$

The development process should itself exemplify the kind of generative traceability the standards seek to support.

7.1.29 4.6 Incremental implementation

The programme should avoid attempting to solve the entire conceptual problem before implementation begins.

A preferred development strategy is:

1. establish governance;
2. stabilize core vocabulary;
3. define a minimal coordinated recording, epistemic, presentation, protection and review profile;
4. test it first on bounded examples and then on appropriately governed real use cases;
5. develop the information model;
6. build exchange schemas;
7. test independent implementations;
8. revise through public and technical review;
9. refine conformance using assessment methods drafted alongside the requirements;
10. maintain the standards as the field evolves.

7.1.30 4.7 Pilot-driven development

Candidate pilots include:

- individual research;
- AI-assisted manuscript development;
- collaborative research;
- institutional decision processes;
- historical reconstruction from incomplete archives.

Pilots are used to test whether the standards are sufficiently expressive without becoming impractically burdensome.

The current planning proposal begins with the programme's own documented decision history and a synthetic contested institutional case. A complete pilot cycle includes evidence, interpretation, challenge, reasoned response or revision, protection, presentation and practical consequences. Real external pilots depend on actual institutional participation and appropriate access arrangements. No participation is presumed.

The comprehensive development plan sets out the proposed portfolio, milestone evidence, dependencies and immediate work queue. The earlier preliminary plan remains available as a historical draft. Planning does not substitute for governance adoption or work-item approval.

7.1.31 5. Design principles

The programme currently follows these principles:

- preserve trajectory, not only output;
- distinguish occurrence from interpretation;
- distinguish present validity from historical existence;
- treat relations as first-class when their own histories matter;
- preserve uncertainty rather than forcing premature certainty;
- preserve alternatives without implying equal feasibility;
- separate preservation from publicity;
- expose mediation in reconstructed presentations;
- distinguish evidence integrity from the warrant of a claim;
- support meaningful contestation and revision of action as well as correction of records;
- examine how recording and recognition affect participation and future possibilities;
- support future reinterpretation;
- maintain compatibility with GR foundations without turning philosophical theory directly into compliance language;
- allow standards to evolve while preserving their own development history.

7.1.32 6. Intended outcome

The long-term goal is a standards infrastructure that supports warranted, revisable recognition and practical action while enabling future actors to recover more than a final artifact.

A successful record should help a later observer understand, within the limits of available evidence:

- what changed;
- what relations mattered;
- what was recognized at the time;
- what alternatives were available;
- how judgments evolved;
- how the field of future possibilities changed;
- and how the recorded process may be continued or reinterpreted.

The programme therefore aims at three linked capacities:

$$\text{future re-recognizability} + \text{reinterpretability} + \text{regenerability}.$$

These capacities provide the broad orientation for the standards family while remaining subject to refinement through the formal standards-development process.

8 README

Original source: `README.md`.

Original source SHA-256: `c0d3d6198fd02f9f64ea027499adf0daa1ebfddc6609ac3b741c729f0cfa737f`.

8.1 Generativity Standards Program

Status: Preliminary standards programme and experimental applications; no adopted technical Standards.

Start here: Programme Brief ·Development plan ·Application setup

Source repository: Generativity-Epistemic-Infrastructure

The Generativity Standards Program develops epistemic and practical infrastructure for recognizing, recording, examining, contesting and revising claims about reality and its generative trajectories. Its concern includes the conditions, encounters, relations, judgments, alternatives and changes in possibility through which an outcome becomes possible.

The programme responds to **symbolic crisis**: instability in the connections among representations, their referents, institutional classifications and practical trust. A traceable record can help people inspect a claim and its grounds. Provenance, technical validity and institutional acceptance remain distinct from the truth of that claim.

This repository brings together the theoretical source corpus, development procedures, working drafts, specifications, review evidence and an application infrastructure maintained through nested Git submodules.

8.1.1 What is being developed

Area	Current work
Standards-development governance	Charter, directives, committee arrangements, ethics and contribution rights, review, maintenance and decision procedures
Recording and presentation	Operational records, relations, generative trajectories, provenance, uncertainty, revision, protection and presentation
Epistemic and institutional practice	Evidence, interpretation, contestation, judgment, jurisprudential interfaces, governance and policy options
Technical infrastructure	Experimental information model, transaction protocol, Git storage, modules, schemas and executable verification
Applications	A generalized visual record workspace and an independent academia application

The conceptual architecture distinguishes the deep metamodel of **constraint, change, structure and difference** from the operational record roles **Entity, State, Event, Process, Relation and Property**. These roles support recording; they do not exhaust GR theory or describe ultimate constituents of reality. Ontological, epistemic, normative, legal, institutional, political-economy and implementation concerns retain their different kinds of authority. See the multilayer architecture and foundation traceability map.

8.1.2 Publication status and reading guide

The publication package contains nine developed TeX working drafts at version 0.3, with prior editions retained. Governance adoption, actual appointments and formal technical work-item approval remain pending. The review dossier records substantive findings, synthetic assessments and remaining evidence gaps.

Publication or source	Read it for
Programme Brief	Motivation, scope, authority and development process
Foundation manuscripts	GR terminology, conceptual history and source interpretation
Governance	Proposed procedures for developing and maintaining the programme
Working-draft package	Charter, Directives, GR/TC 1 charter, ethics/IP, GR-100/110/200/210
Standards-track projects	Draft requirements, including GR-120/130/140/160 and further planned projects
Specifications	Implementable experimental models and protocols, particularly GR-SPEC-120/121/130
Manuals and technical reports	Practical guidance, theory, comparison and experimental semantics
Policy proposals	Recommendatory institutional and public-policy options
Planning and open questions	Dependencies, priorities and unresolved decisions
ADRs, reviews and changelog	Decisions, evidence and development history

A **Specification** can contain precise technical requirements without being an adopted **Standard**. A **Policy / Institutional Proposal** recommends choices and does not itself define technical conformance. The publication taxonomy explains these boundaries.

The working sequence is **Standard Working Draft → infrastructure need → Specification → pilot → feedback to Standard**. The comparative study and drafting models examine ISO/IEC, IEEE, ITU and UN practices without claiming affiliation or adoption of those organizations' authority.

8.1.3 Repository layers

```
generativity_standards_program/             Git repository: programme and canonical publications
├── governance/  standards/  specifications/
├── foundation_manuscripts/  publications/
├── manuals/  technical_reports/  policy_proposals/
├── docs/  decisions/  examples/  schemas/  templates/  tools/
└── applicative_infrastructure/             Git submodule: shared implementation and operations
    ├── common/                            Tracked by the infrastructure repository
    │   ├── packages/gsp_record_protocol/
    │   ├── packages/gsp_git_store/
    │   ├── design/  conformance/
    │   └── tools/
    ├── gr_generalized_application/         Git submodule: generalized application
    ├── gr_academia_application/            Git submodule: academia application
    └── .runtime/                          Ignored private data and local environments
```

These are four source repositories with independent histories. The programme pins an infrastructure commit; that infrastructure commit pins one commit from each application. Shared packages belong to the infrastructure repository. Canonical standards and manuscripts remain in the programme repository.

Repository	Hosted source
Programme	Generativity-Epistemic-Infrastructure
Infrastructure	Generativity-Relational-Epistemic-Applicative-Infrastructure
Generalized application	Generalized-Generativity-Relational-Social-Science-Application
Academia application	Generative-Relational-Academia-Application

The applications also create Git repositories for **user project records** inside their private runtime. Those data repositories have a different purpose and are never application-source submodules.

8.1.4 Obtain the complete workspace

With GitHub SSH access configured, clone the programme and both levels of submodules:

```
git clone --recurse-submodules git@github.com:huangwanhong-maker/Generativity-Epistemic-Infrastructure.git
↪  generativity_standards_program
cd generativity_standards_program
```

For an existing checkout, synchronize the committed submodule URLs and initialize the pinned revisions:

```
git submodule sync --recursive
git submodule update --init --recursive
git submodule status --recursive
```

The submodule URLs use SSH and require access to all four repositories. The Git workflow guide documents the Windows SSH identity setup, remotes and dependency order for publishing. Cloning an application alone obtains its source; the full setup below expects the parent infrastructure layout and shared tools.

8.1.5 Work across repository boundaries

Make and commit a change in the repository that owns the file. When an application changes, commit it first, then commit its updated submodule reference in infrastructure, then commit the infrastructure reference in this programme. A common-package change starts at infrastructure; a standards-only change stays in this repository. Record architectural decisions and affected publication requirements in the programme alongside implementation changes.

Submodule updates check out the revisions selected by the parent repositories. They do not automatically select a domain application's newest work. Before changing a pin, review the relevant change and its verification evidence. See the Git workflow guide for the repository boundaries and maintenance commands.

8.1.6 Run the applications

Requirements: Python 3.11 or later and Git. Academia additionally requires Node.js and npm; the validated setup uses Node 22, and its current frontend tools require Node 22.12 or later on that release line. Dependency installation needs package-registry access. The generalized interface has no Node build.

From this programme directory:

```
python applicative_infrastructure/common/tools/setup_application.py generalized --dev
python applicative_infrastructure/common/tools/setup_application.py academia --dev
```

Launch in separate terminals:

```
python applicative_infrastructure/common/tools/run_application.py generalized
python applicative_infrastructure/common/tools/run_application.py academia
```

Application	Local address	Current scope
Generalized workspace	http://127.0.0.1:8000	Registration, private projects, record graphs, event-defined spacetime and trajectories, first-class Relations, notes/files, atomic Git transactions, historical views and exports
Generative Relational Academia	http://127.0.0.1:8001	Research projects, question-led trajectories, graph exploration, domain record operations, workspaces and native GRRP tooling

Use Python 3's local command name where appropriate on Linux/WSL. The infrastructure guide covers ports, environments, configuration, accounts, backups and independent operation.

The generalized application implements the experimental gsp-record-protocol/0.2 model and gsp.general/0.2 profile. Academia retains native **GRRP v0.1**. Shared account authority, single sign-on and a completed GRRP/general-protocol adapter are not present. Earlier generalized records are converted only through an explicit migration request.

8.1.7 Application gallery: River Commons

River Commons is a comprehensive synthetic demonstration of the generalized workspace: 31 records across all six operational roles, five Events, six retained source files and seven Git revisions. A fictional garden inquiry develops through encounters, provisional access, shared work, competing accounts and later corrections. The later review is recorded before its earlier context, making represented event order visibly distinct from recording order.

[Image description: River Commons record graph with a first-class Relation and its participant roles]

[Image description: Event precedence and an event-defined boundary in the River Commons project]

8.1.8 Visualized spacetime

Space is the ontology topology at a chosen event boundary. The event partial order above supplies the boundaries; the views below show which scoped records and connections apply. Both use the same preserved Git revision.

After the provisional access agreement: two events have passed, and 10 records enter this projection. The trial-access State and provisional stewardship Relation apply.

[Image description: Spacetime after the access agreement: selected event frontier, ontology topology and trial-access State]

After the shared review: four events have passed, and 13 records enter the projection. Trial accounts end; revised access, a renewed stewardship arrangement and the workload concern apply.

[Image description: Spacetime after the review: selected event frontier, changed topology and revised-access State]

Follow a subject through these boundaries. The garden's descriptions progress from **Access not yet arranged** through **A garden open for a trial** to **Access under a revised rota**. The trajectory view retains their explicit event bounds, competing descriptions and uncertainty.

[Image description: Subject trajectories with active, ended and indeterminate descriptions]

These are selected cuts of a partial order, not equally spaced clock instants. The independent water observation remains unordered; incomparable events are not asserted simultaneous. Choosing a boundary changes the view without creating a Git revision.

The full ten-image gallery also shows two temporal cuts of the same revision, subject trajectories, retained files, the upload dialog, a preserved contradiction and a mobile view. The graph overview's visible **care** filter displays 11 of the 31 records; its node positions are arranged for readability. Every account and source material is fictional.

Follow the demo guide to create a separate local demo account and project, explore the story, or reproduce the screenshots. Credentials and runtime records stay outside source control. Preview copies are maintained inside this repository so these images also render across Git submodule boundaries on GitHub.

8.1.9 Verification and publication builds

The application verification guide gives isolated package, API and browser test commands. The relocation report records **427 passing tests and one platform-specific skip**, production builds and preservation checks from the application migration. These are dated implementation results, not a claim of programme adoption, institutional conformance or production readiness.

The subsequent spacetime implementation review records **185 passing tests across focused runs** for the updated generalized/common implementation, including seven browser tests. The event-spacetime design explains how event-defined cuts select represented topology independently of Git recording order.

To compile the nine working drafts using an installed TeX environment:

```
python tools/build_publications.py --wsl Ubuntu-24.04
python tools/check_publications.py
python tools/check_validation_package.py
```

The first two commands need the compiler, fonts and Python packages documented in the publication build guide. WSL/Linux users can run the build script directly with Python 3. Generated PDFs and reports live in ignored build output; a fresh clone needs compilation before generated-PDF links become available.

8.1.10 Data, provenance and preservation

Application source, personal runtime data and generated build output have separate lifecycles. Private account databases, sessions, keys, user project repositories, environments and dependency trees are excluded from source control. A source clone does not transfer user accounts or research records. Back up complete runtime directories using the operation guidance.

Academia's original source history remains in its repository ancestry and a verified Git bundle with an import manifest. The original checkout remains separate. Historical publications and source notices retain their original wording; later decisions and additional grants are recorded explicitly.

8.1.11 Contributing

Read PROGRAMME_BRIEF.md and AGENTS.md before substantive work. Consult foundation manuscripts for GR-specific definitions and preserve disagreements instead of silently reconciling them. Use normative terms deliberately and label unresolved proposals.

For a substantive change, update the affected document, record the issue and alternatives, add or amend an ADR when architecture changes, update CHANGELOG.md, and retain unresolved matters in open questions. Use the templates for work items, comments and assessment evidence. Implementation checks belong with the repository owning the code; programme decisions and conformance authority remain here.

See CONTRIBUTORS.md for contribution attribution and how to maintain the contributor record.

8.1.12 License

Project-authored material is available under the MIT License, with copyright held by its contributors as recorded in CONTRIBUTORS.md. The scope and historical-license notes explain the additional grant, retained historical notices and exclusions. Third-party components keep their own terms; application users' records and uploaded materials are not relicensed merely by being stored in these applications. Each submodule carries its own license and contributor files.

9 WRITING PRINCIPLES

Original source: `WRITING_PRINCIPLES.md`.
Original source SHA-256: `f12e627e0e2a2d8b2a3a13a5b9ad13974304bdb4e73807c3f6052406d3b03104`.

9.1 GRE Writing Principles

This file governs drafting across the entire book. It should be supplied at the beginning of every drafting session together with the relevant chapter session packet.

9.1.1 1. Structural titles

Any Part, Chapter, section, subsection, subsubsection, table-column title, figure-panel title, or comparable structural title should avoid:

- question forms such as `Why ...`, `What ...`, `How ...`, `When ...`, or titles ending in `?`;
- claim-form titles that read like a conclusion rather than a structural locator;
- quantifier-phrase titles such as `All ...`, `Every ...`, `No ...`, unless a technical term genuinely requires it;
- negative or contrastive titles built around `not`, `no`, `instead`, `rather`, or similar oppositional framing;
- ambiguous titles such as `The Problem`, `The Criterion`, `The Issue`, `Discussion`, `Some Remarks`, or titles that carry little information outside their immediate context.

A good title should identify the **structural role, analytical object, and local context** of the material.

9.1.2 2. High cohesion and low coupling

Each section should be understandable even when read directly rather than only as the next turn in a conversation. Section openings should therefore avoid ambiguous pronouns, deictic expressions, and context-dependent phrases such as `this`, `that problem`, `the above`, or `as we just saw` when the referent is not named explicitly.

A section should introduce its own analytical object with enough precision that the reader can recover the local argument without reconstructing the entire preceding conversation.

9.1.3 3. Section openings

The opening paragraph of every section should, where appropriate, state:

1. the section's **role** in the chapter;
2. the section's **objective**;
3. the **structure** of the discussion;
4. the **method or mode of argument** when it matters (historical, interpretive, empirical, formal, comparative, normative, etc.).

The opening should remain scholarly and direct. Avoid essay-like hooks, conversational scene-setting, casual rhetorical questions, or vague motivational prose.

9.1.4 4. Positive and direct prose

Avoid negative contrast constructions when a positive formulation is available, especially:

- `not ... but ...`;
- `is not ...; rather ...`;
- `instead of ...` used as a repeated argumentative device;
- stacked negations used to define a concept only by exclusion.

Negative distinctions remain permissible when analytically necessary, but positive specification should carry the argument whenever possible.

9.1.5 5. Scholarly register

Use formal scholarly prose rather than conversation-like or essayistic prose. Avoid casual transitions, rhetorical filler, and unsupported evaluative adjectives. Claims should state their scope, evidential standing, and limitations precisely.

9.1.6 6. Figures and tables

Every figure and table must:

- have a descriptive caption;
- have a unique `\\label{...}`;
- be referenced in the main text at least once with `Figure~\\ref{...}` or `Table~\\ref{...}`;
- be placed at the **top of a page** wherever feasible, using `[!t]` as the default float placement;
- avoid appearing as an unintroduced visual object.

A figure or table should serve an analytical purpose stated in the prose. Decorative figures are inappropriate.

9.1.7 7. Citation verification before drafting

Every external reference written into the manuscript must be verified from the internet before it is inserted into the paper. Post-verification is not allowed.

Before using a citation:

1. verify the bibliographic record from an authoritative or reliable online source;
2. verify that the source actually supports the intended claim;
3. add the citation to `refs/references.bib`;
4. add a row to `refs/VERIFICATION_LEDGER.tsv` with status `VERIFIED`;
5. only then insert the citation into manuscript prose.

A remembered citation, model-generated citation, secondary citation copied without verification, or plausible-looking bibliographic entry is insufficient.

9.1.8 8. Formula placement and equation discipline

Short mathematical expressions should remain inline when they fit naturally within a sentence.

A displayed formula is appropriate only when display materially improves readability or when the expression is analytically important. Every displayed equation must:

- use a numbered environment such as `equation`, `align`, or `gather` rather than `\\[ ... \\]`, `$$ ... $$`, `equation*`, or `align*`;
- have a unique `\\label{eq:...}`;
- be referenced at least once in the main text with `Equation~\\ref{eq:...}`.

When prose introduces a displayed equation, the preceding prose sentence should be grammatically complete and end with a full stop. For example:

```
The local transformation law is stated in Equation~\\ref{eq:local-law}.
\\begin{equation}
  x_{t+1}=F(x_t,R_t)
  \\label{eq:local-law}
\\end{equation}
```

Do **not** write a comma immediately before a displayed equation as if the display were merely a continuation of an unfinished sentence.

Natural-language relations should be described in prose. Do not use mathematical arrows, `\\neq`, plus signs, or other mathematical operators as shorthand for ordinary-language claims unless the symbols have been formally defined and are doing genuine mathematical work.

9.1.9 9. Formalism must earn its place

Do not introduce mathematics merely to make prose appear rigorous. Every formal object should have:

- a defined analytical role;
- explicit assumptions;
- a stated relation to evidence or interpretation;
- a statement of scope and limitations where necessary.

Formal analogy, structural formalization, and empirically parameterized model should be distinguished.

9.1.10 10. Boxed formulae

Avoid `\\boxed{...}` and visually boxed formulae as a default stylistic device. Use theorem-like environments, propositions, definitions, remarks, or ordinary displayed equations when formal emphasis is needed.

9.1.11 11. Structural blocks

Definitions, propositions, claims, lemmas, theorems, remarks, examples, conjectures, hypotheses, and cautions may be used where they sharpen structure. They should not be used mechanically. Each block type should correspond to its actual epistemic standing.

Use `claim` for a substantive claim whose status is argued in the chapter, `hypothesis` for a testable or provisional mechanism, and `remark` for clarification that does not carry the main argument.

9.1.12 12. Claim strength and revisability

GRE is an open research programme. Distinguish carefully among:

- established argument within the book;
- proposal;
- hypothesis;
- heuristic;
- analogy;
- formal representation;
- empirical finding;
- open problem.

Avoid presenting a useful representation as an ontological proof or a preliminary hypothesis as a settled result.

9.1.13 13. Epistemic humility and scope discipline

Scholarly writing should maintain a close correspondence between the strength of a statement and the strength of its available support. GRE treats intellectual humility as part of responsible and ethical research practice rather than merely a stylistic preference.

Use universal, categorical, or near-universal formulations with particular care. Expressions such as `all`, `every`, `any`, `none`, `never`, `always`, `must`, `cannot`, and categorical constructions beginning with `No ...` should appear only when the relevant domain, assumptions, and evidential basis justify the stated scope.

Where support is partial, historically situated, domain-specific, interpretive, provisional, or theoretically mediated, prefer language that preserves that status. Depending on the local argument, suitable formulations may include `may`, `can`, `often`, `tends to`, `under these conditions`, `within the present framework`, `in the cases considered here`, `the analysis suggests`, `the present argument proposes`, and comparable scoped expressions.

Epistemic humility does not require vague or weak writing. State arguments clearly and directly while preserving their actual domain of validity, uncertainty, and revisability. Avoid strengthening a conclusion beyond the evidence for rhetorical effect. Distinguish observed

evidence from interpretation, interpretation from theoretical extension, and theoretical extension from broader conjecture. Relevant uncertainty, counterevidence, alternative interpretations, and limitations should remain visible when they materially affect the argument.

Strong formulations remain appropriate where they are established by definition, formal proof, explicit assumptions, procedural requirements, legal or institutional rules, or sufficiently robust evidence. Their scope should remain identifiable from the surrounding argument.

9.1.14 14. Ontological restraint

The current GRE framework uses ontological suspension. Relational, field-theoretic, geometric, dynamical, category-theoretic, and spacetime language may provide useful representations without establishing the ultimate ontology of the economic or social world.

9.1.15 15. Historical and disciplinary restraint

Economic concepts, methods, values, and disciplinary boundaries are historically generated. Avoid treating historically specific categories as timeless universals unless the argument establishes the required scope.

GRE is a domain instantiation of broader GR foundations. It should maintain explicit interfaces with GRH, GRG, law, political theory, education, ecology, aesthetics, and AI studies without absorbing those disciplines into economics.

9.1.16 16. Methodological pluralism

Historical/interpretive/qualitative, quantitative/empirical, and formal/computational inquiry are partially irreducible modes of access. Do not present one methodological tradition as automatically epistemically superior. Explain why a method is adequate to the local research question.

9.1.17 17. Value terminology

Generative value is importantly informed by Eglash and related work; GRE should not imply that it invented the entire generative-value tradition. GRE's distinctive questions include heterogeneous value, conversion, circulation, return, capture, dissipation, regeneration, power over conversion interfaces, and justice under partial or absent commensurability.

9.1.18 18. Historical dynamics

Fast–slow dynamics, multiple timescales, criticality, attractors, and field language are available as analytical resources. Their use requires local justification. Early GRH insights are sources for critical inheritance, not canonical commitments.

9.1.19 19. Avoid premature synthesis

A relational translation between theories does not establish identity. Preserve irreducible disagreements, domain-specific remainders, and failed translations. Use equivalence language only at the level actually supported.

9.1.20 20. Cross-references

Every table, figure, displayed equation, theorem-like item when numbered, appendix, and major formal construction should be cross-referenced in prose. Labels should be semantic and stable, for example:

- `fig:value-conversion-interface`
- `tab:value-forms`
- `eq:relational-dynamics`
- `sec:historical-timescales`

9.1.21 21. Drafting granularity

Draft one coherent section at a time. A section may be split across sessions, but the active file should remain a single section source file. Complete local argument structure before moving to the next section. Avoid drafting disconnected paragraphs across many sections simultaneously unless explicitly planning cross-chapter consistency.

9.1.22 22. Vertical page spacing

Preserve consistent local spacing between headings and prose. The manuscript uses `\raggedbottom` so that LaTeX leaves modest residual whitespace at the bottom of a page rather than stretching the vertical glue after a section or subsection heading.

A page may therefore end slightly higher than another page when a following heading and its opening lines need to move together. This is preferable to creating conspicuous blank bands between a heading and its first paragraph.

Do not insert manual `\vspace`, blank display environments, or repeated line breaks to force page-height alignment. Diagnose unusual whitespace at the page-layout level before changing prose.

10 CONTRIBUTING

Original source: `applicative_infrastructure/CONTRIBUTING.md`.
Original source SHA-256: `b2c5620f49e8608fc9a82ce25b44fbd43b8098e91e2f1f29424c196589404ba4`.

10.1 Contributing

Shared protocols, Git storage, launch tools and conformance support belong in this repository. Application-specific features belong in the relevant application submodule. Explain the problem, affected consumers and validation evidence; coordinate incompatible package changes with both applications before updating their pinned revisions.

The project-authored material is offered under the MIT licence, with scope and exceptions. By intentionally submitting original work for incorporation, you offer it under MIT while retaining your copyright. Identify any third-party material, its source, licence and your authority to contribute it. Do not include private runtime data, credentials or signing keys in source changes.

Add your preferred contributor name or organization and a short contribution description to CONTRIBUTORS.md when your work is incorporated. Preserve existing author and third-party notices. Contributions to a distributable Python package also update its packaged contributor list so attribution travels with the distribution.

11 CONTRIBUTORS

Original source: `applicative_infrastructure/CONTRIBUTORS.md`.

Original source SHA-256: `575792d4d60feac3284af25d8e22f64a81817b9f19497424896f64b7bad7d831`.

11.1 Contributors

Copyright (c) 2026 the contributors listed in this file, for their respective contributions.

Contributor	Recorded contribution
Wanhong Huang	Shared infrastructure conception, protocol and application design, development direction.

Domain contributions are credited in generalized application and academia application.

The MIT licence in LICENSE refers to this list. Contributors retain the rights in their respective contributions; this list does not assign ownership of every file to every person or organization listed.

Add a contributor's chosen name or organization and a brief contribution description when their work is incorporated. Preserve existing attribution. Corrections can be proposed through the same review process as other repository changes.

AI tools have assisted drafting, implementation, and review. They are development tools and are not listed as copyright holders. Third-party components retain their own author and licence notices.

12 LICENSE

Original source: `applicative_infrastructure/LICENSE.md`.

Original source SHA-256: `4652c1eb4d4310ea760ecd3b09ec9fd90d578f23a1eae70415a086b1b2eed7e9`.

12.1 Licensing scope

Effective date: 2026-09-22. **Licence:** MIT, under the project owner's explicit instruction for the repository family.

The MIT licence covers project-authored shared packages, tools, conformance artifacts and documentation in this repository. Copyright is held by the contributors listed in CONTRIBUTORS.md, for their respective contributions. The licence text follows the Open Source Initiative MIT text.

The generalized and academia application repositories each carry their own MIT licence and contributor list. Their scope notices remain available at generalized application and academia application. A submodule's licence travels with that repository and does not depend on a parent checkout.

Dependencies and reproduced external materials retain their original notices and terms. MIT here does not grant rights in third-party materials. Private accounts, research records, attachments, keys and project repositories under `.runtime/` are user material, not part of the source licence. Installing or running these applications does not license that content to anyone else.

Contributors retain their rights in their respective contributions. CONTRIBUTING.md states how future contributions are offered and credited. Previously offered permissions and preserved historical notices are not withdrawn by the current MIT grant.

13 README

Original source: `applicative_infrastructure/README.md`.

Original source SHA-256: `8b141077469c48ff873ebb22fcf3655956701f91515bed86e43ed4f9a8f15ce4`.

13.1 Applicative infrastructure

Class: Implementation and operation guide
Status: Experimental shared infrastructure and independent domain applications

Source repository: Generativity-Relational-Epistemic-Applicative-Infrastructure

This repository provides common record and Git-storage packages, repeatable local setup tools and two application submodules. It implements parts of the Generativity Standards Program's research and working specifications while keeping application behavior, protocol evidence and programme authority distinct.

The current domains are a generalized visual record workspace and Generative Relational Academia. Each has a separate entry point, account database, runtime and source history. Academia retains its native GRRP model; consolidation and shared hosting do not establish interoperability with the generalized protocol.

13.1.1 Repository responsibilities

```
applicative_infrastructure/                This Git repository
├── common/                               Shared code and operation guidance
│   ├── packages/gsp_record_protocol/      Model validation, transactions and modules
│   ├── packages/gsp_git_store/            Git storage and atomic publication
│   ├── design/                           Architecture and migration evidence
│   ├── conformance/                      Verification scope and reproduction
│   └── tools/                            Independent setup and launch tools
├── gr_generalized_application/           Application Git submodule
│   └── web_application/                  Python web application and browser interface
├── gr_academia_application/              Application Git submodule
│   ├── web_application/                  React, Fastify and TypeScript packages
│   ├── domain_packages/grrp/             Native Python domain protocol and CLI
│   └── provenance/                       Original source history and import manifest
└── .runtime/                             Ignored; never part of a source commit
    ├── generalized/                      Accounts and user project Git repositories
    ├── academia/                         Accounts, index, native records and keys
    └── environments/                     Separate Python environments
```

Area	Responsibility
Common packages	Reusable implementation with no dependency on a domain application
Generalized application	General records, visual graphs, event-defined spacetime and trajectories, modules, retained files and project transactions
Academia application	Scholarly trajectories, native GRRP operations and domain workspaces
Verification	Tests and the limits of their interoperability claims

This repository is itself a submodule of the programme. Programme standards, specifications, manuscripts, governance and ADRs remain canonical in the parent repository. Links such as the Programme Brief, GR-SPEC-120, GR-SPEC-130 and consolidation decision resolve in that complete checkout. An infrastructure-only clone can run the applications without those publication files.

13.1.2 Demo and gallery

The generalized application's **River Commons** project demonstrates a fictional shared-garden inquiry with 31 records, all six operational roles, five Events, six retained materials and seven Git revisions. Its recorded event order, changing topology, subject trajectories and corrected accounts can be explored together.

[Image description: The River Commons graph and a Relation's named participants]

[Image description: An event partial order in the generalized Spacetime workspace]

13.1.3 Visualized spacetime

The event graph supplies a partial order; each chosen boundary selects a topology of scoped ontology records. These two views share one preserved project revision:

After the access agreement — 2 events passed, 10 projected records. Trial access and provisional stewardship apply.

[Image description: Selected agreement boundary, its ontology topology and the trial-access State]

After the review — 4 events passed, 13 projected records. Trial accounts end; revised access and stewardship accounts apply.

[Image description: Selected review boundary, changed topology and the revised-access State]

The garden's subject trajectory connects **Access not yet arranged**, **A garden open for a trial** and **Access under a revised rota**, retaining their event bounds:

[Image description: Garden and stewardship-team trajectories across event boundaries]

These cuts do not assign a common clock or infer simultaneity. The independent observation remains unordered, and selecting a cut creates no Git revision.

See the complete gallery for ten actual UI screenshots, including earlier and later topology at one revision, file controls and a preserved historical contradiction. The pictured graph uses the visible **care** search filter and a local display arrangement. All content is synthetic.

The demo runbook creates a separate account through the ordinary API and documents screenshot regeneration. Its private credentials and project metadata live under ignored `.runtime/demo/`; the preview images above are deliberate copies maintained by the capture script. This demonstration uses the generalized protocol and does not imply an academia protocol migration.

13.1.4 Clone and maintain submodules

With GitHub SSH access configured, obtain this repository and both application submodules:

```
git clone --recurse-submodules git@github.com:huangwanhong-maker/Generativity-Relational-Epistemic-Applicative-Infrastructure.git
↪  applicative_infrastructure
cd applicative_infrastructure
```

The application sources are hosted independently as Generalized-Generativity-Relational-Social-Science-Application and Generative-Relational-Academia-Application. For the complete programme, recursively clone Generativity-Epistemic-Infrastructure instead. The programme Git guide covers SSH configuration and publishing.

Each application is pinned to a specific commit. After changing an application, commit its source there, then commit the changed submodule reference here. If this repository is checked out inside the programme, commit its updated reference in the programme as well. Common-package and launcher edits belong directly to this repository. Use the following to inspect the selected revisions:

```
git submodule status --recursive
```

After updating this repository, use `git submodule sync --recursive` and `git submodule update --init --recursive` to restore its committed application revisions. Publish application commits before the infrastructure commit that references them; publish infrastructure before a programme commit that references it. A submodule may have a detached HEAD, so select a development branch before committing application changes.

Source submodules are distinct from the Git repositories that applications create for users' records. Private project repositories belong in runtime storage and are excluded from source version control.

13.1.5 Setup

Use Python 3.11 or later and Git on PATH. Academia additionally needs Node.js/npm; Node 22.12 or later on the Node 22 release line is suitable for the current frontend tooling and matches the validated major version. Installation downloads declared dependencies. Commands below run from **this infrastructure directory**:

```
python common/tools/setup_application.py generalized --dev
python common/tools/setup_application.py academia --dev
```

Run either command independently if only one application is needed. Use Python 3's local command name on Linux/WSL. On Windows the setup tool uses extended Python paths for deeply nested dependencies without changing system settings.

Setup creates separate environments under the ignored runtime environment directory. Generalized setup installs its requirements and the two editable common packages; its interface has no Node build. Academia setup installs its native Python package, runs npm's lockfile installation, and builds its protocol, server and client. Repeating setup can reuse an existing environment. Omit the development option when Python test dependencies are unnecessary; academia still needs its declared TypeScript build dependencies.

Cloning an application alone does not reproduce this layout or install shared tooling. The infrastructure checkout is the supported combined development environment. Domain README files describe lower-level entry points and dependencies.

13.1.6 Launch independently

Run each application in its own terminal:

```
python common/tools/run_application.py generalized
python common/tools/run_application.py academia
```

Application	Default address	Default runtime	Session cookie
Generalized	http://127.0.0.1:8000	.runtime/generalized/	gsp_session
Academia	http://127.0.0.1:8001	.runtime/academia/	gra_session

The launcher accepts host and port arguments and defaults to loopback. For example:

```
python common/tools/run_application.py generalized --port 8002
```

Ctrl+C stops the selected process. The launcher resolves paths from its own location, so invoking it by absolute path works from another directory.

Both applications have their own accounts; no shared sign-on or shared project authority is introduced. Generalized registration is available in its interface. Academia preserves its account-provisioning behavior and has an operator CLI when registration is closed. No demonstration account or default password is installed.

Separate ports and cookie names prevent ordinary naming collisions; ports do not isolate browser cookies. Local launch commands are development/operator entry points rather than a production service manager. Local previews created during migration have ignored process logs under the programme's build output.

13.1.7 Configuration

Explicit path overrides passed to the launcher must be absolute. Use separate locations for unrelated deployments.

Variable	Purpose
GSP_DATA_DIR	Generalized account database and project repositories
GSP_COOKIE_SECURE	Set to 1 when generalized is served exclusively through HTTPS
GSP_TRUSTED_HOSTS	Generalized accepted request hostnames
GRA_RUNTIME	Academia parent runtime directory
GRA_RECORDS	Academia native record tree; overrides the derived default
GRA_DB	Academia account/index database; overrides the derived default
GRA_PYTHON	Single absolute Python interpreter path with native grrp installed

Variable	Purpose
GRA_CLIENT	Academia compiled client directory

The launcher selects host and port through its command arguments. Domain guides document additional direct-server settings. A source checkout or environment rebuild does not create a copy of an existing runtime.

13.1.8 Data and recovery

Both SQLite databases contain retained account information. Academia's database also has rebuildable indexes, but that does not make the database disposable. A complete backup includes the matching account database, project repositories, retained material, record-local keys and relevant SQLite journals. Stop the application's writer before a filesystem copy, or use a specifically verified online backup procedure. Treat backup archives as private data.

The application relocation preserved four accounts, three projects, record bytes, native keys and reachable Git histories. It did not convert the legacy generalized project or academia's native records. Detailed scope and checks are in the migration verification and independent audit.

The original migration workspace retains complete source/runtime ZIP backups under ignored programme build/private-backups/; build/migration-current-backup.txt identifies that workspace's backup set. Former local source trees remain under build/retired-webapp/ and build/retired-gsp-record-protocol/. These are local recovery artifacts and do not accompany a clone. The original academia checkout and runtime remain unchanged.

For rollback, stop the new writer before restoring a matched runtime backup and application revision. Restore accounts and record custody together. Do not run two writers against the same restored data directory. Recreate virtual environments after moving their source/environment layout; retaining their old files does not make them portable.

13.1.9 Verification

Install development dependencies first. From this directory on Windows PowerShell:

```
& ./.runtime/environments/generalized/Scripts/python.exe -m pytest -c gr_generalized_application/web_application/pytest.ini
↪  gr_generalized_application/web_application/tests common/packages/gsp_record_protocol/tests common/packages/gsp_git_store/tests
↪  --basetemp .runtime/test-output/generalized -q
& ./.runtime/environments/academia/Scripts/python.exe -m pytest gr_academia_application/domain_packages/grrp/tests --basetemp
↪  .runtime/test-output/academia -q
npm.cmd --prefix gr_academia_application/web_application test
npm.cmd --prefix gr_academia_application/web_application run build
```

Use bin/python instead of Scripts/python.exe and npm instead of npm.cmd on POSIX. Pytest's temporary-output directory is disposable and must never name retained runtime data. Prefer a short checkout/test path on Windows because Git clone tests can encounter path-length limits.

Set the GSP_BROWSER environment variable to msedge to include the generalized browser journeys using installed Edge; the browser test guide describes alternatives. The migration recorded 427 passing tests and one platform-specific skip across the applications and shared packages. These dated checks verify observed behavior and do not establish cross-application semantic equivalence.

13.1.10 Current boundaries and further domains

The generalized application consumes the common packages. Academia currently retains separate Python and TypeScript GRRP implementations. A future adapter needs explicit mappings for identity, signed bytes, authority, disclosure, modules, partial mappings and retained files before interoperability can be claimed.

The applications remain experimental. Generalized sharing, recovery, selective erasure and formal review workflows remain limited; academia retains known identity/custody questions and six affected npm packages in its dated relocation assessment. Review domain-specific limitations before exposing either service beyond its local operating context.

A future domain receives its own repository/submodule, entry point, runtime, profile and operation guide. Extract further common code when a concrete shared interface and preservation tests justify it. Domain history and concepts remain traceable rather than being flattened into a universal application schema.

13.1.11 Contributing and license

Use CONTRIBUTORS.md to maintain contribution attribution. Keep shared packages independent of domain application imports, add meaningful verification for behavioral changes, and update the programme's decisions and specifications when an implementation exposes a conceptual or interoperability gap.

Project-authored material is available under the MIT License, with copyright held by the contributors recorded in CONTRIBUTORS.md. LICENSE.md explains scope, historical additional grants and third-party exclusions. Each application submodule has its own license and contributor record. User-created records, files and research material retain their own rights.

14 README

Original source: `applicative_infrastructure/common/README.md`.
Original source SHA-256: `25962c4ce28a7219b87668fee20961fa3766624b1ed376f19faf47cb28135e15`.

14.1 Common implementation infrastructure

Class: Implementation guide
Status: Experimental shared packages

Component	Responsibility
gsp_record_protocol	Independent record/module/transaction validation, candidate preparation, schema, graph projection and CLI
gsp_git_store	Atomic Git storage, retained material, receipts, history and exports
tools	Explicit setup and independent application launch
verification	Shared package and application regression commands; future independent interoperability checks
design	Relocation provenance and migration evidence

Canonical technical texts remain GR-SPEC-120 and GR-SPEC-130, with their motivating Working Drafts at the programme root. The protocol package owns the single machine-readable schema resource for its version. No copied normative text is maintained here.

The Git package does not depend on Flask, accounts or the protocol validator. The protocol package does not depend on Git or either application. Each receiving application remains responsible for authentication, authority checks, applicable profile semantics and client behavior. Academia's native GRRP and TypeScript protocol packages remain domain-specific; their new location does not turn them into the general shared protocol.

15 README

Original source: `applicative_infrastructure/common/conformance/README.md`.
Original source SHA-256: `cb69439eeb1fd5bf44f15640890749d811c4c1948502133844dbb5a59c3936e0`.

15.1 Implementation verification and interoperability boundary

Class: Verification guide
Status: Experimental implementation tests; no independent cross-application conformance claim

From the programme root after setup, run the shared packages and generalized application together:

```
$verificationPython = '.\applicative_infrastructure\.runtime\environments\generalized\Scripts\python.exe'
& $verificationPython -m pytest -c applicative_infrastructure/gr_generalized_application/web_application/pytest.ini
↪  applicative_infrastructure/gr_generalized_application/web_application/tests
↪  applicative_infrastructure/common/packages/gsp_record_protocol/tests
↪  applicative_infrastructure/common/packages/gsp_git_store/tests --basetemp build/gsp-tests -q
```

Set `$env:GSP_BROWSER='msedge'` to include the browser journeys, using installed Edge. `chrome` or a separately installed Playwright Chromium can also be selected. The chosen `--basetemp` is disposable test output and must not contain runtime or other valuable files. A short workspace path avoids Git for Windows path-length restrictions in cloned test repositories.

Academia's native Python and npm checks remain separately documented in its guide. The original domain protocol fixtures continue to assess that domain implementation. They do not establish a GRRP/general-protocol mapping.

Protocol fixtures remain beside the versioned package tests. This avoids duplicated authoritative copies. When an academia adapter is implemented, cross-application cases will need to exercise identity, signed-byte preservation, unmapped fields, authority, complete/partial mappings, files and failure recovery. That work is distinct from the source relocation verified here.

16 migration audit

Original source: `applicative_infrastructure/common/design/migration_audit.md`.
Original source SHA-256: `5c8853385434f5375e09c7277999ad8ee0f1dd6125b8121f0f4feec1d405456c`.

16.1 Independent migration audit

Document class: Informative implementation verification report
Date: 2026-09-22
Status: Bounded migration checks passed; identified provenance discrepancy corrected and rechecked
Scope: Relocation into `applicative_infrastructure`, without semantic conversion of retained records

This audit independently read the original and relocated data, inspected source provenance, resolved installed packages, evaluated launcher configuration, and checked the two live entry points. It did not create accounts, edit records, change keys, run a reindex, or alter retained user data. Account rows were compared internally; credentials, account identities, record text and key bytes were not included in the report or tool output.

16.1.1 1. Retained runtime

The generalized source was the earlier local `webapp/.data`. The academia source was the original application's ignored `web/packages/server/data`, which contains both records and an account database. The destinations were `.runtime/generalized` and `.runtime/academia`. Source copies remained present when the comparisons were performed. The earlier local web application and packages were subsequently retired into ignored `build/` storage after the programme's separate source-hash guard; this audit's comparisons preceded that retirement.

For each retained record tree, the audit compared relative file inventory, byte length and SHA-256. It then compared Git reference identifiers and reachable commit counts independently of the filesystem comparison. Databases were opened read-only; `PRAGMA quick_check`, table counts and complete `users` rows were compared without printing row contents.

Check	Generalized	Academia
Retained record-tree files	11 source; 11 destination	299 source; 299 destination
File inventory and every compared byte digest	Equal	Equal
Missing, additional or changed record-tree files	0 / 0 / 0	0 / 0 / 0
Retained project repositories	1	2
Git reference sets	Equal	Equal for both projects
Reachable commits	2 at both locations	26 and 8, unchanged at both locations
Source and destination database quick check	`ok`	`ok`
Complete account-row comparison	Equal; 1 account	Equal; 3 accounts
Project-row counts	1, unchanged	2, unchanged

The academia index also contained five trajectories and 29 search rows at both locations when inspected. These derived counts are a consistency observation, not a substitute for preserving the three account rows. Starting that application can rebuild derived index material; the audit therefore compared account content separately.

The generalized project still declares `gsp-workspace/0.1`, contains its one retained record, and has no fabricated transaction receipts or material assets. Its source main reference is unchanged. Filesystem relocation did not perform the separate `project.migrate` operation or retrospectively assign structured relation semantics.

The academia record-tree comparison includes the original Git directories, native GRRP material, project metadata, key-related files and mutable project workspaces. This demonstrates byte preservation for those files at the comparison time. It does not independently validate every historical signature, claim, permission or private-key custody arrangement.

16.1.2 2. Installed packages and application boundaries

The generalized Python environment imports `gsp_protocol` and `gsp_git_store` from the relocated `common/packages` trees. The observed protocol identifier is `gsp-record-protocol/0.2`. The academia environment imports `grrp` from `gr_academia_application/domain_packages/grrp`; the generalized protocol package is not installed in that environment. No observed editable import resolves to the retired local package locations or the external academia source repository.

These results support separation of the application environments and retention of academia's native protocol. They do not demonstrate that academia implements the generalized transaction model or that the two native record formats are interchangeable.

The common launcher's default command and path configuration was evaluated from the programme directory and its parent. The resulting configurations were identical. Default data, database, client-build and Python paths were absolute; relative `GSP_DATA_DIR` and `GRA_DB` overrides were rejected. Default ports are 8000 for generalized and 8001 for academia.

After the launcher update, an absolute `GRA_RUNTIME` override routed both records and the database beneath that selected root, while a relative override was rejected. The academia native runtime resolver was also evaluated from two working directories and returned identical default paths. A Python executable path containing spaces remained one command argument. These checks evaluated configuration only and created no alternate runtime.

The academia server and account CLI use the same runtime-path resolver. `GRA_PYTHON` identifies one executable argument, avoiding the old ambiguity of splitting an executable path containing spaces. The legacy `GRA_GRRP` fallback remains a separate documented compatibility behavior.

The source declares distinct cookie names, `gsp_session` and `gra_session`, and independent session implementations. This prevents accidental name collision. Different localhost ports do not themselves establish browser-cookie isolation or a security boundary between applications on the same host.

16.1.3 3. Live, read-only observations

Both `http://127.0.0.1:8000/` and `http://127.0.0.1:8001/` returned HTTP 200 with HTML. Those requests set no cookie. The generalized public capability endpoint returned `gsp-record-protocol/0.2` and `gsp.general/0.2`. Both listeners were bound to `127.0.0.1` when inspected.

These checks establish that both entry points respond and that the generalized endpoint identifies the expected protocol. This audit did not log into the retained accounts or submit mutations to user data. Browser workflows, domain tests and temporary-data mutation tests are separate verification evidence.

16.1.4 4. Source provenance

All 35 entries in the common relocation manifest match the archived pre-relocation source bytes held in the private source backup. Their source-path inventory contains no runtime, account database, environment or private-key paths under the checked path patterns.

For academia, the source repository remains at the recorded commit with a clean working tree. The preserved history bundle matches its recorded SHA-256, and an independent `git bundle verify` reports a complete history. The all-reference history contains 131 distinct tracked paths. The broad key-path check identified a historical `.grrp/keys/self.pub` public-key path; it found no runtime database, environment file or private-key path under the bounded path rules. This is not a comprehensive content or secret scan.

AUDIT-01 — Corrected and closed. The initial import manifest labeled archive-export bytes as committed Git blob bytes. Independent `git cat-file blob` comparisons found 56 of 121 entries different from that claim. The history bundle and runtime preservation comparisons were unaffected. The corrected import manifest distinguishes raw Git blob bytes, archive-export bytes, pre-edit imported bytes, source checkout bytes and final relocated bytes. The initial manifest remains as explicitly superseded evidence.

The audit independently re-read all 121 raw blobs, generated a fresh archive in memory, compared exported entries against the retained import baseline, and checked final destination hashes. Raw hashes and byte lengths, corrected committed-byte aliases, fresh archive hashes/lengths, retained initial baseline and final destination hashes all matched. All 56 raw-to-export differences were explained by LF-to-CRLF conversion. This closes the inaccurate provenance

label while preserving the observed import history rather than rewriting it as an earlier exact-blob copy.

Public source provenance is separate from private runtime migration evidence. Private backups and inventories remain under ignored `build/`; application state and recreated environments remain under ignored `.runtime/`. Neither belongs in the public source import or its history bundle. Git checks confirmed that both runtime database paths and the private-backup pointer are ignored and untracked.

16.1.5 5. Limits

The comparisons describe a specific migration and observation time. They are not a continuing backup service, a full disaster-recovery exercise, a deployment-security assessment, an independent signature audit, or a whole-GR conformance determination. Subsequent legitimate use can change the destination database and repositories while leaving this recorded migration result valid for its stated scope.

17 migration verification

Original source: `applicative_infrastructure/common/design/migration_verification.md`.
Original source SHA-256: `bfbc326c27689d331782cc16f8acf6004d96dccf12ce6725afa2eb7ad656b36f`.

17.1 Application consolidation verification

Class: Implementation verification report
Status: Relocation completed, 2026-09-22; experimental applications

ADR-0009 records the approved repository boundary. The operation guide provides setup and launch commands. This report describes source/runtime relocation; it does not assert semantic equivalence between academia GRRP and the generalized record protocol.

17.1.1 Source and history

The 35-file generalized application/protocol baseline is recorded in relocation_manifest.json, with original paths, destination paths and before/after SHA-256 digests. Original source hashes were rechecked before retirement. The record protocol implementation and extracted Git-store implementation remain byte-identical. Changes concern imports, runtime defaults, documentation and test/artifact locations; one storage test uses a shorter temporary clone destination for Git for Windows.

The old `webapp/` and `packages/gsp_record_protocol/` trees are retained at ignored `build/retired-webapp/` and `build/retired-gsp-record-protocol/`. They are rollback material, not alternate active implementations. Environments are recreated in the new location; a retired virtual environment is not portable merely because its files are retained.

Academia's source was imported from commit `b98730b46eca5fdf441937aef0180f5b3d4f94dd`. Its 121 tracked source files, original README and component licensing notices are retained with a verified complete source-history bundle. The original checkout remains clean at the same commit. Its provenance guide identifies source-byte representations and the deliberate relocation edits. No outer-repository history was rewritten or merged.

17.1.2 Retained private data

The old generalized writer was stopped before transfer; no academia source writer was running. SQLite databases were copied through the backup API from read-only source connections. Full logical database digests matched immediately after copying and `quick_check` succeeded. Non-database file inventories were compared by relative path and SHA-256; transient SQLite shared-memory files were excluded from file-byte comparison.

Property	Generalized	Academia
Existing accounts	1 preserved	3 preserved
Existing projects	1 preserved	2 preserved
Retained content	1 legacy record	5 native trajectories
Reachable project commits	2 preserved	26 and 8 preserved
Record repository bytes and references	Exact match	Exact match
Identity and authentication material	Existing database/session material retained	Existing account data and native key material retained
Semantic conversion	None; schema 0.1 retained	None; native GRRP retained

The complete source/runtime ZIPs and detailed comparisons remain under ignored `build/private-backups/`, identified by `build/migration-current-backup.txt`. The ZIP archives are the authoritative backup artifacts; an earlier partial filesystem copy in that backup set is not a complete backup. Reports and archives contain private material and are not included in source provenance or the project index. The original academia checkout and data remain unchanged.

Academia startup rebuilds its derived search index in the new database. Consequently later database-file hashes are not expected to equal the offline backup; the independent audit compared complete account rows and native record trees after startup. No migration test accounts or demonstration records were added to retained user databases.

17.1.3 Executed verification

Check	Observed result
Generalized application plus common packages	**128 passed**, including three Edge browser journeys
Academia Python	**208 passed, 1 skipped**; POSIX editor fallback skipped on Windows
Academia TypeScript protocol	**43 passed**
Academia server	**48 passed**, including runtime path checks
Academia production build	Protocol, server and client passed
Academia deep-path write smoke	Separate test project/question created; graph read and GRRP validation passed
New live entry points	HTTP 200 at ports 8000 and 8001; expected protocol/account endpoints respond
Academia live browser	Edge renders the retained project listing with no uncaught JavaScript errors; screenshot inspected
Common launcher	Paths remain stable across working directories; absolute runtime overrides honored; relative overrides rejected
Independent audit	Account rows, record inventories, Git references, source provenance and import locations examined separately; provenance-label finding corrected and closed

All active programme/application guide links resolve. Historical publication and imported historical document links were excluded from this active-navigation check. The source index excludes runtime databases, keys, environments and dependency trees. All three authoritative backup ZIPs passed archive CRC checks.

The combined generalized/common suite ran from the new environment with `GSP_BROWSER=msedge` and `--basetemp build/gm`. Academia's detailed commands, environment information and scope are in its validation report. Reproduction guidance is in common verification.

17.1.4 Limits and subsequent work

The consolidation preserves two independent account and protocol systems. Shared code is available to future domains; academia does not yet consume the generalized protocol or Git transaction implementation. A domain mapping must preserve native identifiers, signed bytes, registrations, disclosure and unmapped content before interoperability can be claimed.

The inherited academia lockfile has six reported affected npm packages, documented in its validation report. Dependency maintenance, identity/custody findings from the earlier source review, deployment isolation, measured accessibility and a full operational restoration rehearsal remain separate work. Different ports and cookie names prevent ordinary namespace collisions; ports do not isolate browser cookies. Current services bind to loopback by default.

These checks establish the observed migration behavior. They do not adopt a Standard, certify production security, validate institutional practice or warrant the truth of recorded claims.

18 README

Original source: `applicative_infrastructure/common/packages/gsp_git_store/.pytest_cache/README.md`.
Original source SHA-256: `73fd6fccdd802c419a6b2d983d6c3173b7da97558ac4b589edec2dfe443db9ad`.

18.1 pytest cache directory

This directory contains data from the pytest's cache plugin, which provides the `--lf` and `--ff` options, as well as the `cache` fixture.

Do not commit this to version control.

See the docs for more information.

19 CONTRIBUTORS

Original source: `applicative_infrastructure/common/packages/gsp_git_store/CONTRIBUTORS.md`.
Original source SHA-256: `f46b2d3be5a213afca5f9e5e5f3a5eda448756a5e93deeb923a0ebc9b74ea09f`.

19.1 Contributors

Copyright (c) 2026 the contributors listed in this file, for their respective contributions.

Contributor	Recorded contribution
Wanhong Huang	GR concepts, protocol and application design, and development direction.

The MIT licence in LICENSE refers to this list. Contributors retain the rights in their respective contributions; this list does not assign ownership of every file to every person or organization listed.

Add a contributor's chosen name or organization and a brief contribution description when their work is incorporated. Preserve existing attribution. Corrections can be proposed through the same review process as other repository changes.

AI tools have assisted drafting, implementation, and review. They are development tools and are not listed as copyright holders. Third-party components retain their own author and licence notices.

20 README

Original source: `applicative_infrastructure/common/packages/gsp_git_store/README.md`.
Original source SHA-256: `7ec844b808b447304e7e47c6f3c2ccd290632a5d40632a36580ce1975c8dc4ab`.

20.1 Generativity Git store

Document class: Software package guide
Status: EXPERIMENTAL, version 0.2.0
Python: 3.11 or later; Git executable required on `PATH`

An application-independent Git storage binding for project records, complete project transactions, retained material and revision history. Each project uses a separate bare repository. The package has no Flask, SQLite, browser or protocol-validator dependency. Its Python runtime uses only the standard library and invokes the installed Git executable.

The binding implements the storage responsibilities described in GR-SPEC-130. The separate record protocol package supplies model validation and transaction preparation. Applications supply authentication, authorization, verified upload metadata, recorder attribution, request replay matching and their own presentation.

This extraction preserves the existing workspace adapter's behavior. Moving the adapter into a shared package does not establish independent application interoperability, adoption of a Standard or factual warrant for stored statements.

20.1.1 Install and import

From the standards-programme repository root, using the application's chosen Python environment:

```
python -m pip install -e applicative_infrastructure/common/packages/gsp_git_store

from pathlib import Path
from gsp_git_store import GitStore, Conflict, NotFound, StoreError, LimitExceeded

store = GitStore(Path("private-project-data"))
```

The data directory and its contents need application-administrator-controlled filesystem access. Instantiating a store creates its `repositories` directory if needed. It does not create an account, authorize a caller or choose a project owner.

20.1.2 Public API

Method	Result and responsibility
`create_project(project, actor)`	Initialize a separate bare repository and return its initial commit; modern projects receive the binding manifest
`head(project_id)`	Current complete project commit
`snapshot(project_id, revision=None)`	Project manifest and records read from one accepted revision
`get_record(project_id, record_id, revision=None)`	Record and its selected revision
`commit_transaction(project_id, snapshot, receipt, actor, expected_head, assets=None)`	Publish the prepared candidate, receipt and retained file bytes through one conditional reference update
`transaction_receipt(project_id, transaction_id)`	Original committed receipt/result and observed current head, or `None`
`history(project_id, record_id, revision=None)`	Up to 100 commits affecting the record, pinned when a revision is supplied
`project_history(project_id, revision=None)`	Up to 100 project commits
`asset_file(project_id, digest, revision=None)`	Caller-owned binary temporary file positioned at byte zero
`bundle_file(project_id)`	Caller-owned binary temporary file containing complete accepted reachable history

Method	Result and responsibility
`limits()`	Applicable storage limits for application capability disclosure

`write_record()` and the in-memory `bundle()` helper remain compatibility interfaces. New coordinated application writes use `commit_transaction()`; HTTP downloads use `bundle_file()`.

`snapshot` is the complete prepared `{project, records}` candidate. `receipt` identifies its `transaction_id`, `expected_head`, reason, actor, digest and change account. `assets` maps verified SHA-256 strings to temporary source `Path` objects. The adapter independently checks and freezes supplied bytes before retaining them. The protocol package evaluates semantic structure; the store evaluates storage identities, bounds, understood descriptor/material closure and publication.

20.1.3 Publication and reads

The binding prepares immutable blobs, trees and a commit, then conditionally advances `refs/heads/main` from `expected_head`. The accepted project therefore contains either the previous complete snapshot or the new complete snapshot. Prepared objects can remain unreachable after a failed publication; they are not accessible as accepted project revisions.

Receipts are retained at `.gsp/transactions/<transaction-id>.json`. Their original resulting commit is resolved from the path's introduction. The application checks actor and request digest before treating a receipt as a replay and does so before rejecting an old base. The storage method itself rejects duplicate receipt paths; it does not authenticate idempotent requests.

New projects using `gsp-workspace/0.2` receive `.gsp/protocol.json`, asset and transaction trees. An unfamiliar or extended binding manifest is preserved and blocks mutation. Legacy project dictionaries and old commits remain readable. Migration is a separately prepared explicit transaction, not a side effect of reading.

Project snapshots use bounded Git batch reads instead of launching a process for each record. Requested revisions must be complete commit identifiers reachable from the selected project's accepted history. Repository-relative Git execution preserves support for long Windows data paths.

20.1.4 Material, streams and limits

Assets are stored at `assets/<sha256>`. Original filenames are metadata rather than storage paths. Existing assets remain in later trees when a descriptor is detached or replaced; this custody policy preserves their historical bytes. A current-snapshot application export needs to select only its intended referenced material. A full Git bundle deliberately includes reachable historical material and receipts.

The initial limits include 10 MiB per file, 20 MiB of distinct supplied asset bytes per storage transaction, eight distinct supplied blobs, 128 MiB of unique retained asset blobs in the current tree, 1,000 records, 2 MiB per serialized JSON resource and 32 MiB for the serialized project-plus-record snapshot. The HTTP/protocol layers separately count all incoming parts, including duplicate bytes, and may impose narrower transport limits. Call `limits()` when disclosing the binding's bounds.

The retained-asset budget does not bound unreachable objects, receipt-ledger growth, Git metadata, backups or total filesystem use. Operators remain responsible for capacity and recovery arrangements.

Close every returned stream, including when response creation or delivery fails:

```
## The application has already authorized the descriptor at this project revision.
with store.asset_file(project_id, descriptor["sha256"], revision) as content:
    while block := content.read(64 * 1024):
        consume(block)
```

Knowledge of an asset digest or commit identifier is not authorization. The caller must check project access and the requested record/file descriptor at the selected revision before delivering bytes. The store does not implement accounts, encryption at rest, selective erasure, legal holds, malware examination or independent attestation. Git content identity and recording attribution do not establish truth or immutable custody against the server operator.

20.1.5 Errors

`StoreError` is the safe storage-error base class. `Conflict` reports a stale publication base or duplicate published transaction identifier; `NotFound` reports invalid or unavailable identifiers/resources; `LimitExceeded` reports a declared binding limit. All are exported from `gsp_git_store`.

The application distinguishes authentication/validation failures from these storage outcomes. After an uncertain publication response, it recovers through the transaction receipt rather than asserting that nothing committed or silently creating a new transaction identifier.

20.1.6 Tests

The standalone suite uses temporary data directories and real Git repositories, including concurrent writers, failed publication, material identity/limits, historical reads, immutable receipts, bundle restoration and legacy migration. It does not require an application server or an account database.

```
python -m pip install -e 'applicative_infrastructure/common/packages/gsp_git_store[test]'
python -m pytest -c applicative_infrastructure/common/packages/gsp_git_store/pyproject.toml
↪  applicative_infrastructure/common/packages/gsp_git_store/tests --basetemp build/shared-git-store-tests
```

The pytest configuration also permits source-tree testing before installation. Test results establish their tested storage behavior and environment, not broader semantic or institutional conformance.

20.1.7 License and contributors

This package is available under the infrastructure repository's MIT License, with copyright held by the contributors recorded in CONTRIBUTORS.md. The license scope notes preserve third-party terms and distinguish software licensing from the rights in user-created records. Programme governance drafts remain separate from this express software grant.

21 README

Original source: `applicative_infrastructure/common/packages/gsp_record_protocol/.pytest_cache/README.md`.

Original source SHA-256: `73fd6fccdd802c419a6b2d983d6c3173b7da97558ac4b589edec2dfe443db9ad`.

21.1 pytest cache directory

This directory contains data from the pytest's cache plugin, which provides the `--lf` and `--ff` options, as well as the `cache` fixture.

Do not commit this to version control.

See the docs for more information.

22 CONTRIBUTORS

Original source: `applicative_infrastructure/common/packages/gsp_record_protocol/CONTRIBUTORS.md`.
Original source SHA-256: `f46b2d3be5a213afca5f9e5e5f3a5eda448756a5e93deeb923a0ebc9b74ea09f`.

22.1 Contributors

Copyright (c) 2026 the contributors listed in this file, for their respective contributions.

Contributor	Recorded contribution
Wanhong Huang	GR concepts, protocol and application design, and development direction.

The MIT licence in LICENSE refers to this list. Contributors retain the rights in their respective contributions; this list does not assign ownership of every file to every person or organization listed.

Add a contributor's chosen name or organization and a brief contribution description when their work is incorporated. Preserve existing attribution. Corrections can be proposed through the same review process as other repository changes.

AI tools have assisted drafting, implementation, and review. They are development tools and are not listed as copyright holders. Third-party components retain their own author and licence notices.

23 README

Original source: `applicative_infrastructure/common/packages/gsp_record_protocol/README.md`.
Original source SHA-256: `a3c60a7344614fdab69c20db235db4f905f5f3712ab5c33a968c3b4fcf2731e7`.

23.1 GSP record protocol package

Class: Experimental implementation package
Package version: `0.3.0` (additive temporal capability; base protocol identifiers below are unchanged)
Protocol: `gsp-record-protocol/0.2`
Record schema: `gsp-workspace/0.2`
Profile: `gsp.general/0.2`

This independent Python package validates bounded record graphs, prepares transactions, and produces incidence and event-based spacetime projections. It has no Flask, database, filesystem-storage, or Git dependency. The CLI reads a supplied JSON file; the preparation library does not publish changes or inspect actual attachment bytes.

The information-model Specification defines the experimental contract and its limits. The design separates semantic graphs, recording history, and views. Passing these validators is not factual verification or full GR conformance.

23.1.1 Install and inspect

From the repository root, using a Python 3.11+ environment:

```
python -m pip install -e ./applicative_infrastructure/common/packages/gsp_record_protocol
python -m gsp_protocol validate-snapshot
↪  applicative_infrastructure/common/packages/gsp_record_protocol/tests/fixtures/graph_snapshot.json
python -m pytest applicative_infrastructure/common/packages/gsp_record_protocol/tests
```

Restricted Windows environments can supply an existing writable parent and a fresh `--basetemp` path to pytest.

23.1.2 Public API

Function	Result and responsibility
`capabilities()`	Fresh dictionary describing protocol, profile, modules, operations, and library limits.
`validate_transaction(tx)`	Structural request validation. It cannot resolve references without a snapshot.
`normalize_snapshot(snapshot)`	Deep-copied read adaptation with `legacy`, `source_schema_version`, and `read_adaptation`. Original schema declarations remain unchanged.
`validate_snapshot(snapshot)`	Schema and scoped semantic report, including warnings for unsupported or unstructured material. Does not inspect actual file bytes.
`project_graph(snapshot)`	Snapshot-bound nodes and incidence/neutral-reference edges, warnings, selection declaration, and source `head`.
`project_spacetime(snapshot, after=None)`	Explicit event partial order, ancestor-closed cut, scoped ontology topology, trajectory groups and diagnostics. `None` selects all events; `[]` selects the empty cut. No storage writes.
`request_digest(tx, files_meta={})`	SHA-256 of RFC 8785 canonical JSON `{transaction: tx, files: files_meta}`. File metadata comes from an adapter that has actually hashed received bytes.
`prepare_transaction(snapshot, tx, actor, now, files_meta={})`	Candidate `snapshot`, `receipt`, and `changed_record_ids`. Inputs are unchanged. The returned head still identifies the expected parent.

`ProtocolError` carries `code`, `message`, and a `fields` mapping. HTTP status, authentication, authorization, binary acquisition, idempotent receipt lookup, storage budgets, conditional publication and recovery belong to the binding. The storage adapter records the new commit after publication; this package does not predict a self-referential commit identifier.

The actor has `id` and `display_name`. The recording timestamp is an ISO 8601 value with an offset. `files_meta` maps each declared multipart name to exactly `sha256` and integer `byte_length`; server paths are excluded. Duplicate, missing, extra and mismatched parts fail validation.

23.1.3 Module and graph rules

Implemented version `1` modules are `gsp.relation`, `gsp.notes`, `gsp.files`, `gsp.event_order`, and `gsp.temporal_extent`. The two temporal modules require `required: true` so earlier readers preserve them and block edits that cannot validate their constraints. Optional unknown modules or unsupported versions survive unrelated edits exactly and remain read-only. Required unsupported modules block project mutation. New unknown modules cannot be introduced through this implementation's editing interface.

An unsupported declared project profile also blocks mutation, including migration. Reads preserve its declaration and report an interpretation warning. An absent profile in a legacy workspace remains eligible for explicit migration. A structural report does not claim to assess an unfamiliar profile's additional requirements.

Every record remains a node. A structured Relation is independently selectable and contributes one edge per participant incidence. Orientation `in` points from the participant to the relation; `out` points from the relation to the participant; `undirected` has no asserted arrow direction. A neutral cross-reference is separately labeled `kind: reference`; its `source` records where the navigation reference is stored, without asserting a directional substantive relation.

Legacy snapshots retain their `gsp-workspace/0.1` declarations during reads. Only a sole `project.migrate` operation, with the `migration` change category, produces current schema content. Migration does not infer relation participants or change earlier account attribution/timestamps.

23.1.4 Event-defined topology

The additive GR-SPEC-121 extension keeps the base protocol/schema/profile at 0.2. Event order is asserted by first-class Relation records with matching `gsp.relation` incidences. Git ancestry, recording timestamps and free-text dates never determine that order. Event ranks support layout; incomparable events are not thereby simultaneous.

Temporal extents specify inclusive start and exclusive end boundaries, each explicitly an Event reference, unknown, or unbounded within a stated account scope. Records without an extent remain unscoped. Only accounts established active at a cut contribute to its induced topology; omitted relation participants are diagnosed. An optional subject reference groups accounts into a stated trajectory without proving target identity or continuity.

Cycles are retained as contradictory accounts with a diagnostic event graph and no fabricated cut or topology. Unsupported event-order versions likewise prevent a cut; unsupported extent versions make the affected presence indeterminate. This projection selects applicability claims; it does not simulate event effects, infer causation, resolve competing accounts, or reconstruct an unrecorded historical state.

23.1.5 Limits and evidence

The reusable profile permits 100 operations, 1,000 records, 32 incidences per relation, eight binary parts, 10 MiB per file and 20 MiB combined binary parts. Module JSON is bounded to 256 KiB; transaction JSON to 2 MiB; snapshot JSON to 64 MiB. These are application limits, not GR theoretical requirements. A binding can declare tighter limits; the current HTTP binding uses 1 MiB transaction JSON and its Git reader uses 32 MiB aggregate snapshot JSON.

The tests exercise semantic cycles, parallel and higher-order relations, partial incidence, repeated participant roles, independent qualification dimensions, opaque modules, migration, final-reference validation, retained material descriptors, replay-digest inputs, historical projections, invalid inputs and the CLI. Static fixtures are stipulated examples. They do not constitute an independent academia implementation or an institutional pilot.

24 CONTRIBUTING

Original source: `applicative_infrastructure/gr_academia_application/CONTRIBUTING.md`.
Original source SHA-256: `38c11a3c6659933950025859b27bbd318ffb6d328134754fb5014a7b4c80e519`.

24.1 Contributing

Use this repository for academia-specific workflows, the native GRRP implementation and its web application. Explain how a change affects research acts, provenance, contestation and portability. Preserve source history and distinguish a proposed shared-protocol adapter from a completed semantic migration. Keep private research records, accounts and keys outside the source repository.

The project-authored material is offered under the MIT licence, within the current scope. By intentionally submitting original work for incorporation, you offer it under MIT while retaining your copyright. Identify third-party material, its terms and your authority to contribute it; access to a research record alone is not permission to publish it.

Add your preferred contributor name or organization and a short contribution description to CONTRIBUTORS.md when your work is incorporated. Changes to GRRP also update its packaged contributor list. Preserve prior author and organizational credits, external notices and historical licensing artifacts. AI tools may be acknowledged as tools, not as copyright holders.

25 CONTRIBUTORS

Original source: `applicative_infrastructure/gr_academia_application/CONTRIBUTORS.md`.
Original source SHA-256: `0ca6ed514b41159077a3efece79ef79b6c8c5e38adf033eb6354ce2b49f560b5`.

25.1 Contributors

Copyright (c) 2026 the contributors listed in this file, for their respective contributions.

Contributor	Recorded contribution
Wanhong Huang	GRA papers, GRRP design, original application development, and subsequent design direction. Source Git author variants include `HUANG WANHONG` and `Wanhong HUANG`.
Serendip Commons Society	Organization credited in the original application copyright notice and GRRP package authorship metadata.

Attribution is grounded in the preserved original README, original licensing statement, GRRP package metadata, and source Git history. Commit authorship is evidence of contribution, not by itself a determination of ownership. This file preserves the organizational credit without inventing an assignment of individual rights.

The MIT licence in LICENSE refers to this list. Contributors retain the rights in their respective contributions; this list does not assign ownership of every file to every person or organization listed.

Add a contributor's chosen name or organization and a brief contribution description when their work is incorporated. Preserve existing attribution. Corrections can be proposed through the same review process as other repository changes.

AI tools have assisted drafting, implementation, and review. They are development tools and are not listed as copyright holders. Third-party components retain their own author and licence notices.

26 LICENSE

Original source: `applicative_infrastructure/gr_academia_application/LICENSE.md`.

Original source SHA-256: `0617f4b27c8d9088452d16b2c9ad48407e9c08b000a2d6bde27626928b912459`.

26.1 Licensing scope

Effective date: 2026-09-22. **Licence:** MIT. **Authority:** explicit project-owner instruction to use MIT across the four project repositories and credit all contributors.

The MIT licence applies to the project-authored software, GRRP implementation and specifications, documentation, tests, research papers, and other project-controlled materials distributed in this repository. Its copyright notice credits the contributors listed in CONTRIBUTORS.md, for their respective contributions. The licence text follows the Open Source Initiative MIT text.

26.1.1 Earlier licences and the current grant

The imported application previously stated AGPL-3.0-or-later for software, CC BY 4.0 for documentation, and CC BY-NC 4.0 in the four research papers. The present MIT grant is additional permission for the project-authored material in the current repository. Earlier permissions remain available; the old publication notices are preserved rather than rewritten as if they had always said MIT.

In particular, the project-authored content of the four PDFs in `papers/` is now also offered under MIT. The PDF bytes and their embedded CC BY-NC 4.0 notices remain unchanged as historical source artifacts. A redistribution relying on MIT includes this scope notice, `LICENSE` and `CONTRIBUTORS.md` with the PDF to make the additional permission explicit. This grant does not extend to externally authored material quoted or reproduced within a paper.

The earlier licensing statement, AGPL licence text, migration-era notes, original README and source Git bundle remain preserved. These record earlier terms; they are not the current package licence declaration. The transition record identifies the change and unchanged artifacts. The original external checkout is unaffected.

26.1.2 Scope boundaries

Dependencies, copied external works and third-party notices retain their respective terms. This project does not claim authority to relicense them. Research records, manuscripts, datasets, media and other content supplied by application users retain their own rights; hosting or processing them does not apply the software licence to them.

No copyright assignment is required by this statement. Contributors retain rights in their respective contributions, with future contributions offered as described in CONTRIBUTING.md.

27 README

Original source: `applicative_infrastructure/gr_academia_application/README.md`.
Original source SHA-256: `21f65b0dc13ce602a52a8392539da3e5c814384efc28de0193b3471c3d75a9bb`.

27.1 Generative Relational Academia

Class: Domain application and development guide
Status: Experimental application retaining native GRRP v0.1
Source repository: Generative-Relational-Academia-Application

Generative Relational Academia records research as an evolving trajectory: questions, positions, objections, transformations, decisions and connections can remain inspectable alongside the material through which inquiry develops. The web application presents projects, trajectories and record workspaces; the native Python implementation also supports local command-line use.

This repository is the academia application within the Generativity Standards Program. Its existing GRRP identifiers, signatures, transition rules and domain behavior are preserved. Alignment with the generalized application's record protocol remains separate design and implementation work. Imported theoretical papers retain their historical role; the current programme manuscripts and recorded decisions guide programme-level interpretation.

27.1.1 Current capabilities

- Browse shared projects and search their records; signed-in users can create and operate their own projects.
- Open questions within a project and follow the trajectories of identified states and transitions.
- Explore graph views, select a record or connection, and inspect its record, disclosure and workspace panels.
- Retain research material and working content beside the relevant subject rather than only at project level.
- Invoke native research acts through the interface and Python CLI, including claims, challenges, transformations, decisions and connections.
- Use native GRRP validation, signatures, registrations, disclosure declarations and portable record tooling within that protocol's existing scope.

The web guide explains the hosted model, and the Python package guide documents the CLI. Search is a filtering facility rather than a participant or trajectory ranking. A cryptographically valid or well-formed record does not by itself establish that the recorded claim is true.

27.1.2 Repository layout and authority

```
gr_academia_application/               This application Git repository
├── web_application/
│   ├── packages/client/               React and Vite interface
│   ├── packages/server/               Fastify host, accounts, SQLite and record operations
│   └── packages/protocol/             Native @gra/protocol TypeScript implementation
├── domain_packages/grrp/              Native Python implementation and CLI
├── provenance/                       Import manifest and original Git history bundle
├── docs/                             Interface guides and historical overview
├── notes/  plans/  papers/            Imported domain research and design history
└── LICENSE  LICENSE.md  CONTRIBUTORS.md
```

The application is a submodule of applicative_infrastructure, which pins a specific revision. Its original Git ancestry is retained, and the provenance guide records the original source commit, archived bundle and path mapping. The original overview remains in docs/history/original_README.md; its historical status and licensing statements should be read with the current scope notes.

Native Python grrp and TypeScript @gra/protocol remain domain packages. This application does not yet use the common generalized record protocol or Git transaction implementation. It has independent accounts, permissions and runtime records. Links to the parent Programme Brief and specifications resolve when the complete programme is checked out.

For the supported combined development layout, clone infrastructure with its submodules using GitHub SSH access:

```
git clone --recurse-submodules git@github.com:huangwanhong-maker/Generativity-Relational-Epistemic-Applicative-Infrastructure.git
↪  applicative_infrastructure
cd applicative_infrastructure
```

To obtain only academia's source, use `git clone git@github.com:huangwanhong-maker/Generative-Relational-Academia-Application.git gr_academia_application`. For the complete programme and canonical publications, recursively clone Generativity-Epistemic-Infrastructure. Its Git workflow guide covers Windows SSH configuration and remotes.

27.1.3 Install and run

Use Python 3.11 or later, Git, and Node.js/npm. Node 22.12 or later on the Node 22 release line supports the current frontend tools and matches the validated major version.

The supported combined setup runs from the **parent infrastructure directory**, with its application submodules initialized:

```
python common/tools/setup_application.py academia --dev
python common/tools/run_application.py academia
```

Open **http://127.0.0.1:8001**. Setup creates a separate Python environment, installs the relocated native package, installs the npm lockfile and builds the protocol, server and client. The development option includes Python test dependencies. It does not create demonstration accounts or seed research records.

The shared tools belong to the infrastructure repository. A clone of this application alone contains its Python and Node sources but not those tools or the predefined environment layout. For a manually configured installation, install the Python package, run npm's lockfile installation/build in the web workspace, and provide explicit absolute paths for the runtime and Python interpreter.

After setup, the compiled server can be launched directly:

```
node "<absolute-academia-directory>/web_application/packages/server/dist/main.js"
```

Defaults are resolved from source location instead of shell working directory. The default interpreter still expects the parent infrastructure environment unless GRA_PYTHON selects another installed interpreter.

For interface development, run these in separate terminals from this application's web_application directory:

```
npm.cmd run dev --workspace @gra/server
npm.cmd run dev --workspace @gra/client
```

Use npm on POSIX. The optional Vite client uses port 5174 and proxies API requests to the server on port 8001.

27.1.4 Accounts

Academia preserves its existing account-provisioning behavior. When public registration is closed, the operator CLI creates accounts. From this application's web_application directory:

```
npm.cmd run account --workspace @gra/server -- list
npm.cmd run account --workspace @gra/server -- add "<account-name>" --password "<chosen-password>" --party
↪  "<user-generated-public-party-key>"
```

Replace placeholders locally. The password must be at least eight characters; the current CLI accepts it as a command argument, so shell history and process visibility need consideration. Supplying a party key generated by the participant avoids the CLI generating and displaying a private key. Omitting the party flag invokes the existing key-generation bootstrap flow.

The same runtime configuration applies to the server and account CLI. Accounts represent access to this host, while native record identities and signing material have their own custody. Account database columns alone do not establish that a host cannot sign for a party: native record directories can contain private keys.

27.1.5 Runtime configuration and backups

Default locations below are relative to the parent infrastructure directory.

Variable	Default	Purpose
GRA_RUNTIME	.runtime/academia	Parent runtime
GRA_RECORDS	.runtime/academia/records	Native record trees, Git histories, material and keys
GRA_DB	.runtime/academia/index.sqlite	Retained accounts plus rebuildable indexes
GRA_PYTHON	.runtime/environments/academia/Scripts/python.exe on Windows; bin/python on POSIX	Interpreter with the native Python package installed
GRA_CLIENT	gr_academia_application/web_application/packages/client/dist	Built client
GRA_HOST / GRA_PORT	127.0.0.1 / 8001	Direct-server address

Supply absolute paths for location overrides. The shared launcher selects host and port through its command arguments. GRA_PYTHON is one executable path and supports spaces; GRA_GRRP remains the legacy simple-command override. The session cookie is gra_session, distinct from generalized's cookie.

Back up the complete account database and records tree, including private key material and active journals, with appropriate access restrictions. Stop the writer for a filesystem backup or use a verified online procedure. Accounts are not reconstructable from the derived record index. Source history, npm dependencies and virtual environments cannot replace a runtime backup.

Relocation preserved the existing three academia accounts, two projects and five trajectories without altering native record semantics. Those are properties of the migrated local runtime; source clones contain none of that private data. The original source checkout/runtime remains separate and unchanged. See migration evidence for the backup and comparison boundary.

27.1.6 Verification

After development setup, from this application directory on PowerShell:

```
& ../.runtime/environments/academia/Scripts/python.exe -m pytest domain_packages/grrp/tests --basetemp
↪  ../.runtime/test-output/academia -q
npm.cmd --prefix web_application test
npm.cmd --prefix web_application run build
```

Use bin/python and npm on POSIX. The test-output directory is disposable and must not name retained user data. The native Python and TypeScript vector suites check agreement on protocol identifiers.

The relocation validation report records **208 Python tests passed, one platform-specific skip, 43 TypeScript protocol tests passed and 48 server tests passed**, plus a production build and isolated deep-path record operations. These assess the native domain application; they do not verify a generalized-protocol adapter.

27.1.7 Current limits and next work

The inherited lockfile's dated migration audit reports six affected npm packages. Dependency maintenance remains open. Native identity/custody choices, disclosure behavior, account recovery and production operation also need dedicated review before broader deployment.

Generalized transaction receipts, modules, concurrency behavior and epistemic recording requirements are not automatically supplied by relocating this application. Future alignment needs an explicit preservation mapping, including signed bytes, native identifiers, registrations, disclosure and unmapped content. Avoid rewriting imported records or papers to make them appear to have used later programme concepts.

Demo tools create accounts and research records. Use a separate explicitly configured runtime when exercising them; they are not setup prerequisites.

27.1.8 Contributing and license

Commit academia source changes here, then update the application reference in infrastructure and its reference in the programme. Keep native protocol vectors and preservation tests alongside behavioral changes. Record cross-domain mapping decisions in the programme and shared design material rather than silently changing domain meaning.

Publish academia's commits before the infrastructure commit that references them, followed by the programme's infrastructure update. Select a development branch before committing in an initialized submodule, which normally begins with a detached HEAD. Existing remote ancestry is preserved through ordinary fast-forward publishing.

Project-authored software, documentation and research material are available under the MIT License, with copyright held by contributors recorded in CONTRIBUTORS.md. LICENSE.md and licensing provenance explain the additional grant and retained historical notices. Third-party components and user-created research records retain their own terms.

Copyright (c) 2026 all contributors listed in CONTRIBUTORS.md, for their respective contributions.

28 README

Original source: `applicative_infrastructure/gr_academia_application/docs/gallery/README.md`.
Original source SHA-256: `34c155d408f2200cde21a1515e362975a65b03bc1b6b709db5ca5f665ccdddae`.

28.1 Gallery

Real output from a real record, not mock-ups.

file	what it is	made by
`01-front-page.png` … `08-search.png`	the hosted interface, signed out and signed in	`node web/tools/gallery.mjs`, against a running server
`trajectory.svg`	a trajectory drawn from the record	`grrp graph -o trajectory.svg`
`release.md`	the document a release emits	`grrp export`

To remake the screenshots:

```
cd web
npm run account --workspace @gra/server -- add ada --password '…'
npm run dev                  # in one terminal
node tools/gallery.mjs       # in another; needs a project with some work in it
```

The script needs `puppeteer`, which is deliberately **not** a dependency of anything — `npm install -D --no-save puppeteer` when you want it. A gallery tool should not be something the project needs in order to build.

29 release

Original source: `applicative_infrastructure/gr_academia_application/docs/gallery/release.md`.
Original source SHA-256: `30cbc38ea0a9b0d8c8096de4b1893743841eaec253ec38499bf49dc542e8b95b`.

29.1 trust

Question. Is trust a property obtaining between individuals?
Released 2026-08-07T11:50:06Z ·release `44090b81ceee` ·state `960f13b89624` ·protocol `grrp/0.1`

> **Unattested.** Every transition in this record was registered by the party who performed it. A record registered by one party alone carries utility to its author and no evidential weight, and this document does not claim otherwise.

29.1.1 Released state

Narrow the account to institutional settings.

29.1.2 Objections standing at release

None recorded at the time of release.

29.1.3 Lineage

- `a670a1a0d460` 2026-08-07T11:48:32Z — question of a question ·disposition `unresolved` ·unattested
  - — → `c61866d366bf`
- `90cf6a20a497` 2026-08-07T11:48:32Z — claim of a hypothesis ·disposition `accepted` ·unattested
  - `c61866d366bf` → `8d80ee2acf3e`
- `577a907c294f` 2026-08-07T11:48:33Z — challenge of an assumption (cito:disagreesWith) — occasioned by objection ·disposition `unresolved` ·unattested
  - `8d80ee2acf3e` → `ef349b87ae16`
- `5985ea33b1cc` 2026-08-07T11:48:34Z — transformation of a hypothesis (cito:updates) — occasioned by objection ·disposition `accepted` ·unattested
  - `8d80ee2acf3e` → `b9493578195b`
- `4f355b76652c` 2026-08-07T11:48:36Z — transformation of a hypothesis (cito:updates) ·disposition `accepted` ·unattested
  - `b9493578195b` → `960f13b89624`
- `44090b81ceee` 2026-08-07T11:50:06Z — release of an artefact ·disposition `accepted` ·unattested
  - `960f13b89624` → `960f13b89624`

29.1.4 Contributors

- `_UYkhksvK82EuS2A` — performer

Generated from release `sha256:44090b81ceeec4674fcc5b324969c11cf98152833fa4941f2b5a011774c71338` by grrp, an implementation of grrp/0.1. The record this document was generated from can be obtained and continued under a different implementation without anyone’s permission.

30 LICENSE.before MIT

Original source: `applicative_infrastructure/gr_academia_application/docs/history/LICENSE.before-MIT.md`.

Original source SHA-256: `eb10bc17c76529f1d238ae97a08b3ad8f448320822bb28ca1e9086cc7f20650b`.

30.1 Licensing

Generative Relational Academia (GRA) is developed as open scholarly infrastructure intended to remain freely usable, inspectable, extendable, and continuable by researchers, institutions, and communities.

30.1.1 Software

The `grrp` reference implementation and other software in this repository, unless otherwise stated, are licensed under the **GNU Affero General Public License, version 3 or any later version (AGPL-3.0-or-later)**.

Copyright © 2026 Wanhong Huang and all contributors listed in CONTRIBUTORS.md.

The complete licence text is provided in `LICENSE`.

The choice of AGPL reflects the generative and commons-oriented design of this project. GRA may be deployed as network-accessible scholarly infrastructure, and developments emerging from the shared implementation should remain capable of circulating back into the commons.

30.1.2 Specification and documentation

The GRA and GRRP specifications and documentation are intended to be openly forkable, independently implementable, and continuable across infrastructures.

They are licensed under the **Creative Commons Attribution 4.0 International licence (CC BY 4.0)** unless otherwise stated.

Two requirements of the design particularly motivate this openness:

- The specification must be licensed so that **any party may fork it**, and conformance to a fork must be expressible in the version identifier. Otherwise, custodianship of the specification becomes a position of authority rather than a service (Paper IV, Requirement 19.4).
- A record must permit **continuation elsewhere**. This is one of the five joint properties of portability, and portability is the principal bound this design places on the authority of any infrastructural position within it (Paper I, Requirement 16.2).

The licensing of the protocol does not require an independent implementation of GRA or GRRP to use the licence of the reference software merely because it implements the protocol.

30.1.3 Research records and contributed content

The software and documentation licences of this repository do not automatically determine the licences of research records, manuscripts, datasets, media, or other scholarly content created, deposited, referenced, or managed through GRA.

Such materials remain subject to the licences and rights specified by their respective authors or rights holders.

30.1.4 The four papers

The PDFs in `papers/` each carry their own licence notice within the document:

Creative Commons Attribution–NonCommercial 4.0 International (CC BY-NC 4.0).

They remain under those terms until their licence notices are revised by their author.

Where this licensing statement and a document's own licence notice differ, the licence stated within that document governs that document.

31 LICENSING NOTES.before MIT

Original source: `applicative_infrastructure/gr_academia_application/docs/history/LICENSING_NOTES.before-MIT.md`.

Original source SHA-256: `af7b0ab32d77abe75896a40710d9093926b9cf68d7f4f055e1711eb124824661`.

31.1 Licensing preservation notes

Status: Informative import record, 2026-09-22; no change of licence.

The source `LICENSE.md`, Python package metadata, and npm package metadata identify the software as **AGPL-3.0-or-later**. The source GRRP README instead ended with a stale MIT statement. The active relocated README now refers to the repository's existing AGPL licensing statement; the earlier text remains recoverable from the source Git bundle and import manifest.

The source licensing statement linked a `LICENSE` file that was absent. The official AGPL v3 text was retrieved from `https://www.gnu.org/licenses/agpl-3.0.txt` on 2026-09-22 and saved as `../LICENSE` (34,523 bytes; SHA-256 `0d96a4ff68ad6d4b6f1f30f713b18d5184912ba8dd389f86aa7710db079abcb0`). The "or later" choice remains in the preserved licensing statement and package metadata.

The preserved copyright notice refers to `CONTRIBUTORS.md`, also absent in the imported source. No contributor list has been invented. Source commit authorship is available in the history bundle; authorship metadata is not itself a determination of copyright ownership.

The documentation and papers retain the distinct licences described in `LICENSE.md` and their own notices. Research records and contributed content do not acquire the software licence solely by being handled by this application.

32 original README

Original source: `applicative_infrastructure/gr_academia_application/docs/history/original_README.md`.
Original source SHA-256: `cda22e27690eae441d5cca3791eac52edfff75bc068183fae3cb4906960774bd`.

[!IMPORTANT]

32.0.1 Building the next open infrastructure for generative academia

Recent changes across the open-science infrastructure landscape have again highlighted how difficult it is to sustain open scholarly spaces over the long term.

Knowledge and academia develop through continuous co-evolution, propagation, discussion, revision, and co-creation within a commons. Research projects are living generative processes: ideas emerge, relations form, evidence changes understanding, discussions redirect trajectories, and new knowledge creates conditions for further knowledge.

This is one of the motivations behind **Generative Relational Academia (GRA)**.

GRA aims to develop an open academic protocol and infrastructure supporting familiar scholarly functions such as research project management, publication, persistent identification and DOI integration, while placing particular emphasis on the **generativity and evolving trajectory of research itself**. We are exploring how research processes, epistemic transitions, provenance, collaboration, discussion, AI participation, and relations among scholarly objects can become visible, interoperable, reconstructable, and capable of continuing across platforms.

This is currently an independently initiated open project. We welcome researchers, developers, librarians, open-science communities, universities, research infrastructures, and anyone interested in the future of scholarly communication to discuss, experiment, contribute, or explore possible cooperation with us.

If you are interested in co-creating this infrastructure, please feel free to contact us or contribute directly to this repository:

Wanhong HUANG Serendip Commons Society huangwanhong@serendip.ngo

32.1 Generative Relational Academia (GRA)

Infrastructure for recording how understanding changes.

Scholarly communication transmits finished artefacts and discards the *trajectory* that produced them — which assumption was abandoned, which objection forced the abandonment, which approach was tried for six months and set aside, which direction was chosen over which alternative and on what ground. GRA is a protocol, and a reference tool, for keeping that record.

Stage 0 — design and standardisation. Four papers are drafted and the protocol is specified as **GRRP v0.1**, which has **no deployment history and no evidence of use** — every requirement in it is a proposal about what such use would need. The reference tool `grrp` implements the protocol through the **open tier**, and **all eight acceptance tests pass**. It has not yet been used on real work.

The protocol now exists **twice**: in Python (`grrp/`) and in TypeScript (`web/packages/protocol`), agreeing byte-for-byte on 35 shared vectors. A protocol nobody has implemented twice is a protocol whose specification has not been tested — and that suite found a real one on its first run, where the two languages stripped different sets of trailing whitespace and produced two different identifiers for the same document.

A hosted interface is being built in `web/`: **a host for projects, which is not their authority.** It stores no private key, computes no quantity over anyone, and can be deleted without costing anybody a record.

32.1.1 Gallery

Everything below is real output from a real record — the philosophy case from the specification. Nothing here is a mock-up. The screenshots are taken from a running server by web/tools/gallery.mjs; the drawings are emitted by the tool itself. The command that produced each one is named.

32.1.2 The front page, signed out

Reading what people have shared, and searching it, needs no account. An account is access to one host, not permission to look — and a front door that showed nothing until you signed in would have already decided it was the authority.

[Image retained in source archive.]

32.1.3 A project, as one graph

Every question in a project, in one picture — the demonstration record `field-memory`, which carries every node and edge kind the graph model names. The deeper rose edge **crosses between questions**; the labelled capsule on a line is a **connection: a reified edge**, drawn as an edge and openable as a node, because it is one. Nodes drag; the view pans and zooms; positions are your view only, recorded nowhere.

Left to right is distance from a question, not importance. Nothing is ranked, sized or coloured by how much it matters, and no line is marked the principal one.

[Image retained in source archive.]

32.1.4 One subject, in full — including an edge

Selecting anything lights what it touches and lets the rest recede. Here the selected subject is a **connection** — the reified SUPPORTS edge between two questions — opened as a node beneath the drawing with its record panel (the signed payload, the CiTO binding, registration, the full identifier), its disclosure panel, and **its own workspace**. The acts row records against it through `grrp`, whose refusals are shown verbatim.

[Image retained in source archive.]

32.1.5 What happened, under one question

[Image retained in source archive.]

32.1.6 Search, which filters and does not rank

No relevance ordering, no best match, no score. Matches come back in the same order everything else is listed in, and the API says so in its own payload so that a second client cannot present them as ranked without contradicting it.

[Image retained in source archive.]

32.1.7 The trajectory, drawn by the tool itself

[Image retained in source archive.]

```
grrp graph -o trajectory.svg
```

One column per step away from the question. Edges are labelled by the act that made them. The two positions on the right **diverged, and are drawn identically** — nothing in the picture designates a principal line, because nothing in the record does. In inquiry a fork is frequently the correct outcome, so plurality is the normal shape of a healthy record rather than an unfinished one.

The objection in amber is `unresolved` and has never been answered. It stays there.

32.1.8 Where the work stands

```
$ grrp show
trust   (trust)
  question   Is trust a property obtaining between individuals?

  live positions
    960f13b89624  Narrow the account to institutional settings.
    9168b1900d17  Keep the general scope and weaken the claim.
    these diverged. Neither is the canonical one.

  unanswered
    a670a1a0d460  question    Is trust a property obtaining between individuals?
    68985dd9b7cb  challenge   The revision cannot now distinguish trust from complian⋯

  unattested throughout - useful to you, evidence to nobody
```

Derived from the log, never stored. The last line is the honest one: **a record you registered yourself is useful to you and is evidence to nobody.**

32.1.9 What you still owe an answer to

```
$ grrp open
trust - trust
  a670a1a0d460  question     2026-08-07T11:48:32Z
      Is trust a property obtaining between individuals?
  68985dd9b7cb  challenge    2026-08-07T11:48:34Z
      The revision cannot now distinguish trust from compliance.
      against b9493578195b
```

This is also **the entry path**. Each item is an identified state that someone holding no prior standing in your work can reference in a challenge, a connection or a verification — and be judged on the act itself, not on who they are.

32.1.10 What a ground leaves disclosable

```
$ grrp disclose 616bb79843 --class private --ground appropriability
disclosed 616bb79843a1  at private
  ground   appropriability - the content whose disclosure would destroy that excludability

  What this ground leaves disclosable, and what you must still disclose:
    appropriability: the existence of the work, the questions pursued, the decisions
    taken and their reasons, and negative results

  Misapplied, this is: rent-seeking secrecy - secrecy obtained on an economic
  justification that does not apply.
```

The residue is surfaced at the moment of withholding, because it is the **one question a reader can always ask**: was what the ground leaves disclosable in fact disclosed? A declaration accompanied by its residue costs the declaring party something; one without it costs nothing.

32.1.11 What it refuses

The most characteristic thing about the tool is what it will not do.

```
$ grrp register 3bd6fc72e6
[C2] you cannot register your own act. Credibility follows from the distribution of
registrations across parties who did not coordinate, and follows from no property of
the record itself.

$ grrp disclose 687087cf --class private --ground hazard
[C7] disclosure may widen and never narrow. 687087cf329f is at 'public'; 'private'
is narrower. A party who has read a record retains what they read, so an operation
offering the appearance of withdrawal would misdescribe to your own participants a
state of affairs obtaining outside this record.

$ grrp disclose 616bb79843 --release-at 2030-01-01
refused: a schedule may be shortened, never extended (2027-06-01).
  Recording the attempt, because it should be visible that it was made.
[C7] a delay that can be extended indefinitely is a permanent withholding made to
look temporary.
```

Each refusal names the constraint and says what to do instead, because a protocol that refuses things without saying why reads as a bug.

32.1.12 The document it emits

```
grrp release && grrp export <release> -o paper.md
```

docs/gallery/release.md — the released state, **the chain of transitions that produced it**, the parties with their CRediT roles, the content absorbed from elsewhere with its attribution, and the objections standing unresolved at the moment of release. Assembled from records made in the course of the work, with no additional writing.

That last section is the one no other process can produce, and the reason adoption does not require anyone to stop publishing.

32.1.13 The local page, and the hosted one

```
grrp ui                     # single user, loopback, no account, no network
cd web && npm run dev       # a host: accounts, projects shared between them
```

Both are **Level 3 — an application over the record, outside conformance**: everything they offer is available from the command line, no module of the record imports them, and a test asserts that a record written from a page and one written from the terminal are the same record.

The hosted one stores **public keys only**. It has no column a private key could go in, which is what makes an attestation registered there worth anything: a host holding both parties' keys could forge one, and C2 would be bookkeeping rather than evidence. Deleting its whole database costs a reindex and nothing else — a test asserts that by deleting it and checking every record returns identical from the files.

32.1.14 The argument in four steps

1. The artefact is weakening as evidence. A published artefact conveyed information about its producer's capacity *only because producing it was costly in a way that discriminated between producers*. The evidence was never in the object — it was in the difference between what the object cost different producers. Where that cost falls for producers of every capacity at once, the discrimination goes while the artefact, the practice, and the systems reading it all remain in place. **The failure is invisible from inside the practice**, because the artefacts continue to arrive and continue to be counted.

2. So the trajectory becomes a candidate — but it inherits the same problem. Two hundred entries describing questions, attempts, failures and revisions, internally consistent and plausibly paced, are an *easier* object to fabricate than the paper they purport to have produced. Length, detail and the appearance of struggle are properties a fabricated record has as readily as a true one. **Preserving a research process establishes nothing on its own.**

3. Therefore credibility must come from distribution, not from content. A transition registered by **a party distinct from the one who proposed it** is costly to fabricate in proportion to the number of parties who would have to participate in the fabrication. The precedent is old: the bound, paginated laboratory notebook countersigned by a witness who was not the inventor — evidential *without* disclosing its contents to anyone. This is why GRA is a **protocol and not a platform**: a platform operator is party to every entry and cannot supply the independence the record's credibility depends on.

4. And the binding constraint is capture cost, not representation. Systems adequate to represent issues, positions, objections, options, claims and evidence have existed since 1970 — IBIS, gIBIS, Compendium, design-rationale notations, scholarly claim ontologies — built by capable people with funding, connected to deployed standards. **They were not adopted.** The documented cause is that the work of recording fell on the party who gained least from the record, at the moment they could least bear it, in a form that served a different party later.

The first constraint on the design follows: every act the protocol defines is one a participant performs for a reason of their own, with the record falling out of its performance. An act that exists *so that a record should exist* will not be performed, and any part of the design depending on such an act is moved to an optional tier or removed.

32.1.15 What is recorded

The unit is **not** a document, a comment, or an output. It is a **transition**: an identified prior state became an identified posterior state, through a typed act performed by a party and registered by a party.

```
state s_k  ──[ act: challenge  •  target: assumption  •  relation: modifies ]──▶  state s_k+1
               performer: A          registrar: B (distinct, signed)
               disposition: unresolved
```

A **trajectory** is the directed graph of these. **The "current state" is computed from the graph and never stored as an authority.**

This is what no existing system records. Platforms that decompose a publication into typed linked units show that a second hypothesis exists; they do not show that *this objection converted the first hypothesis into it*. Commentary systems attach a remark to an artefact — nothing transitions, no state is superseded, and the relation between the comment and any later change lives only in the author's memory.

32.1.16 Transitions are typed along five independent dimensions

Not one flat list of several dozen tags. Agreement between people classifying the same event declines as the number of categories rises, and a vocabulary requiring deliberation re-introduces the capture cost the whole design exists to avoid.

Dimension	Values	Extensible?
act	`question` `claim` `challenge` `transformation` `decision` `connection` `verification` `release`	fixed by the protocol
target	question ·assumption ·hypothesis ·concept ·theory ·method ·path ·artefact	by charter
relation	extends ·modifies ·replaces ·refines ·generalises ·specialises ·transfers	bound to **CiTO**
trigger	reflection ·literature ·experiment ·simulation ·observation ·discussion ·objection ·failure ·automated suggestion ·**entry of a new party**	by charter
disposition	`accepted` ·`contested` ·**`unresolved`**	fixed by the protocol

`unresolved` is not optional. Most objections in theoretical work are never resolved: they stand, and the work proceeds beside them. A vocabulary recording only acceptance and rejection would produce a systematically false record of the fields this project most concerns — and would exert pressure toward **fabricated closure**.

Contribution is not an act. It types a party's part **in** an act, and binds to **CRediT**.

32.1.17 Three planes

```
Applications          search  •  matching  •  summarisation  •  visualisation  •  assessment of content
                      ── outside conformance. The protocol requires none of it. ──
        ▲
   TRANSITION PLANE   typed transitions  •  parent links  •  attestation + signature  •  attribution and
                      absorption links  •  disposition  •  disclosure class + declared ground
```

```
                  APPEND-ONLY. The system of record.
      ▲  registration by a responsible party promotes an event to a transition
EVENT PLANE       auto-generated records that something occurred: meetings, comments, file
                  changes, permission changes, model operations.
                  PRIVATE TO PARTICIPANTS. Never exported, never indexed.
      ▼  delegation
Substrates        version control  •  repositories and persistent identifiers  •  federation protocols
                  ── existing, maintained by others, not reimplemented here ──
```

The event plane is cheap to populate and carries **no epistemic claim**. It is also where the surveillance hazard falls: a complete log of who attended and whose files changed is a monitoring record by construction. It is confined to participants and reaches wider disclosure **only through a transition that references it**.

GRA contributes the transition plane and the rules governing promotion into it — and nothing else. Storage, identifiers, append-only history, content addressing, archival deposit and transport all exist, are maintained by parties with the resources to keep maintaining them, and are delegated.

32.1.18 Withholding

An arrangement that records how understanding changes **must** be able to withhold. The question is never *whether* but **on what ground — and what follows from the ground**.

Nothing here confers a right to exclude. Withholding is justified **by a reason, never by a title**, and the reason does work: it determines what is withheld *and what must still be disclosed*.

Ground	Condition	What it restricts	**Residue — must still be disclosed**
rivalry	a resource admits limited simultaneous use	**access to the resource**	**the trajectory in full**
hazard	propagation of the content creates risk	the propagable content of a method	existence, questions, decisions, interpretations, non-conveying results
exploratory vulnerability	exposure now would suppress or distort the work	**the timing of exposure**	**everything, at the scheduled time**
appropriability	funding requires excludability	content whose disclosure destroys excludability	existence, questions, decisions, **negative results**

The residue rule is the operative rule of the whole design. Without it, every ground collapses into the same thing — silence with a justification attached. With it, a restriction becomes a **dated, attributable assertion**, and a reader has one checkable question: *was what the ground leaves disclosable in fact disclosed?*

That question is the only observable available in every case. **A declaration accompanied by its residue costs the declaring party something; a declaration withholding it costs nothing — and the second is the signature of misapplication.**

Three further rules:

- **Disclosure is monotone.** It may widen and must not narrow. **There is no `unpublish` operation** — a party who has read a record retains what they read, and an arrangement offering the appearance of withdrawal misdescribes to its own participants a state of affairs obtaining outside it. A scheduled release may be **shortened, never extended**.
- **Restriction is per record**, never per repository or per project. A single line of work carries states disclosed to everyone, to a group, and to nobody, with the differences declared and grounded.
- **Content is separable from the attested skeleton**, so **redaction removes content while leaving the graph and the signature chain intact** — and the record of the redaction itself is never removed.

The design cannot separate the valuable from the dangerous within a trajectory, **because they are the same material** — so it separates the *parties to whom it is disclosed* rather than filtering the content.

32.1.19 How it is adopted, if it is

The design assumes it will be used first by **one researcher, alone, with no collaborators**. If the tool is not worth using by a single person on the first day, nothing that follows happens.

Tier	Adds	What its adopter gets
Personal	transitions with parent links against identified prior states ·append-only log with derived views ·three acts (`claim`, `challenge`, `release`) ·content separable from skeleton	a searchable record of what was ruled out **and why** ·a standing list of objections not yet answered ·**a citable release with its chain**
Group	attestation by a distinct party · CRediT roles ·absorption links · disclosure classes with declared grounds ·administrative operations recorded	**evidence** — credibility begins where a second party registers ·visible attribution of changes · onboarding a new member from the record
Open	propagation with declared profile ·distributed custody ·archival deposit of released material · charter reference ·operator-independent identifier resolution	exchange with parties elsewhere ·continuation of the record beyond any operator ·entry of strangers through the open register

The personal tier delivers utility and no evidential weight, and the two must not be confused. Every transition in a self-registered trajectory is marked **unattested**, and stays marked on export.

Two things make the tiers matter economically. **Each tier must return something at its own scale**, so no party is ever asked to act on a benefit that requires others. And the **minimum viable adopting unit** is small: two parties who register each other's transitions at the group tier; one community with an implementation and a charter at the open tier. A design whose minimum unit was a discipline would need an agreement nobody can broker. This one needs a decision two people can take on a Tuesday.

A release emits a citable document — the released state, the chain of transitions leading to it, the parties with their roles, the absorption links with their attributions, and **the objections standing unresolved at the moment of release** — assembled from records created in the course of the work, with no additional effort. Nothing here asks anyone to stop publishing.

32.1.20 The entry path

A trajectory holds states whose disposition is `unresolved`: obstacles met, objections standing, questions raised without answers. That set, published at each disclosure class, is a **register of open problems**, and any party holding **no prior position at all** may reference one in a `challenge`, a `connection` or a `verification` — decided on the act itself.

This matters because the usual qualifications fail. *Demonstrated contribution* requires access in order to be satisfied and grants access in return for satisfaction; *trust extended by existing participants* has the same shape with an extra step. Both are closed against every party who holds no prior position — which reproduces, at the scale of a working group, exactly the exclusion the project diagnoses at large scale.

32.1.21 What this project does not claim

The papers spend a substantial part of their length forbidding specific claims. They are repeated here because they are the ones most likely to creep back into a description of the work.

- **It does not reduce competition or democratise recognition.** Standing is a *positional* good: the aggregate available in a field is fixed by construction. Making more contributions visible **redistributes** recognition; it does not create it. What may be claimed is that it **changes what competition rewards** — and that attribution mechanisms will therefore be *resisted* by parties who benefit from the present invisibility of others' contributions.
- **It does not produce serendipitous encounters.** There is no evidence that infrastructure increases productive unplanned encounter, and the strongest qualitative study of an arrangement designed to produce it reports occupants developing strategies to *avoid* it. What may be claimed is a lowered **cost of preparation**: a recorded, available state is preparation externalised, so that another party's preparation may meet it.
- **It does not measure capacity.** Two trajectories may coincide entirely in their recorded appearance while differing entirely in the generativity of the relations that produced them. **The record holds what occurred, not what the relation was capable of.**
- **It does not make another party's work continuable from where they stopped.** A record carries only the *articulable fraction* of what its participants held; the rest transmits, if at all, by working alongside them. What transfers is **the redirection of attention** — that an approach was attempted, on what assumption, and what obstruction was met.
- **It computes no scores.** No quantity over participants or over trajectories, and no total order over either. Not transition counts, not attestation depth, not contribution shares, not "trajectory health". This costs the arrangement the ability to report that a project is going well or to rank contributors for a committee, and the cost is real and accepted. *(Counts **within** one trajectory, shown without comparison across trajectories or participants, are permitted.)*
- **It requires no AI.** Every conformant operation is performable with a text editor and a version-control system. A model may *propose* a transition and may **not author or register one**, and a model-originated proposal is marked as such.
- **It has no merge.** Two revisions of a concept do not compose, no conflict region localises, and no test decides the result. Integration appears only as a **synthesis** (a state referencing several parents) or an **absorption** (content taken from elsewhere, with attribution to its originator). **In inquiry a fork is frequently the correct outcome, and plurality is the normal shape of a healthy record.**

32.1.22 What is known to be unsolved

These are stated as open, not as oversights. A difficulty counts as *addressed* only where there is a mechanism, an identified party who bears its cost, and a stated condition under which the mechanism fails. Four fail that test:

- **Assessment capacity.** Every mechanism lowers the cost of contributing and lowers the cost of assessing by nothing, so congestion follows *from the design working*. The usual remedy — ranking — is excluded. The remaining options (reciprocal obligation, bounded intake, maintainer triage) are all charter matters and all place an unfunded burden on a few parties. **This is the difficulty most likely to determine whether a conforming arrangement survives at scale.**
- **Maintainer labour.** Unfunded, concentrating on few parties, growing with adoption, with no party whose interest is proportional to the benefit. The open-source record is a warning here, not an encouragement.
- **The regressive incidence of overhead.** Recording falls hardest on those with the least time and the least standing — the population the diagnosis concerns. The byproduct principle addresses the *magnitude* and the *timing* of that cost, and not its *distribution*.
- **Recognition of attributed contribution.** No property of a protocol makes a community count what it records.

And two the papers name as structurally beyond the four grounds: **downstream reuse** of trajectory records by parties who did not produce them (the design's own criterion marks uncompensated corpus assembly as *extractive*, and supplies no mechanism against it), and **hazard restrictions**, which admit no scheduled release and so commit a community to maintaining a class indefinitely.

32.1.23 How this project would be shown to have failed

Stated in advance, so they can be looked for:

1. **Personal-tier adoption without progression to the group tier**, over a substantial population and period — the arrangement would have delivered private utility without the attested records on which every evidential claim rests, and become **a note-taking convention**.
2. **Records in which the `decision` act is rare while transformations are common** — the act on which the reuse of abandoned work depends is not being performed, and making it cheap was insufficient.
3. **Group-tier declarations alongside registration patterns of pairs who register only each other** — attestation operating as a formality.
4. **A widely used external score computed over conformant records** — the exclusion of scalar measures displacing the dynamic rather than preventing it.

Beyond the specification, the whole account is withdrawn on any of: a deployed system or published specification already taking the transition between identified states as its unit with registration by a distinct party; a specification already defining admissible acts and their effect on a shared state for scholarly work, with conformance conditions; evidence that the rationale-capture systems failed for reasons **other than capture cost**; or evidence that the artefact's separating condition has **not** weakened.

32.1.24 Repository

```
papers/   the four working drafts (CC BY-NC 4.0)
notes/    dense working notes on each paper, a glossary, and a gap analysis  ← start here
plans/    implementation-plan.md — the single build plan, as a checklist
          design-nodes-time-and-occasions.md — decisions taken before building
grrp/     the reference implementation, Python — the protocol is defined against it
web/      the hosted interface, TypeScript
            packages/protocol   GRRP again, in TypeScript. Browser and server.
            packages/server     Fastify + SQLite. Owns no protocol decisions.
            packages/client     React. Disposable by design.
docs/     the gallery above
```

32.1.25 The papers

I ·Designing Generative Relational Academic Infrastructure	The problem, the prior art conceded in full, and **sixteen requirements** derived from it.
II ·Incentives, Collective Action, and Adoption	Whether any of this happens. Where the commons dilemma actually sits, the positional bound, **the absorption test**, and ten predictions with their refutations.
III ·Grounds of Restriction	Disclosure governance: four irreducible grounds, each with an object, a residue, and a named failure.
IV ·Specifying the GRRP	**The normative specification, v0.1** — record model, act vocabulary, attestation, absorption, disclosure, redaction, identity, propagation, conformance tiers and tests.

Notes: Paper I ·Paper II ·Paper III ·Paper IV ·Glossary ·Gaps and actions

32.1.26 The reference implementation

`grrp/` — a command-line tool recording trajectories as typed transitions in an ordinary git repository, in plain text, **with no server, no account, and no network**. Plan: plans/implementation-plan.md.

```
cd grrp && pip install -e . && python -m pytest

grrp init
grrp new "Is trust a property obtaining between individuals?"
grrp claim     -m "Trust obtains between individuals."
grrp challenge -m "This omits institutional power."      # defaults to the live position
grrp transform -m "Trust is shaped by asymmetry of power." --answering <challenge>
grrp decide --abandon      # omit -m and your editor opens, asking for the reason
grrp connect --to doi:10.1234/x -m "Same obstruction, other field."
grrp verify --failed -m "Independence does not hold in the target domain."

grrp show        # where this stands: question, live positions, what is still open
grrp open        # what you still owe an answer to — and the entry path for strangers
grrp release && grrp export <release> -o paper.md
```

Milestone	
M0 skeleton, canonical hashing, `init`	**built**
M1 personal tier — five acts, append-only log, derived views, `open`, `show`, `export`	**built — this is the ship point**
M2 full act vocabulary, `check` over the whole chain, separable content, `redact`	**built**
M3a group tier — keypairs, signatures, `register` with performer ≠ registrar	**built**
M3b CRediT attribution, absorption links, contested attribution, synthesis	**built**
M3c disclosure classes, grounds, monotone release	**built**
M4 open tier — `bundle`/`continue`, profile declaration, deposit, sealed registration	**built**
UI a local page — Level 3, outside conformance	**built**

The acceptance tests are written against the constraints rather than the features, and **all eight now pass** — including the last one: bundle on one machine, continue on another with no shared service, and get one graph rather than two.

Conformance is **self-declared and checkable from the record**. There is no certification body and none is required: a doubting party obtains the record under the continuation requirement and verifies the signatures, the identifier construction, and the presence of the required fields.

> `plans/implementation_plan.md` was an earlier draft that predated the specification and conflicted with it — "commit" for the epistemic unit, a flat type list, and roadmap items excluded as scalars. It has been retired; see notes/gaps-and-repo-actions.md for what it got wrong and why.

32.1.27 Status and declaration of interest

Stage 0. The specification is **v0.1**, published with an amendment procedure rather than as finished — a specification published as finished would contradict the account it specifies. **There is no implementation, no deployment history, and no evidence of use.** Every requirement is a proposal about what such use would need, and the requirements are expected to be wrong in ways argument cannot anticipate.

Amendment is itself conducted through a conforming record: a proposal is a **state**, objections are **challenges**, revisions are **transformations**, and adoption is a **release at the widest class** — enumerating the objections that stood unresolved at the moment of adoption.

Declaration of interest. GRA is developed by the **Serendip Commons Society**, which would host an implementation of the protocol and is a candidate custodian of the specification. Two rules follow and are held without exception. The society's activity is **evidence for no claim** in the papers. And every requirement imposed on a custodian applies to the society itself — including that **the specification be forkable**, that **stewardship of the specification be separated from operation of any implementation**, and that any conflict be recorded together with the arrangements limiting it.

The papers state that an arrangement in which the proposing party maintained the charter, operated the implementation, and held the restricting authority **would be an instance of the concentration the project diagnoses**. Declaring that conflict is a condition of the account's coherence, not a courtesy.

32.1.28 Contributing

The most useful contributions are the ones that would show the account wrong: a system or specification that already occupies the gap; a **reasonable restriction that fits none of the four grounds** (which would show the set incomplete — the account invites the observation, since a typology whose exhaustiveness cannot be challenged is a stipulation); or a demonstration that an act the protocol requires has no purpose for the party performing it.

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32.1.29 Licence

AGPL-3.0-or-later for the software. See LICENSE.md. © 2026 Wanhong Huang and Serendip Commons Society.

The choice is not incidental. Two requirements of the design constrain it, and the AGPL discharges both while adding a third thing this design wants: the specification must be licensed so that **any party may fork it** — otherwise custodianship is a position rather than a service (Paper IV Req. 19.4); and a record must be **licensed so that continuation elsewhere is permitted**, which is one of the five joint properties of portability, and portability is the only bound this design places on the authority of any position within it (Paper I Req. 16.2).

What the AGPL adds is the network clause, and it bears directly on the central risk here. A host that ran a modified GRA as a service would have to offer its modifications. **A closed fork cannot become the place everyone's records live** — which is the failure this whole design is arranged against, and the one a permissive licence would leave open.

Three things it deliberately does not reach:

- **The protocol.** An independent implementation of GRRP does not inherit this licence merely by implementing the specification. If it did, C10 would be a slogan.
- **Research records and contributed content.** Manuscripts, datasets, media and records created or managed through GRA remain under whatever their authors and rights holders specify.
- **The four papers.** The PDFs in papers/ each carry their own **CC BY-NC 4.0** notice inside the document and remain under it until those notices are revised. Where this repository's licence and a document's own notice differ, the document's notice governs that document.

33 README

Original source: `applicative_infrastructure/gr_academia_application/domain_packages/grrp/.pytest_cache/README.md`.

Original source SHA-256: `73fd6fccdd802c419a6b2d983d6c3173b7da97558ac4b589edec2dfe443db9ad`.

33.1 pytest cache directory

This directory contains data from the pytest's cache plugin, which provides the `--lf` and `--ff` options, as well as the `cache` fixture.

Do not commit this to version control.

See the docs for more information.

34 CONTRIBUTORS

Original source: `applicative_infrastructure/gr_academia_application/domain_packages/grrp/CONTRIBUTORS.md`.

Original source SHA-256: `491017f3cd6f8be897671c61e88e53ec8664e9369cbc7227fd865a6f65b6d7d6`.

34.1 Contributors

Copyright (c) 2026 the contributors listed in this file, for their respective contributions.

Contributor	Recorded contribution
Wanhong Huang	GR concepts, protocol and application design, and development direction.
Serendip Commons Society	Organization credited in the original GRRP package authorship and application copyright notice.

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Add a contributor's chosen name or organization and a brief contribution description when their work is incorporated. Preserve existing attribution. Corrections can be proposed through the same review process as other repository changes.

AI tools have assisted drafting, implementation, and review. They are development tools and are not listed as copyright holders. Third-party components retain their own author and licence notices.

35 README

Original source: `applicative_infrastructure/gr_academia_application/domain_packages/grrp/README.md`.
Original source SHA-256: `571ab1e6fbdab7b60750257689a1e75cf7e541e9f55d6d530b16e01daf019d7a`.

35.1 grrp

Reference implementation of the **Generative Relational Research Protocol v0.1**, specified in *Specifying the GRRP*. **The specification governs where the two differ.**

A command-line tool that records the trajectory of an inquiry as **typed transitions** in an ordinary git repository, in plain text, **with no server, no account, and no network**.

Status: M0–M4, plus a local page. All eight acts, redaction, attestation, attribution and absorption, grounded disclosure, and portability. **All eight acceptance tests pass.** M5 is the conformance suite.

35.1.1 The unit of record

Not a document. Not a comment. A **transition**: an identified prior state became an identified posterior state, through a typed act performed by a party and registered by a party.

```
state s_k  ──[ act: challenge  •  target: assumption  •  relation: cito:disagreesWith ]──▶  s_k+1
               performer: key:ed25519:⋯    disposition: unresolved
```

A **trajectory** is the directed acyclic graph of these. **The current state is computed from the graph on demand and is never stored as an authority** — a stored snapshot becomes the thing people trust, the log drifts from it or is edited to match it, and every claim about integrity fails at once.

35.1.2 Install and use

```
pipx install -e .          # or: python -m pip install -e .

grrp init
grrp new "Is trust a property obtaining between individuals?"
grrp claim      -m "Trust obtains between individuals."
grrp challenge  -m "This omits institutional power."
grrp transform  -m "Trust is a process shaped by asymmetry of power." --answering <challenge>
grrp decide     --abandon        # no -m: opens your editor and asks for the reason
grrp connect    --to doi:10.1234/x -m "Same obstruction, other field."
grrp verify     --failed -m "Ran it on the target domain; independence fails."
grrp redact     <state> --ground consent_withdrawn

grrp show                  # where this stands: question, live positions, what is open
grrp open                  # what you still owe an answer to — and the entry path
grrp state                 # the live positions, derived
grrp log
grrp release               # publishes, enumerating objections that still stand
grrp export <release> -o paper.md
grrp check                 # verify the record, and this tool against the protocol
grrp ui                    # a local page, if you would rather see it than read it
```

35.1.3 The page

```
grrp ui        # anywhere — it does not need a record to exist yet
```

Serves a page on the loopback interface. From it you can **start a record** (a directory, and a git repository inside it if you want one), open a question, record any act, register a colleague's proposal, release, and **see the trajectory drawn**: one column per step away from the question, edges labelled by the act that made them, divergent branches side by side and drawn identically.

It is **Level 3 — an application over the record, outside conformance**. Everything it offers is available from the command line, no module of the record imports it, and deleting it

would leave the record untouched. That last claim is checked by a test rather than asserted. Stdlib only, no account, nothing leaves the machine.

It is tested for what the design forbids, because a screen is where the temptation is strongest: no quantity over participants or trajectories, no branch marked principal *in the drawing or anywhere else*, no control that narrows disclosure, no approve or veto, and the word *merge* nowhere at all — not in the page, not in the stylesheet.

A test also asserts that a record written from the page and one written from the terminal are the same record. Both go through `actions.py`, so the page is an application over the protocol rather than a second implementation of it.

35.1.4 Credit

```
grrp claim -m "…" --contributor bo=Methodology     # CRediT roles, attached to the act
grrp transform -m "…" --from <state>               # content you took, credited to its producer
grrp transform --with <state> -m "…"               # a synthesis drawing on several branches
grrp contest <tx> -m "…"                           # this attribution is wrong
```

Attribution attaches to **an act**, not to a finished work. A contributor statement says a person contributed to a paper; this says which change in the content of a claim a person produced.

An absorption link confers **attribution and no power to prevent, condition or reverse the use**. Rights to exclude, multiplied across many small contributions, produce the fragmentation in which downstream work needs so many permissions that it does not occur. A party who does not want their state absorbed has one instrument, and it is the disclosure class of that state.

`grrp contest` records that an attribution is wrong. Nothing is deleted or altered, and **no party is empowered to settle it** — what the record contributes is that both positions are visible with their dates.

35.1.5 Leaving

```
grrp bundle -o traj.zip        # the complete record: no permission, no service
grrp continue traj.zip         # anywhere, under any implementation
grrp profile --json            # what another implementation needs to read it
grrp deposit <release> -o dir/ # an archival package, released material only
grrp custody add "the departmental archive"
grrp custody succession "passes to …"
```

Portability is not export. A data dump leaves you with an archive. What matters is that the record can be *continued* elsewhere, with what you record next referencing what you obtained as parents — **one graph, not two**. That capacity is the only bound this design places on the authority of anyone holding a position over your record, including whoever wrote this tool.

Records that arrive are **copied byte for byte and never normalised** — rewriting them would invalidate their signatures. A signature that will not verify, a parent that is absent, a version this tool cannot read: each is **retained and marked**, never discarded, because discarding what an implementation does not understand is how a record quietly becomes a different record.

Two parties continuing the same record independently produce **a divergence**. Both are kept, neither is principal, and no reconciliation is offered.

35.1.6 Not ready to show anyone

```
grrp seal -m "…"          # records that you held this, at this time. Not what it is.
grrp openseal <state>     # later, when you choose
```

It **does not establish priority** — priority is a community's recognition of a claim, and no tool manufactures that. A sealed state **generates nothing**: no objection, no connection, no encounter, because nobody can see it. And an unanchored time is your own assertion; it becomes evidence to someone who does not trust you only if you publish the identifier somewhere you do not control.

35.1.7 Withholding

```
grrp charter adopt --classes private,group,public   # yours to decide; there is no default set
grrp grounds                                        # the four, and what each leaves disclosable
grrp disclose <tx> --class private --ground appropriability
grrp disclose <tx> --class private --ground vulnerability --release-at 2027-01-01
```

The question is never whether to withhold but **on what ground — and what follows from the ground**. There are four, the set is closed, and each leaves a **residue that must still be disclosed**:

ground	restricts	residue
rivalry	access to the resource	**the trajectory in full**
hazard	the propagable content of a method	existence, questions, decisions, interpretations, results that do not convey the method
vulnerability	the timing of exposure	**everything, at the scheduled time**
appropriability	content whose disclosure destroys excludability	existence, questions, decisions, **negative results**

Declaring a ground prints its residue and the named failure it becomes if misapplied. That residue is the one question a reader can always ask: *was what the ground leaves disclosable in fact disclosed?*

Disclosure may widen and never narrow. There is no `unpublish`. A schedule belongs only to vulnerability — the only ground with a terminus — fires by itself at the stated time, and **may be shortened but never extended**; an attempt to extend is refused *and recorded*, because a delay that can be extended indefinitely is a permanent withholding made to look temporary.

35.1.8 Two parties

A record you registered yourself is useful to you and is **evidence to nobody**. One colleague's key is what makes it evidence, and it is the whole of the setup that takes.

```
grrp key mine                     # hand this to them
grrp key add bo key:ed25519:⋯      # they do the same with yours
                                  # the record is now at the group tier

grrp claim -m "Trust obtains between individuals."
## claim  a72fe32c349e  (proposed)
## not yet in the log. Another party registers it:
## grrp register a72fe32c349e

grrp pending                      # what waits on you, and what of yours waits on them
grrp register a72fe32c349e        # they run this; you cannot
grrp withdraw <tx>                # a registrar undoing their own attestation
```

At the group tier **you cannot register your own act**, so what you perform is a proposal until someone else takes responsibility for it. That is where a record's credibility comes from: not from its content, its length or its detail, but from being registered by parties who did not coordinate.

`grrp register` refuses when the two keys are identical, and names the constraint. A withdrawal is itself an act, so it too must be registered by another party — the rule does not bend for the party undoing something.

`GRRP_KEY=<name>` selects which local key acts, for a machine two parties share and for the tests.

You rarely need to name a state. `challenge`, `transform`, `decide` and `release` default to the live position, which is what you almost always mean, and saves copying a hash out of one command into the next. Where two positions are live they refuse and list both with their text — nothing in the design gives the tool a basis for picking one.

Omit `-m` and your editor opens, with a prompt for the act you are performing. `decide` gets the longest prompt, because articulating why a direction was set aside is the expensive act and the one everything else depends on. Set `$GRRP_EDITOR` if you want a different editor here than in git.

Every command's `--help` states **`Purpose (for you):`** — what the person running it gets. That is checked by the test suite, because the reason every comparable system since 1970 went unadopted is that the work of recording fell on the party who gained least from the record.

35.1.9 Layout

```
.grrp/
  profile.yaml              protocol version, tier, hash, canonicalisation, party, vocabularies
  keys/self.pub             the private key is gitignored and never leaves the machine
  events/                   local event plane — gitignored, never exported
trajectories/<traj-id>/
  trajectory.yaml
  states/<hash>.md          content: separable, redactable
  transitions/<hash>.yaml   skeleton: append-only, never rewritten
  disclosure/<hash>.yaml    sidecar (M3): class and ground, outside the identifier
  releases/<hash>.yaml
```

35.1.10 Two design decisions worth stating

Disclosure is a sidecar, not a field in the transition file. The illustrative skeleton in the build brief shows `disclosure:` inline. Keeping it there forces a choice between two rules that both have to hold: *any edit under `transitions/` is detected*, and *changing a class or a scheduled release firing invalidates nothing*. Putting disclosure in `disclosure/<id>.yaml` lets both stay strict, and it is what the specification's own git deployment (§21.5) recommends for the same reason. Touches **C3, C7, C8**.

Registration is excluded from the identifier; the signature covers the identifier. The identifier is computed over the covered payload and the parent identifiers, and excludes `registration` and `disclosure`. A signature (M3) will cover `{id, registrar, time}`, so it binds the registrar and the time without self-reference and stays valid when disclosure widens or content is redacted. The cost, stated plainly: at the personal tier, where nothing is signed, **editing the `registration` block of a transition is not detectable by `grrp check`.** Every covered field is. This is acceptable only because the personal tier carries no evidential weight in the first place, and it closes at M3.

35.1.11 Derivation rules

Views are computed, never stored. The rules are choices you are entitled to disagree with, so they are stated in one place (`views.py`):

produces a state	every act writes a posterior state
supersedes its prior	`transformation` only
retires its prior	`decision` whose relation is `cito:retracts` (i.e. `--abandon`)
a **live position**	posterior of `claim` or `transformation`, not superseded and not retired
answered	a challenge or failed verification that a later `transformation` or `decision` names among its parents

A trajectory's opening **question is a state and not a position**: it is what the work is about, it does not stop being so when someone takes a view, and it stays on the open register until something answers it. It also anchors the first claim, so that even the first transition references an identified prior state rather than the project as a whole.

Objections, decisions and releases produce states too, but those are annotations on a position rather than positions themselves, so they are not candidates for "the current state". Nothing is edited to mark a challenge answered — the graph already records it.

35.1.12 What this tool will not do

- **No scores, rankings, counts across trajectories, or dashboards.** No quantity over participants or over trajectories is computed, stored, displayed or exported. Counts *within* one trajectory, shown without comparison, are permitted. When something feels like it wants a number, that is the constraint working.

- **No merge.** Two revisions of a concept do not compose, no conflict region localises, and no test decides the result. Integration is a **synthesis** (a state with several parents) or an **absorption** (content taken with attribution). The word does not appear in the interface.
- **No principal branch.** Where the work diverges, both directions are kept and neither is marked canonical, default or current. In inquiry a fork is frequently the correct outcome.
- **No unpublish.** Disclosure may widen and never narrow. A party who has read a record retains what they read, and an operation offering the appearance of withdrawal would misdescribe the world to the people relying on it.
- **No model, no network, no database.** Every operation runs with a text editor and git. A model may *propose* a transition and may not author or register one; a model-originated proposal is marked as such (`trigger: ai_suggestion`).
- **No editing.** A recorded transition is never altered or removed. A correction is a further transition referencing the one corrected.
- **No silent erasure.** `redact` removes a state's content and leaves everything else: that the transition occurred, by whom, of what type, where in the graph — and that a redaction was performed and on what ground. A system that erased the trace of an erasure would leave a record misdescribing its own history in a way no later reader could detect. It also tells you plainly that earlier git commits still hold the text, because possibility is not lawfulness.

35.1.13 Bindings

Relations bind to **CiTO**, contributor roles to **CRediT**, provenance concepts to **PROV**. Values stored are identifiers, never display labels — a record holding the word `extends` is uninterpretable once a second vocabulary uses the same word differently. Three relations the design names have no CiTO counterpart (`generalises`, `specialises`, `transfers`); they are available as `local:` values, are flagged as local, and need a charter to define them.

35.1.14 Records are bytes

A state's identifier is the **hash of the bytes of its file**, so anyone holding the file can check it with `sha256sum` and no knowledge of this tool:

```
sha256sum trajectories/*/states/*.md      # the hash is the filename
```

Nothing in a record is ever written in text mode, because that translates newlines on the way out and would leave a file whose name is a hash of something the file no longer contains. `grrp init` also writes a `.gitattributes` telling git not to rewrite the record on checkout, and `grrp check` verifies that every state's content still yields its identifier.

35.1.15 A walkthrough

```
bash examples/walkthrough.sh        # all four phases
bash examples/walkthrough.sh 1      # just the first
```

Works the philosophy case from the specification: a claim about trust, an objection that it omits institutional power, a transformation accepting it, a second objection that is never resolved, a divergence, and a release enumerating the objection still standing. Then a failed check and an abandoned direction, a second party registering, and finally withholding on a ground and leaving with the record.

It builds everything under `./grrp-walkthrough` and touches nothing else.

35.1.16 Tests

```
python -m pytest
```

The acceptance tests are written against the constraints, not the features:

---

1 no scalar over participants or trajectories, in source or in any command's output

2	the whole flow runs with no network, no model and no service
3	every command's `--help` names the purpose it serves for the person running it
4	editing anything under `transitions/` is detected by `grrp check`
5	a disclosure change does not invalidate verification
6	after `grrp redact`, the chain verifies, the graph is unchanged, and the redaction is recorded
7	`grrp register` refuses when performer and registrar are identical
—	acts default to the live position, and refuse rather than guess at a divergence
—	omitting `-m` opens an editor; the prompt below the cut is never recorded
8	*(M4)* `bundle` here, `continue` there, one graph and not two — **skipped**

Skipped tests are present and named, so what is not yet built is visible rather than absent.

35.1.17 Next

Use it on real work for two weeks before M2. Record what was annoying — those notes are the input to everything after this, and they belong in a trajectory.

35.1.18 Licence

MIT — see the application LICENSE, scope notes and CONTRIBUTORS.md. Copyright remains with the respective contributors. The licensing history records the earlier inconsistent notices and the explicit additional MIT grant; archived source and historical notices remain preserved. This software license does not determine the rights in research records created with the tool.

36 README

Original source: `applicative_infrastructure/gr_academia_application/notes/README.md`.
Original source SHA-256: `8ef2de44ad7bf00971ffb80c094d36f03aadcc7af4fb3c985ee18e1f29891c1d`.

36.1 Notes on the GRA papers

Working notes taken while reading the four papers in papers/. They are dense on purpose: the intent is that these files can be used **instead of** re-reading 217 pages of PDF, and that any claim made in this repository can be traced back to the paper and requirement that licenses it.

Quotation is used heavily where the papers' own wording is the point — several of the design rules are stated as *"an error to be corrected"* or *"the single most likely implementation error"*, and paraphrase loses their force.

36.1.1 Files

File	What it holds
paper-I-design-and-requirements.md	The problem, the survey of prior art, the derivation, and **the sixteen requirements (R1–R16)**. Start here.
paper-II-incentives-and-adoption.md	Why any of this might not happen. The commons dilemma, the positional bound, **the absorption test**, the dominance argument, **ten predictions with refuting observations**. Mostly a list of things the project may not claim.
paper-III-grounds-of-restriction.md	Disclosure. **Four irreducible grounds, each with an object, a residue, and a named failure.** The residue rule. The shared component of value, evidence and hazard.
paper-IV-grrp-specification.md	**GRRP v0.1 — the normative specification.** Record model, act vocabulary, attestation, absorption, graph, disclosure, redaction, identity, propagation, durability, charters, amendment, **conformance tiers and tests**, a git deployment, worked examples, failure modes.
glossary.md	Every fixed term with the definition and citation. Use this when writing anything user-facing.
gaps-and-repo-actions.md	Where this repository currently diverges from the papers, what to change, and what is still the user's decision.

36.1.2 The shortest possible summary

Scholarly communication transmits finished artefacts and discards **the trajectory** that produced them. An artefact carried evidence about its producer only because producing it was costly *in a way that discriminated between producers*; that discrimination is weakening. So attention moves to the trajectory — but **a trajectory record is as cheaply fabricated as the artefact whose function it would inherit**. Its credibility can therefore only come from **distribution across parties who did not coordinate**, which is why this is a **protocol** and not a platform: a platform operator is party to every entry.

The representational problem was solved repeatedly between 1970 and now, and every such system failed on **capture cost**. So the first constraint is: **nothing may be required of a participant that the participant would not do anyway.**

Everything else follows from those four sentences.

36.1.3 Reading order if you only have an hour

1. glossary.md — 10 min, gives you the vocabulary.

2. Paper I notes §11–§13 and §22 — the derivation and the sixteen requirements.
3. Paper IV notes §6, §8, §20 — the act vocabulary, attestation, and the conformance tests.
4. Paper II notes §12 and §16 — the dominance argument and the ten predictions.

36.1.4 Provenance of these notes

Extracted from the PDFs and read in full on 2026-08-06. Section, definition, claim and requirement numbers are the papers' own. Where a numbered cross-reference in a paper was broken in the source (a few `??` and `refsec:` artefacts survive in the PDFs), the note resolves it from context and says so.

37 gaps and repo actions

Original source: `applicative_infrastructure/gr_academia_application/notes/gaps-and-repo-actions.md`.
Original source SHA-256: `6db395e6f6001abfc23889f722df425ca890675c1e9fee2e90485ff2576bb2e2`.

37.1 Gaps between the repository and the papers

Written after reading all four papers. Each item names **what the repo says**, **what the papers require**, and **the action**. Ordered by how much damage the divergence does.

37.1.1 A. Conflicts that would make the repo non-conformant or misleading

37.1.2 A1. "GRA Commit" is the wrong word — and it is the exact word the papers refuse

Repo: README.md has a section headed *"GRA Commit Concept"*, and the retired `plans/implementation_plan.md` used "Commit" throughout (Stage 1 "Semantic Commit System", "Create GRA commits", "commit types").

Papers: *"the epistemic unit is called a **transition** throughout, in place of a **commit**, since the protocol is layered over version-control systems whose commits appear in the same repositories and **the collision would mislead every implementer**."* (Paper I §2.7)

Action: rename everywhere → **transition**. [check] Done in the README, the new plan, and the tool.

37.1.3 A2. Flat "commit types" instead of the five-dimension factorisation

Repo: `implementation_plan.md` Stage 1 lists a single flat enumeration — Progress ·Failure ·New problem ·New idea ·New question ·Literature integration ·Objection ·Response ·Synthesis.

Papers: *"A transition is typed along **five independent dimensions** with small closed vocabularies, in place of a single enumerated list. An implementation **must not** define a single enumerated type combining these dimensions."* (Paper I Req. 13.3; Paper IV Req. 6.1) — because inter-rater agreement declines as categories rise, and deliberation over classification re-introduces capture cost.

Also: the flat list has **no `unresolved` disposition**, which Paper IV Req. 6.3 makes mandatory and non-extensible; without it *"a record admitting only acceptance and rejection would be systematically false about the fields this protocol most concerns, and would exert pressure toward fabricated closure."* And "Progress" is not an act at all.

Action: replace with `act × target × relation × trigger × disposition` (see glossary.md). [check] Done in the README, the new plan, and the tool.

37.1.4 A3. Roadmap items that are forbidden scalars

Repo: `implementation_plan.md` Stage 4 — *"Generate progress reports"*; Stage 5 — *"Trajectory risk analysis"*, *"Research obstacle detection"*, *"Similar trajectory search"*, *"Similar failure discovery"*.

Papers: R10 / Req. 20.4 — an implementation **fails conformance** where it computes, stores, displays or exports **any total order or numeric measure over participants or over trajectories**, including counts of transitions, counts of attestations, contribution shares, activity indices and derived scores. Paper II Claim 8.4 adds that even an *absorption* score violates it. And Paper I §22.2: R10 costs the arrangement *"the ability to report that a project is going well"* — that is precisely what "progress report" and "trajectory risk analysis" name.

Action: - Anything that ranks, scores, or reports "health/progress/risk" across trajectories or participants is **out of the protocol entirely**. It may exist as an **L3 application**, clearly labelled as outside conformance, and the papers note the party building it *"owns the consequences"*. - Within-trajectory counts shown **without cross-trajectory or cross-participant**

comparison are permitted (Req. 20.4, second sentence). A "what I ruled out this month" view is fine; a dashboard number is not. - **Similar-trajectory / cross-field matching must additionally be removed from any adoption argument** (Paper II Claim 13.5): it is not decomposable by tier, returns nothing to any adopting party, and is "a late property of an adopted arrangement". Paper I Claim 18.3 says the same and adds that the matching problem itself is **unsolved and belongs at L3**.

37.1.5 A4. The staging is inverted — the adoption-critical features are scheduled last

Repo: `implementation_plan.md` puts *"Generate paper outline from trajectory"* at Stage 4 and integration/collaboration at Stages 2–3; there is no personal-tier ship point.

Papers: R15 + Paper II Req. 11.4 — *"An arrangement is adoptable only where its minimal form is worth adopting by a single participant with no other participants present."* And **R16 / Req. 12.7** — **emission of a citable document from a release** is *the* mechanism that makes adoption possible under the dominance argument (Paper II §14). The GRRP plan gets this right: **"M1 — Personal tier. Ship here."**

Action: re-order so the personal tier (three acts + append-only log + derived views + `open` register + **`export` on release**) is the first shippable unit, matching plans/implementation-plan.md. [check] Reflected in the README and in the new single plan, whose M1 is marked as the ship point.

37.1.6 A5. The two implementation plans disagreed with each other — *resolved*

Repo: `plans/implementation_plan.md` (Stages 0–7, commit-based, platform-flavoured: "Discussion System", "Feedback System", "AI research assistant") and `plans/GRRP-implementation-plan.md` (M0–M5, transition-based, CLI, no server, no account, no network).

They are not two views of one plan; they encode **different designs**. The GRRP plan is the one derived from the specification.

Action: [check] **`plans/implementation_plan.md` has been retired** (removed; recoverable from git history), and `plans/GRRP-implementation-plan.md` has been folded into a single plans/implementation-plan.md. The specification governs where that plan and the papers differ.

37.1.7 B. Claims the papers forbid

The papers spend a lot of length forbidding specific sentences. These are the ones most likely to reappear in a README, a grant application, or a website.

Do not write	Why	Cite
"makes scholarship less competitive" / "democratises recognition" / "dissolves hierarchy"	recognition is **positional**; attribution redistributes and does not create it. *"any passage implying otherwise is an error to be corrected"*	P-II Claim 6.2
"GRA will increase serendipitous encounters"	no evidence; the best qualitative study reports **avoidance**. Only *cost of preparation* may be claimed	P-I Req. 3.2; P-II Claim 15.4
"adopt this because it benefits scholarship collectively"	*"available to no individual party, and its repetition is the characteristic error of proposals in this field"*	P-II Claim 12.4

Do not write	Why	Cite
"a trajectory record proves the work happened"	attestation asserts **registration at a time**, not truth, improvement, or understanding; **collusion is not eliminated**	P-IV Claim 8.4, §23.1
"personal-tier records are verified / corroborated"	the personal tier carries **utility and no evidential weight**; every transition must be **marked unattested**	P-IV Req. 20.3
"merge two branches"	no merge operation exists; the word must not appear	P-I Claim 14.1; P-IV Req. 10.5
"restrict the instrument, open the reasoning" (as general policy)	correct under **rivalry**, **exactly wrong under hazard** — the reasoning is where the hazard lives	P-III Claim 4.1
"publish the trajectory minus the dangerous parts"	value in reuse, evidential force and hazard are **the same component**	P-I Prop. 20.2; P-III Claim 9.3
"sealed registration establishes priority"	it records that a party held a content at a time. **A timestamp is not priority**	P-IV Req. 15.7
"the record makes a research process available"	a record carries **the articulable fraction**; capability does not transfer	P-I Claim 10.1, Def. 20.1

37.1.8 C. Things the papers require that are missing from the repo entirely

1. **A declaration of interest.** Paper I §2.8 and Paper III Claim 11.6 both bind the author's society: *"the requirements imposed on a custodian apply to that society without exception, including that the specification be forkable and that stewardship of the specification be separated from operation of any implementation."* Paper IV Req. 19.4 makes it normative. **The repo, operated by Serendip Commons Society, should state this in the README.** [check] Added.

2. **The four "findings that would show the specification inadequate"** (Paper IV §24.4) are the project's own evaluation plan and have no home in the repo. [check] Added to README as an explicit failure-conditions section.

3. **The four unaddressed difficulties** (Paper II §17.2): assessment congestion, maintainer labour, regressive overhead incidence, recognition of attributed contribution. These are *known holes*, not oversights. [check] Added to README.

4. **Licence — resolved: MIT.** [check] Paper I Req. 16.2 property (4) requires the record to be *"licensed so that continuation elsewhere is permitted"*, and Paper IV Req. 19.4 requires the specification to be licensed so **any party may fork it**. CC BY-**NC** satisfied neither, and was not a software licence for `grrp` either. MIT discharges all three. The four PDFs still carry an embedded CC BY-NC notice and remain under it until their author revises them.

5. **An `open` register / entry-path affordance** is required by Req. 6.5 and is the answer to the bootstrap failure (Paper I §17). The GRRP plan has `grrp open` and calls it *"the entry path"*. Good. It should not be described anywhere as a nice-to-have.

37.1.9 D. Implementation traps the papers name explicitly

Worth pinning here because each is described as *the* likely error.

- **Signature coverage** — *"Getting this wrong makes ordinary operation invalidate signatures — the single most likely implementation error."* Spec §8.3 says the signature covers

the disclosure class; deployment §21.5 says commit signatures therefore break on scheduled release, and the workable arrangement is to hold the class **in a separate file the signature does not cover**. Follow §21.5.

- **A stored authoritative current state** — *"the requirement most often violated in practice, since a stored current state is convenient and fast. Where a stored snapshot is authoritative … every claim the protocol makes about credibility fails at once."* Caches must be reconstructible and marked derived. (Req. 4.4)
- **Unattended/default registration** — *"a default that registers unattended proposals violates the requirement, because the record's credibility rests on registration meaning something."* (Req. 4.3)
- **Exporting or indexing the event plane** — *"the failure with the largest consequence for participants and the one an implementer is most likely to introduce while improving a feature."* (Req. 3.1, §23.4)
- **Disclosure by inference** — revealing a record's existence through a gap, an identifier sequence, or the shape of a derived view. *"A genuine implementation hazard and easy to introduce accidentally."* (§11.4, §23.3)
- **Reconstruction of redacted content from its content-derived identifier** where the content is short and its space small → **apply a per-record secret before computing the identifier**, a decision that must be made **in advance**. (§13.5, §23.3)
- **Normalising received records** — invalidates their signatures and destroys the property that makes propagation worth having. (Req. 16.5)
- **Per-repository rather than per-record disclosure** — the git deployment *approximates and does not meet* Req. 11.5; class changes require **moving** a record, and the movement must be recorded as an administrative operation. (§21.5)

37.1.10 E. Status of the repo's own actions

Item	Status
Notes folder with per-paper notes + glossary	[check] this folder
README rewritten against the papers	[check]
Both old plans folded into one plans/implementation-plan.md	[check]
`grrp` reference implementation, M0 + M1	[check] grrp/ — 36 tests passing, 3 skipped and named for M2–M4
Licence settled as **MIT** — discharges Req. 19.4 (forkable specification) and Req. 16.2(4) (continuable record)	[check]

37.1.11 F. Decisions taken while building M0/M1, and why

These touch the hard constraints, so they are recorded rather than buried in the code.

1. **Disclosure lives in a sidecar (`disclosure/<id>.yaml`), not inline in the transition file.** The illustrative skeleton shows it inline. Keeping it there forces a choice between two rules that both have to hold — *any edit under `transitions/` is detected* and *changing a class invalidates nothing*. The sidecar lets both stay strict, and it is what the specification's own git deployment (§21.5) recommends for the same reason. **Touches C3, C7, C8.**

2. **The identifier excludes `registration`; the signature (M3) will cover `{id, registrar, time}`.** Registrar cannot be inside the identifier, because at the group tier a proposal is registered by a *different* party later, and the identifier would change under its own children. **The cost, stated plainly: at the personal tier, where nothing is signed, editing the `registration` block is not detectable by `grrp check`.** Every covered field is. Acceptable only because the personal tier carries no evidential weight, and it closes at M3. **Touches C2, C3.**

3. **A keypair is generated at `init`, three milestones before anything is signed**, so that party identifiers recorded from the first day stay valid when signing arrives. The private key is written unencrypted; a passphrase belongs with signatures, not before them.

4. **`--abandon` is `cito:retracts`, not a new field.** The design names an abandonment relation that CiTO has a genuine counterpart for. Three relations it names have none (`generalises`, `specialises`, `transfers`); those are `local:` values, flagged as local, and need a charter. **Touches C12.**

5. **A challenge is answered by the graph, not by an edit.** A `transformation` or `decision` naming the challenge among its parents is what takes it off the open register. Nothing is rewritten. **Touches C3.**

6. **The opening question is a state and not a position.** It anchors the first claim (so even the first transition references an identified prior state), it stays on the open register until something answers it, and it is not a candidate for "the current state". **Touches C4.**

7. **Transitions are committed to git automatically when inside a work tree**, and only the paths `grrp` wrote — a researcher's tree is usually dirty, and committing anything else would be taking a decision that is not the tool's. `check` and every read command work on the files alone.

8. **Ordering follows the graph, not the clock.** Two transitions recorded in the same second are listed parents-first; recorded times only break ties among transitions with no path between them.

38 glossary

Original source: `applicative_infrastructure/gr_academia_application/notes/glossary.md`.
Original source SHA-256: `784def677e74030697a2833484dd9d968ee31415caccb43726842128c237ab02`.

38.1 Glossary — GRA / GRRP

Terms as the four papers fix them. Where a term also has a settled sense in an adjacent literature, the divergence is marked. **Bold** entries are the load-bearing ones.

38.1.1 The record

Trajectory — the directed graph whose vertices are **states** and whose arcs are **transitions**; an ordered record of the transitions a shared understanding has passed through, with the acts and the parties to them. **A trajectory is identified by the record, and its current state is *derived* from the record, never stored alongside it.** *(P-I §2.7, P-IV Def. 2.1)*

State — an identified condition of a shared understanding at a point in a trajectory: the recorded content plus the identifier under which it is addressed. **Created by a transition and never modified.** Its *form* is deliberately unspecified — prescribing the form of a scholarly claim would be prescribing research practice. *(P-IV Def. 5.1)*

Transition — **the unit of record.** A change from one identified state to another, produced by a typed act performed by a party and **registered by a party**. *(P-I Def. 2.8, P-IV Def. 2.1)* > Called **transition**, never *commit* — the protocol is layered over version-control systems whose > commits appear in the same repositories, and the collision would mislead every implementer. > *(P-I §2.7)*

Event — an automatically generated record that *something occurred* (a meeting was held, a comment posted, a file changed, a permission altered). **Asserts nothing about an understanding.** Near-zero cost, possibly large volume. Lives on the **event plane**, private to participants by default. *(P-IV Def. 2.2, Req. 3.1)*

Artefact (reference) — a produced object referenced by a record: document, dataset, recording, transcript, release. Held by substrates, not by the protocol. *(P-IV Def. 2.2)*

Promotion — the act by which an **event becomes a transition**: a responsible party registers it. Candidates may be proposed by any means (including model analysis of the event plane); **a proposal becomes a transition only when a party registers it**, and a model-originated proposal must be marked as such. *(P-IV Req. 4.3)*

Administrative operation — a record concerning *the arrangement* rather than the understanding (disclosure class changed, key rotated, redaction performed, fork declared, attribution contested). Same envelope, **mandatory `kind` field**, no act/target/relation/disposition. Must be distinguishable from transitions — otherwise administrative activity inflates apparent generativity, and a position holder could act without leaving an inspectable record. *(P-IV Req. 4.6)*

Skeleton / content — **skeleton** = identifier, kind, parent links, state references, typed fields, parties, signature, disclosure class and ground. **content** = the material referred to. **Stored separately, referenced by content-derived identifier**, so removing content leaves the skeleton valid and the signature chain intact. This is what makes redaction possible in an append-only log. *(P-IV Def. 13.1, Req. 13.2)*

38.1.2 The factored type — five dimensions, small closed vocabularies

(P-I Req. 13.3, P-IV Req. 6.1. Never flatten into one enumerated list: agreement between classifiers declines as categories rise, and deliberation over classification re-introduces capture cost.)

act *(fixed, 8)* — `question` ·`claim` ·`challenge` ·`transformation` ·`decision` ·`connection` ·`verification` ·`relea se` **target** *(charter-extensible)* — question ·assumption ·hypothesis ·concept ·theory ·method · path ·artefact **relation** *(bound to CiTO)* — extension ·modification ·replacement ·refinement ·generalisation ·specialisation ·transfer **trigger** *(charter-extensible)* — reflection ·literature ·

experiment ·simulation ·observation ·discussion ·objection ·prior failure ·automated suggestion ·**entry of a new party disposition** *(fixed, 3)* — `accepted` ·`contested` ·**`unresolved`**

> **`unresolved` is required and the vocabulary is fixed because of it.** Most objections in theoretical work are never resolved: they stand, and the work proceeds beside them. A record admitting only acceptance and rejection would be **systematically false** about the fields this protocol most concerns, and would exert pressure toward **fabricated closure**. *(P-IV Req. 6.3)*

Decision — the act that records a direction taken or abandoned **with the reason**. *A path recorded as abandoned without a reason cannot be revisited by anyone.* **The demanding act** — the one whose purpose for its performer is weakest, and the one on which reuse of abandoned material depends. *(P-IV §6.2, §22.4; P-II Claim 11.3)*

Release — a declaration, never a judgement. Declares a state published at a class and records **the objections standing unresolved against it at that moment**. Must not be presented as certifying, validating or approving. Also the object to which a priority claim attaches where a community honours registration. *(P-IV Def. 12.5, Req. 12.6)*

Synthesis — a transformation with **two or more parents from distinct branches**, producing a state its performer **composed** from what those branches reached. **The branches it draws on continue to exist; a synthesis is a further state, not a resolution of the divergence.** *(P-IV Def. 10.4)*

Divergence — two or more transitions sharing a parent and producing distinct successors. **Both preserved; neither designated principal, default, canonical or current; no ordering over branches may be recorded or exported.** *(P-IV Def. 10.2, Req. 10.3)* > **Disanalogy with software forks:** in software a fork is a coordination failure to be reunified. **In > inquiry a fork is frequently the correct outcome, and plurality is the normal shape of a healthy > record.** *(P-I §14.4)*

Merge — does not exist. Version control merges because changes to distinct text regions compose, a conflict can be localised, and a test decides the result. **Two revisions of a concept satisfy none of the three.** Integration appears only as a **synthesis** or an **absorption**. *The word must appear nowhere in the specification or the UI. (P-I Claim 14.1, P-IV Req. 10.5)*

38.1.3 Parties, credit, credibility

Party — an entity capable of performing and registering acts, **identified by a public key**. **Continuity of identity is required; legal identity is not.** Pseudonymous participation must be permitted at every tier. *(P-IV Def. 14.1, Req. 14.3)*

Registration — the act by which a transition enters the log. **Attestation — registration performed by a party other than the one who proposed the transition**, recorded with that party's identifier and signature. *(P-I Def. 2.9, P-IV Def. 2.3, Req. 8.1)* > **What it asserts:** that an identified party registered a transition at a time. > **What it does not assert:** that the change was an improvement, that the claim is true, or that the > registering party understood it. *(P-IV Claim 8.4)* > **Never counted.** Attestation depth is a scalar over trajectories and would be farmed by reciprocal > registration. *(P-IV Req. 8.5)*

Distributed attestation — the design's answer to fabrication. **Credibility follows from the distribution of registrations across parties who did not coordinate, and from no property of the record's content, length or detail.** *This is why the design is a protocol and not a platform: a platform operator is party to every entry and cannot supply the independence. (P-I Req. 12.2, Claim 12.3)*

Attribution — the recording of a party's part in an act, with a **CRediT** role. **Attaches to an act, not to a finished work** — *a contributor statement says a person contributed to a paper; this record says which change in the content of a claim a person produced. (P-IV Req. 9.1)*

Absorption — the taking of content from a state in one trajectory into a transition in another. The **absorption link** records the state absorbed from, **the party who produced it**, and the transition that took it. *(P-IV Def. 9.2, Req. 9.3)* > **No veto (Req. 9.4).** An absorption link confers **attribution and no power to prevent, condition or > reverse use** — the moral-rights construction, chosen to avoid the anticommons. **A party who does not > wish their state absorbed has one instrument: its disclosure class.**

Absorption test — the criterion separating a **generative** arrangement from a **competitive** one: *examine the record of the work that proceeded and look for transitions whose content originated in work that was **not selected**, with attribution.* **Where such transitions are absent, the arrangement is competitive whatever its constitution states.** Applied by readers, **never computed as a score.** *(P-II Def. 8.1, Req. 8.2, Claim 8.4)*

Competitive / generative arrangement — turns entirely on **what becomes of unselected work**, not on openness of entry, number of participants, or manner of decision. *An open arrangement discarding losing proposals is competitive; a closed arrangement that takes up and credits a rejected proposal's method is generative. (P-II Def. 8.1)*

Encounter — a transition performed by **a party who has performed no prior act in the trajectory**, with a trigger identifying the occasion. **No new primitive** — the trigger dimension covers it. *(P-I Def. 18.1)* > Every claim about encounters is **envisagement** and must carry the counter-evidence (Irving et al. > 2020: occupants of a building designed for serendipitous collaboration developed strategies to avoid > it). What may be claimed is a lowered **cost of preparation** — never an increased frequency of > encounter. *(P-I Req. 3.2, P-II Claim 15.4)*

38.1.4 Disclosure

Disclosure class — a value attached to a **record** (not a repository, project or trajectory) governing to whom it may be disclosed. **Ordered by inclusion. Enforced by the implementation, opaque to the protocol, interpreted by the charter.** *(P-III Def. 2.1, P-IV Def. 11.1, Req. 11.5)*

Ground — the **declared reason** for restricting disclosure. **A property of a restriction, not of a record** — the same content may be restricted on different grounds in different arrangements, with different consequences. **A closed set of four.** *(P-III Def. 2.2, Req. 2.5)*

Residue — **what remains disclosable at the widest class while a restriction on that ground is in force.** *A ground with an empty residue licenses total silence.* **The residue requirement is the operative rule of the whole account** — without it every ground collapses into silence with a justification attached. *(P-III Def. 2.3, Req. 2.6)*

Ground	Condition	Object restricted	Residue	Named failure
rivalry	a resource admits limited simultaneous use	**access to the resource**	**the trajectory in full**	a restriction on access converted into a restriction on knowledge
hazard	propagation of the content creates risk	the **propagable content of a method**	existence, questions, decisions, interpretations, non-conveying results	widest restriction on the strongest justification, **unfalsifiable from outside**
exploratory vulnerability	exposure at this stage suppresses or distorts the work	**the timing of exposure**	**everything, at the scheduled time**	postponement converted into permanent withholding
appropriability	funding requires excludability	content whose disclosure destroys excludability	existence, questions, decisions, **negative results**	**rent-seeking secrecy**

Irreducible — rivalry restricts a *resource*; the others restrict *content*. Hazard restricts what a *reader* could do; appropriability what a *competitor* could sell. Vulnerability restricts a *time*; the others a *set of parties*. *(P-III Claim 7.1)* **Composition** — where several grounds obtain, each is declared separately and **the residue disclosed is the intersection.** Declaring more grounds is **not free** — each is an assertion that can be found false. *(P-III Req. 7.2)* **Termini** — vulnerability ends **on a recorded schedule**; rivalry when the resource is uncontended (unenforced); appropriability when the funding purpose is served (**known to the declaring party alone**); **hazard does not end.** *A community wishing its record to open over time must prefer the ground that ends. (P-III Claim 7.4)*

Monotone disclosure — disclosure may widen and must not narrow. No `unpublish` operation exists. *Ground: a party who has read a record retains what they read, so an apparent withdrawal misdescribes to participants a state of affairs obtaining outside the system.* A schedule may be **shortened, never extended or cancelled**; any attempt must be recorded. *(P-III Claim 5.1, P-IV Req. 12.1, 12.4)*

Redaction — removal of **content** while the **skeleton remains**. The redacted record continues to assert that a transition occurred, by whom, of what type, at what graph position. **The record of the redaction must not be removed, the graph must not change, and redacted content must not be represented as never having existed.** *(P-IV Def. 13.3, Req. 13.4–13.5)*

Sealed registration — publication of a **content-derived identifier** of a state, plus registering party and time, **with the content disclosed to nobody**. Asserts that the party held that content at that time. **Available at every class, including disclosure-to-nobody.** *(P-I Def. 19.1, P-IV Def. 15.1)* > **A timestamp is not priority.** It evidences possession, not understanding. **It generates nothing > while sealed** — no objection, no connection, no encounter; it purchases *the possibility of later > opening*, not the benefits of early opening. It adjudicates nothing against independent arrival. And its > time is evidence only if **anchored in a medium the implementation does not control.** > *(P-IV Req. 15.6, 15.7, §15.5)*

Conditional / structured access — supplying a capability **without transferring the artefact that confers it**, under conditions the supplier enforces. Applied here: a party is **admitted to a restricted class** under a charter's assurance requirements, **with the admission and its ground recorded.** The mechanism that makes work under the hazard ground possible at all. *(P-III Claim 4.3)*

38.1.5 Structure and governance

The four levels *(P-I Def. 2.1)* — **L0 external law** (described, never encoded; reaches the design only *negatively*, through structural incapacity) ·**L1 operating norms** (the charter: which classes exist, who belongs, retention, consent, conduct, assurance, extended vocabularies) ·**L2 protocol** (the capacity: state model, act vocabulary, registration, attribution, parent links, classes as opaque enforced values, conformance) ·**L3 application** (interfaces, capture assistants, search, matching, summarisation, **assessment of content** — replaceable, and the protocol is implementable with none of it). > **The protocol carries the capacity; the normative level carries the content.** *(Req. 2.2)*

Operating charter — an identified, **versioned** document a community adopts, stating its rules. **The protocol references it by identifier and interprets nothing in it. The charter is where everything contested lives.** A record must carry the charter identifier and version that governed it. Amendments are **prospective only**. *(P-IV Def. 18.1, Req. 18.2–18.4)*

Description language vs. interaction protocol — a **description language** fixes a vocabulary for recording what occurred and imposes no condition on what may occur (PROV, CRediT, CiTO, Web Annotation, RO-Crate are all of this kind). An **interaction protocol** fixes **which acts are admissible, what each does to a shared state, which party may perform each, and what conformance requires.** *This distinction is where the word "protocol" in the title is meant literally. (P-I Def. 7.1, Claim 7.2)*

Protocol vs. plan — a **plan** specifies outcomes and the steps to them. A **protocol** specifies admissible acts and their effect on a shared state, **and leaves every participant's trajectory undetermined.** Relation = grammar to sentences. *Any drift into prescribing what participants should record, conclude or value is an error to be corrected, not a position to defend. (P-I Def. 2.3)*

Functional vs. structural position — a position is **functional** where constituted by acts the arrangement requires, recorded and attributable, with occupancy depending on continuing to perform them. It is **structural** where occupancy confers persistent standing, or where others' capacity to act depends on the holder's permission. *(P-I Def. 15.1)* **Admissibility of authority** — two joint conditions: **(i)** the constituting acts are recorded and attributable and visible; **(ii)** participants **retain the capacity to proceed without the holder's permission**. *Visibility without exit produces documented autocracy; exit without visibility leaves participants unable to judge whether to leave. (P-I Req. 15.2)* > **Four positions the design**

generates (not imports): **registrar ·trajectory steward ·> holder of disclosure authority ·custodian of the specification.**

Portability *(five joint properties, P-I Req. 16.2)* — the complete record is **(1)** obtainable by any participant **without permission ·(2)** in a **self-describing format readable without the producing software ·(3)** carries **identifiers that stay resolvable when held elsewhere ·(4) licensed** to permit continuation ·**(5) continuable under the same protocol by an implementation the original operator does not control. > Property 5 is what distinguishes portability from export.** A data dump satisfies 1–4 and leaves > departing participants with an archive. **> Portability is the bound on the authority of every position** — the cost of exit, not any rule > addressed to the holder. *(Claim 16.1)* But it **secures the record, not the participants, not the > resources, and not the standing** — and it bounds the **restricting** authority weakly, because a > departing party cannot take what they were never shown. *(P-III Claim 11.4)*

Propagation — the movement of **transitions** between trajectories (**lateral**) and between independent implementations (**inter-implementation**). **Dissemination of finished artefacts is excluded from the term.** *(P-I Def. 2.11, P-IV Def. 16.1)* **Continuation** — obtaining the complete record without permission and continuing it elsewhere, with appended transitions **referencing the obtained ones as parents so the result is one graph and not two.** *(P-IV Req. 16.4)* **Exchange minimum** — the only things two implementations must agree on: record structure, act and disposition vocabularies, bound-vocabulary identifiers and versions, **content-derived identifier construction**, and **signature scheme**. *The last two cannot be relaxed. (P-IV Req. 16.2)*

Conformance tiers *(cumulative)* — **personal** (one participant; three acts; **utility and no evidential weight**) → **group** (attestation, roles, absorption, classes; **credibility begins**) → **open** (propagation, distributed custody, deposit, charter reference; **exchange and stranger entry**). *(P-IV Def. 20.1)*

Open register — the set of states whose disposition is `unresolved`, made available at each disclosure class. **This is the entry path**: a party holding no prior position may reference such a state in a `challenge`, `connection` or `verification`, decided on the act itself. *(P-I Req. 17.2, P-IV Req. 6.5)*

38.1.6 Concepts from the argument

Separating condition — an artefact carries evidence of its producer's capacity **only while producing it is more costly for a lower-capacity producer**, by a margin making it worthwhile for one and unattractive for the other (after Spence 1973). **The evidence was never in the object; it was in the difference between what the object cost different producers.** *(P-I Def. 11.1)* > A **uniform fall in production cost** weakens the evidential function while the artefact, the practice > and the systems reading it all remain in place — **and the failure is invisible from inside the > practice.** *(Prop. 11.2)*

Capture cost — the documented cause of the non-adoption of every rationale-capture system since 1970: **the work of recording falls on the party who gains least from the record, at the moment they can least bear it, in a form that serves a different party later** (Grudin 1988). **The representational problem was solved; this is what defeated it.** *(P-I Claim 8.1)*

Byproduct principle (R1) — every act the protocol defines is one a participant performs **for a reason of their own**, with the record falling out of its performance. **An act existing so that a record should exist will not be performed.** *(P-I Req. 8.2, P-IV Req. 4.2, test at Req. 20.6)*

Articulable fraction — that part of what a trajectory's participants held which they were able to put into the record. **Its complement transmits, if at all, by working alongside them, and no property of the record's design recovers it** (Collins 1974/2010; MacKenzie & Spinardi 1995). *(P-I Def. 20.1)*

The omitted component — what a finished artefact does not contain: approaches attempted and abandoned, the reasons, the constraints discovered, the parameters that mattered, the practical technique. **> It carries the value in reuse, the evidential force, AND the hazard — at once. > No design publishes the trajectory minus its dangerous parts and retains the benefit, because the > parts are the same parts.** All three scale together

with the articulable fraction, and **no design > alters the ratio.** > *This is why the account is a typology of grounds separating **parties** rather than a filtering rule > separating **content** — and why the **residue**, lying outside the component, is the only part of the > design that gains something without giving something up. > (P-I Prop. 20.2; P-III Def. 9.1, Prop. 9.2, Claims 9.3–9.5)*

Generativity — the capacity of a relation to produce states that neither party held. Distinguished from the developmental-psychology sense and from Zittrain's platform sense (the capacity of a *technical system* to admit contributions). *(P-I §3.2)* > **Trajectory ≠ generativity (P-I Def. 10.2, Prop. 10.3).** A trajectory is the recorded sequence — an > object that can be inspected. Generativity is a **capacity**, of which the trajectory is *one > realisation among those that were possible*. **Two trajectories may coincide entirely in recorded > appearance while differing entirely in the generativity of the relations that produced them.** > *This is the deep ground of the no-scalar rule: a quantity computed over a trajectory measures a > realisation, not a capacity, and that is an error no amount of data corrects.*

No scalar (R10) — the protocol defines **no scalar quantity over participants or over trajectories, and admits no total order over either.** Local, two-valued acceptance conditions replace indicators throughout. **Counts of records within a single trajectory, presented without comparison across participants or trajectories, do not violate it.** *(P-I Req. 2.6, P-IV Req. 20.4)* > Cost stated openly: cannot report that a project is going well, cannot rank contributors for a > committee, cannot summarise a trajectory's standing in a number.

Positional good — a good whose value consists in the holder's **rank** among others, so the aggregate available is **fixed by construction** and increases in supply do not increase it (Hirsch 1976). **Standing is positional.** *(P-II Def. 2.2, Claim 6.1)* > Therefore: **attribution redistributes recognition; it does not create it** — and parties who benefit > from the present invisibility of others' contributions are made worse off, **which predicts resistance.** > **No claim that the arrangement reduces competition, dissolves hierarchy, or increases recognition may > stand anywhere in the series.** *(Claim 6.2)*

Subtractable goods — the four things a commons dilemma actually attaches to here: **review/assessment capacity** (the one the design most strains) ·**maintainer labour** ·**the instrument** ·**community trust**. *(P-II Claim 3.3)* **Knowledge itself is non-rival — the tragedy of the commons has no object in it, and its failure mode is underprovision, not overuse.** *(Claims 3.1–3.2)*

Private-benefit sufficiency — an arrangement is adoptable **only where its minimal form is worth adopting by a single participant with no other participants present.** *An arrangement whose benefits appear only at scale is never adopted, since no party is ever in a position to obtain them. (P-II Req. 11.4; = R15)*

Dominance argument — in an environment rewarding output rate, a group adopting an arrangement with **any net cost** is disadvantaged **irrespective of its epistemic merits**, and sustained, adopting groups are **selected against**. *Two escapes only: net private benefit, and insulation from output-rate selection. (P-II Claim 12.1)*

Compatibility (R16) — a participant must be able to obtain, **from a conforming record and without additional work**, an artefact of the kind the incumbent reward system accepts. Mechanism: **emission on release** — the state, its chain, contributors with roles, absorption links with attributions, and the objections standing at release. *(P-II Req. 14.1, P-IV Req. 12.7)* > **It postpones the conflict with incumbent interests and does not remove it — and the conflict returns > at exactly the point at which the arrangement begins to succeed.** *(Claim 14.4)*

Minimum viable adopting unit — the smallest set of parties for which benefits exceed costs **without participation by anyone outside the set**. **Group tier: two parties who register each other's transitions. Open tier: one community with an implementation and a charter.** *A design whose minimum unit was a discipline requires an agreement nobody can broker; a design whose minimum unit is a seminar requires a decision two people can take on a Tuesday. (P-II Def. 13.3, Claim 13.4)*

Sparsity / plurality — of a selection: **sparsity** = the interval between selection events measured against the interval over which a line of work develops; **plurality** = the number of applied criteria **that cannot be combined into a single ordering**. **Plurality is not preserved under frequent application, so sparsity is a *condition* of plurality.** Charter parameters, not protocol parameters. *(P-II Def. 10.2, Claims 10.3–10.5)*

Dissipation — the aggregate effort entrants expend in a contest **in excess of what the**

selection required. Opening a selection to more entrants **increases** it, disproportionately burdening those for whom preparation is a larger share of available time. *(P-II Def. 7.1, Claim 7.2)*

38.1.7 Modal conventions used throughout the series

Analysis — states what is the case, supported by evidence or argument. **Design** — states what a specification requires, supported by derivation from a requirement. **Envisagement** — states what would follow in use; **supported by nothing available at present.** > No envisagement sentence appears in a design section, and every envisaged consequence is stated > conditionally with its conditions named. *(P-I Convention 2.4)*

Formal / empirical / conjecture *(Paper II's marking, Req. 2.3)* — **formal** follows from stated assumptions; **empirical** is supported by cited studies with population and strength stated; **conjecture** is neither, and is marked wherever it appears.

Standard for a solution *(Paper II Req. 2.4)* — a difficulty is **addressed** only where there is **a mechanism**, **an identified party who bears its cost**, and **a stated condition under which the mechanism fails**. A mechanism without an identified cost-bearer is recorded as **unaddressed**.

Sources: Paper I ·Paper II ·Paper III ·Paper IV

39 paper I design and requirements

Original source: `applicative_infrastructure/gr_academia_application/notes/paper-I-design-and-requirements.md`.

Original source SHA-256: `7477c313889f96460aca5933502d02e495eee2ac584a4d939007bf6380c1e9fd`.

39.1 Notes — Paper I: *Designing Generative Relational Academic Infrastructure*

Subtitle: A Protocol Framework for Collaborative Knowledge Evolution and Propagation **Author:** Wanhong Huang (huangwanhong@serendip.ngo) ·working draft, 2026 ·CC BY-NC 4.0 **Length:** 76 pp, 26 sections. Source: papers/GRA-paper-I-…pdf

Role in the series: the *design and standardisation* paper. States the problem, concedes prior art, derives **16 requirements**, sketches the architecture. Does **not** specify the protocol (→ Paper IV) and reports **no implementation**.

39.1.1 1. The one-paragraph argument

Scholarly communication transmits finished artefacts and discards the *trajectory* that produced them. Two developments make that discard worth revisiting. (a) **Evidence:** an artefact carried information about its producer's capacity only because producing it was costly *in a way that discriminated between producers*; when production cost collapses for everyone at once, the discrimination is lost while the artefact and the systems reading it stay in place. (b) **Reuse:** the omitted material (failures, abandoned directions, objections) is not worthless — it transfers to problems its authors never considered. So attention moves to the trajectory. But a trajectory record is *as cheaply fabricated* as the artefact whose function it would inherit. Therefore its credibility must rest on **distribution across parties who did not coordinate** — and that requires a **protocol, not a platform**, because a platform operator is party to every entry.

39.1.2 2. Six method instruments (§2) — these govern everything downstream

39.1.3 2.1 The four levels (Definition 2.1) — *the single most load-bearing instrument*

Level	Held by	Contains
L0 external law	jurisdictions	consent, data protection, erasure rights. **Described, never encoded.** Enters L2 only *negatively*, as a constraint ruling designs out.
L1 operating norms	communities + custodian	which disclosure classes exist, who belongs to them, retention periods, conduct, review templates. Adoptable/revisable.
L2 protocol	the specification	state model + act vocabulary; registration/attestation; attribution + absorption links; parent links + divergence; disclosure classes **as opaque enforced values**; conformance.
L3 application	implementers/users	interfaces, capture assistants, search, structural matching, summarisation, visualisation, **evaluation of content**. Replaceable; protocol implementable with *none* of it.

Requirement 2.2 (Capacity and content). An element belongs to L2 only where interoperability requires agreement on it *and* it survives change in surrounding technology. **The protocol carries the capacity; the normative level carries the content.**

Consequences: all analytical/AI capability is L3. A data model that cannot express redaction forecloses lawful operation in every erasure-rights jurisdiction — no charter repairs that.

39.1.4 2.2 Protocol vs plan (Def. 2.3)

A **plan** specifies outcomes and steps to them. A **protocol** specifies which acts are admissible, what each does to a shared state, and what conformance is — and *leaves every participant's trajectory undetermined*. Relation = grammar to sentences. Any drift into prescribing what participants should record/conclude/value is **an error to be corrected, not a position to defend**.

39.1.5 2.3 Modal marking (Convention 2.4)

Three modes, never mixed: **analysis** (what is the case, with evidence) ·**design** (what a spec requires, by derivation) ·**envisagement** (what would follow in use — supported by nothing yet). No envisagement sentence in a design section.

39.1.6 2.4 Borrowed analogies carry stated boundaries

From version control: append-only history, content addressing, parent links, branching. **Not merging.** From network protocols: layering, implementation-independence, conformance. **Not** delivery guarantees, formal verification, packet semantics.

39.1.7 2.5 No redefinition (Req. 2.5)

Where a deployed standard defines a needed vocabulary, **bind to it**. New terms only where nothing deployed covers the case. Cost: dependency on vocabularies the project doesn't maintain.

39.1.8 2.6 No scalar (Req. 2.6) — *the most counterintuitive constraint*

No scalar quantity over participants or over trajectories; no total order over either. Local two-valued acceptance conditions replace indicators throughout. Cost stated openly: cannot report "a project is going well", cannot rank contributors for a hiring committee, cannot summarise standing in a number. Anyone wanting one computes it at L3 and owns the consequences. Grounds: (i) reactivity/Goodhart — a measure adopted for evaluation becomes the object of effort (Espeland & Sauder 2007); (ii) deeper — a quantity over a trajectory measures a **realisation, not a capacity** (Prop. 10.3).

39.1.9 2.7 Fixed terms

- **Trajectory** — ordered record of the transitions a shared understanding has passed through, with the acts and the parties. *Current state is derived from the record, never stored alongside it.*
- **Transition** — a change from one identified state to another, by an act of a stated type, referencing the prior state, registered by a party.
- **Attestation** — registration of a transition **by a party distinct from the one proposing it**, with identifier and signature.
- **Disclosure class** — value governing to whom a record may be disclosed; enforced at L2, interpreted at L1. **Ground** — the stated reason for restricting, which determines both what is restricted and what remains disclosable.
- **Propagation** — movement of transitions *between* trajectories and *between independent implementations*. Excludes mere dissemination of finished artefacts.
- Terminology note: the epistemic unit is called a **transition**, never a "commit", to avoid collision with version-control commits in the same repositories.

39.1.10 2.8 Declaration of interest

Author founds a society that would host an implementation and is a candidate custodian. Two rules: the society's activity is evidence for nothing; and every requirement on custodians applies to it without exception (forkable spec; stewardship separated from operation).

39.1.11 3. Motivating conditions (§3) — *motivation, not evidence*

Encounter condition. Much of what changes an inquiry arrives from outside its plan (Merton's serendipity pattern; Dunbar 1997 on lab meetings as sites of analogical conceptual change). Present arrangements make such encounters structurally improbable. - **Claim 3.1** is narrow: the design lowers the **cost of preparation** — a recorded, available state is preparation externalised so another party's preparation may meet it. *Not* a claim about the frequency of encounter. - **Req. 3.2:** every statement about encounters is envisagement, and the counter-evidence must be cited alongside it. Counter-evidence: Irving et al. 2020 — occupants of a building designed for serendipitous collaboration developed strategies to *avoid* it.

Generativity condition. *Generativity* here = the capacity of a **relation** to produce states neither party held. Distinguished from the developmental-psychology sense and from Zittrain's platform sense (capacity of a technical system to admit contributions). Evidence that artefact volume/composition is changing (Glynn 2024; Liang et al. 2024 on 6–17% AI-modified text in CS peer reviews; redundant-publication growth 2022–24) — but **no study measures the evidential value of an artefact directly**, so the whole argument is explicitly conditional.

C2PA content provenance is the instructive parallel: it certifies *who asserted what and when*, not truth; and embedded credentials get stripped on redistribution. Both limitations reappear here and force the two answers: **registration by a distinct party** and **portability**.

39.1.12 4–10. The survey (concessions) — *what is already occupied*

39.1.13 §4 Correspondence networks

Mersenne, Hartlib, Oldenburg. The circulating unit was a **state of an inquiry**, not a result; circulation was mediated by a party who held the network; the record was retained **privately**. *Philosophical Transactions* (1665) began as a **periodic digest of Oldenburg's post** — i.e. the periodical **compressed an existing layer and then displaced it** (Claim 4.1), keeping the **registration of priority** and shedding the **warranting detail** (Shapin & Schaffer 1985 on Boyle's circumstantial "literary technology"; Bazerman 1988 on the contraction). **The countersigned laboratory notebook** — bound, paginated, signed by a witness who was not the inventor — is the nearest historical precedent for attestation, *and it shows attestation is compatible with keeping the content private*. Boundary: establishes precedent only. Nothing about feasibility, desirability, or magnitude at present scale.

39.1.14 §5 The reputation-mediated model

Cycle: standing → resources → work → standing (Merton 1968, Matthew effect). **Two functions conceded without qualification and which any proposal must preserve:** (1) concentration of resources on evidenced capacity; (2) **priority as the reward that makes early disclosure rational** (Merton 1957). Documented difficulties: low inter-assessor agreement (Cole et al. 1981; Pier et al. 2018; Fang et al. 2016); competition consumes ~the value of the awards (Gross & Bergstrom 2019); **penalty on novel combination** (Boudreau et al. 2016; Wang et al. 2017) — assessment computes expected value from precedent (Claim 5.1). Political economy: standing is a **positional good** (Hirsch 1976) — competition for it cannot be dissolved by increasing supply; credentialing is consumed cheaply by parties who bear none of its cost; incumbency is concentrated while reform benefit is diffuse (Olson 1965). **Adoption cannot be expected on merit.** Boundary: every cited study samples producers who *entered* the procedures — silent by construction about the population the diagnosis concerns.

39.1.15 §6 Open platforms

Conceded in full: preregistration + Registered Reports (pre-commitment works, but only where the outcome lies in the future); repositories/identifiers/deposit (**taken as substrate, never reimplemented**); **Octopus** — 8 publication types along research stages, hierarchical linkage, priority registered at every stage, open post-publication review; ResearchEquals; open commentary. **Limitation that matters:** a comment attaches to an *artefact*; where it persuades an author, the relation between comment and change is **recorded nowhere**. **Claim 6.1** — nothing surveyed takes *the transition between two identified states* as its unit, and four functions are absent throughout: attested registration; absorption attribution; portability as a bound on authority; grounded restriction. Structural note: every system here is a **platform** (operator, database, location).

39.1.16 §7 Standards — bind, don't redefine

PROV (entities/activities/agents, derivation, attribution) ·CRediT (contributor roles) ·CiTO (typed citation relations) ·W3C Web Annotation (body/target/motivation + selectors) · RO-Crate/FAIR packaging ·micro/nanopublications ·repository notification + federation protocols. **Definition 7.1 / Claim 7.2 — the pivot of the paper:** all of these are **description languages** (fix a vocabulary for recording what occurred, impose no condition on what may occur). GRA specifies an **interaction protocol** (which acts are admissible, what each does to a shared state, which party may perform each, what conformance requires). None of the standards requires registration by a second party, constrains record order, or defines conformance *for a process* rather than a document.

39.1.17 §8 Rationale capture — *the decisive section*

IBIS (Kunz & Rittel 1970) → gIBIS (Conklin & Begeman 1988) → Compendium/dialogue mapping; design rationale QOC (MacLean et al. 1991); scholarly claim ontologies (ScholOnto, Buckingham Shum et al. 2000; micropublications, Clark et al. 2014). > **Claim 8.1. The representational problem is solved** — since 1970, repeatedly, by capable > funded people, connected to deployed standards. **The recorded cause of non-adoption is capture > cost:** the work of recording falls on the party who gains least, at the moment they can least > bear it, in a form serving a different party later (Grudin 1988).

> **Requirement 8.2 (Recording as byproduct).** Every act the protocol defines is an act a participant performs **for a reason of their own**, with the record falling out of its performance. An act existing so that a record should exist will not be performed; any element depending on such an act is moved to an optional tier or removed.

Excludes: general obligation to document reasoning; any separate structuring stage after the work. Admits: an objection registered because the raiser wants a claim changed; a decision recorded because a group must remember what it ruled out; a release declared because the author wants something citable.

39.1.18 §9 Norms, ethics, law

Mertonian norms govern *results*, not process. Authorship criteria + CRediT attach credit to a finished work — **this design moves the attachment point to a change within one**. Fricker 2007 (testimonial + hermeneutical injustice) names the diagnosis but supplies no infrastructure. **Claim 9.1** — copyright (expression), patent (invention), trade secret (non-disclosure), moral rights (attribution/integrity) all protect *finished products*. **None protects a party's position in an ongoing process of generation.** Two consequences: the design offers **evidence, not a right** (sealed registration); and attribution is modelled on **moral rights** — attribution *without any power to exclude* — to avoid the anticommons (Heller & Eisenberg 1998; Boyle 2008). Lex informatica (Reidenberg 1998; Lessig 2006) accepted: a data model *is* a normative fact — but the response is to keep protocol rules few, explicit, inspectable, and push contested content to L1.

39.1.19 §10 The limit of legal reconstruction

Evidence is discrete; generation is continuous. The design **improves the sampling without changing its character** (Claim 10.1). Causal attribution under cumulative/nonlinear conditions strains the counterfactual test (Wright's NESS; Halpern & Pearl). > **Definition 10.2 / Proposition 10.3.** A **trajectory** is the recorded sequence. The > **generativity of a relation** is its capacity to produce states its participants did not hold. > Two trajectories may **coincide in recorded appearance while differing entirely in generativity** > — the record holds what occurred, not what the relation was capable of.

This is the deeper ground of the no-scalar rule. **Open question the paper does not answer:** how generativity is to be *represented*, *reasoned about*, *utilised*, and *protected*. GRA contributes to the first only.

39.1.20 11–20. The derivation (Part II) — where the requirements come from

39.1.21 §11 Displacement of evidential value

Def. 11.1 (separating condition) — after Spence 1973: an artefact carries evidence of capacity only while producing it is *more costly for a lower-capacity producer*, by a margin making it worthwhile for one and unattractive for the other. **The evidence was never in the object; it was in the difference between what the object cost different producers. Prop. 11.2** — a uniform fall in production cost weakens the evidential function while the artefact, the practice, and the systems reading it all remain. **The failure is invisible from inside the practice.** (Says nothing about quality of content.) **Req. 11.3** — any replacement channel must satisfy the same separating condition. Since expense is excluded by Req. 8.2, credibility must rest on **something the producing party does not control alone** → §12.

39.1.22 §12 Fabrication and distributed attestation

Claim 12.1 — a record held and produced by a single party inherits the artefact's fabrication cost. Length, detail, internal consistency, and the appearance of struggle are properties a fabricated record has as readily as a true one. Three sources of credibility: **cost** (excluded by 8.2) ·**pre-commitment** (real but only covers what lies in the future) ·**distribution** (general). > **Requirement 12.2 (Distributed attestation).** A transition is registered by a party distinct > from the one proposing it, with that party's identifier recorded. Credibility follows from the > **distribution of registrations across parties who did not coordinate**, and from **no property of > the record's content, length or detail**.

Implications: registering must be **cheap** (Grudin applies to registrars too); entries must be tamper-evident (content addressing + parent links — available from the substrate, no new crypto). **Limits:** attestation establishes registration, not truth/improvement/understanding; requires ≥2 parties (personal tier has *zero* evidential weight and is justified by usefulness alone); collusion is raised in cost, not eliminated; **counting attestations is forbidden** (a scalar; farmable by reciprocal registration). > **Claim 12.3 — why a protocol and not a platform.** A platform can host a record but cannot supply > the independence its credibility depends on, since the operator is party to every entry.

39.1.23 §13 The unit of record

Candidates rejected: **utterance** (unreadable volume; burden moves to interpretation), **output** (Octopus-style — shows a second hypothesis exists, not that *this objection* converted the first into it), **artefact version** (difference computed, reason absent by construction). **Adopted: the transition.** Components + why each: prior state ref (a change naming no antecedent degrades into commentary) ·posterior state ·typed act (searchability) ·performing party (attribution) ·registering party (Req. 12.2) ·disposition ·absorption links. > **Req. 13.1 (Granularity).** A transition references a **specific identified prior state**. > A record attached to a project, repository or document as a whole is not a transition.

This *diagnoses* §6's observation: commentary systems never became epistemic infrastructure because a comment attaches to an artefact — nothing transitions, no state is superseded.

Worked case 13.2 (social theory, 3 steps): trust-between-individuals → [party B objects: omits institutional power] → trust-as-process-shaped-by-power-asymmetry → [party C, entering from commons governance, connects to monitoring/graduated sanction] → trust-generated-under-governance. Exhibits: two transitions each referencing the state altered; an objection by a non-author with acceptance as disposition; an **encounter** (entering party) at step 3; both attributable *without either claiming to have authored the theory*.

Three consequences: *curation follows from the unit* (a two-hour meeting altering no state produces no record — nobody decides what deserved keeping, so nobody holds a position over the archive); *performativity resisted* (inflating the record requires recruiting a registrar); *compression without a model* (typed transitions are readable by anyone — this is what independence requires in practice).

> **Req. 13.3 (Factorisation of the type).** Type is factored into independent dimensions with small closed vocabularies, not one flat enumerated list. Flattening multiplies terms and inter-rater agreement declines as categories rise; deliberation over classification re-introduces capture cost.

Dimension	Values
act (8)	question ·claim ·challenge ·transformation ·decision ·connection ·verification ·release
target	question ·assumption ·hypothesis ·concept ·theory ·method ·path ·artefact
relation	extends ·modifies ·replaces ·refines ·generalises ·specialises ·transfers → **binds to CiTO**
trigger	self ·literature ·experiment ·simulation ·discussion ·objection ·failure ·model suggestion ·entering party
disposition	accepted ·contested ·**unresolved**

Contribution is not an act — it types a participant's part in an act and binds to CRediT. **The `unresolved` disposition is essential:** most objections in theoretical work are never resolved; a vocabulary with only accept/reject would produce a systematically false record and exert pressure toward **fabricated closure**.

39.1.24 §14 Divergence, and no merge

Identity of a state across transitions is **a matter of record, not adjudication** — a state is a later version of another where a chain connects them; whether they are "the same theory" is a reader's L3 judgement. **Claim 14.1 — no merge operation.** Version control merges because (i) identity criteria exist at byte/line level, (ii) changes to distinct regions compose, (iii) a test decides the result. **None holds for a state of an understanding.** What is called integration is either a **synthesis** (a new state referencing ≥2 parents) or an **absorption** (taking content from another trajectory *with attribution to its originator*). **The word "merge" appears nowhere in the specification.** A trajectory is a **directed graph, not a sequence**. Two states sharing a parent = divergence; neither is designated the principal line. **Attribution crosses divergence. Disanalogy with software forks:** in software a fork is a failure to be reunified; in inquiry a fork is *frequently the correct outcome*. **Plurality is the normal shape of a healthy record.** Forgone: canonical current version; automatic reconciliation; protection against the attention cost of plurality.

39.1.25 §15 Positions and functional authority

Four positions the design **generates** (not imports): **registrar** ·**trajectory steward** ·**holder of disclosure authority** ·**custodian of the specification**. Openness does **not** dissolve hierarchy — contradicted by Shaw & Hill 2014 (concentration of decision rights in open peer-production communities) and Michels 1962. The design assumes it is false. > **Def. 15.1.** A position is **functional** where constituted by acts the arrangement requires, > recorded and attributable, with occupancy depending on continuing to perform them. It is > **structural** where occupancy confers persistent standing, or where others' capacity to act > depends on the holder's permission. > **Req. 15.2 (Admissibility).** Two joint conditions: (i) constituting

acts are recorded as > transitions or administrative operations, attributable and visible; (ii) **participants retain the > capacity to proceed without the holder's permission** (supplied by portability, §16).

Neither suffices alone: visibility without exit → documented autocracy; exit without visibility → participants can't tell what a holder has done. *This is why administrative operations are recorded distinctly from transitions.* Limits: a protocol cannot prevent positions forming; **recording is not review** (a steward who always declines one participant's transitions leaves a complete record and the protocol does nothing — L1 responds); the condition secures *capacity*, not practice.

39.1.26 §16 Portability as the bound on authority

Hirschman 1970 (exit/voice): availability of exit conditions everything about how voice operates, **whether or not exit is used**. > **Claim 16.1.** In this design the bound on any position's authority **is the cost of exit**, not > any rule addressed to the holder. (Rules require an enforcer; the enforcer occupies a position; > the regress terminates only where a participant can act without anyone's permission.) > **Req. 16.2 (Portability) — five joint properties.** The complete record (transitions, > attestations, attribution, parent links) is (1) obtainable by any participant **without > permission**; (2) in a **self-describing format readable without the producing software**; > (3) carries **identifiers that stay resolvable when held elsewhere**; (4) **licensed** to permit > continuation; (5) **continuable under the same protocol by an implementation the original operator > does not control**.

Property 5 is what distinguishes portability from export. A data dump satisfies 1–4 and leaves departing participants with an archive. Evidence: open-source forks are rare *because the option exists*. Contrast: editorial secessions in publishing are notable events — **Claim 16.3**: their rarity is evidence about **exit cost**, not about the quality of what was departed from. A journal's standing lives in its title and indexing; it does not leave with the people. **Limits:** portability secures the record — **not the participants, not the resources, not the standing**. Standing is positional and held by the arrangement. It converts a prohibitive exit cost into a substantial one; expecting frequent secession is unwarranted.

39.1.27 §17 Entry paths

Four candidate qualifications: demonstrated contribution ·code of conduct ·trust extended by existing participants ·verification of competence. > **Claim 17.1 (bootstrap failure).** Qualification by demonstrated contribution *requires access in > order to be satisfied and grants access in return for satisfaction* — closed against every party > with no prior position. Trust-extension has the same form with an extra step.

(Same shape as Arrow 1962 on information as a commodity, and as §5's novelty penalty. Also the empirical mechanism by which open communities concentrate decision rights.) > **Req. 17.2 (Entry path).** At least one path exists by which a party with **no prior position** > may perform an act **decided on the act itself**; cheap to attempt; its **material supplied by the > arrangement**; outcome verifiable by others.

The mechanism is already in the vocabulary: a trajectory holds states whose disposition is `unresolved` — standing objections, open questions, obstacles. A **register of unresolved states is the entry path** (cf. `grrp open` in Paper IV). A stranger may `connect`, `challenge`, or `verify` against an identified state; each is decided on content; none requires standing. Untouched: volume/attention rationing; conduct+moderation (L1); competence for restricted classes; and the fact that an arrangement whose participants decline every stranger still *conforms* — the record of declining is what a reader has to go on.

39.1.28 §18 Encounter and the participant set

A trajectory changes in **content** and in **who holds it** — both are transitions. > **Def. 18.1 (Encounter).** A transition performed by a party who has performed **no prior act** in > the trajectory, with a trigger identifying the occasion. No new primitive is added — the trigger > dimension already covers it. > **Claim 18.2.** The record holds **the generation of the arrangement that produced an > understanding**, not the understanding alone. Where the unit is an output, an entering > participant leaves no trace beyond a name on a later artefact.

Uses: attribution for parties who altered a trajectory **without producing an artefact of their own**; conditions of productive encounter become inspectable (material for study, not a protocol function). > **Claim 18.3 (matching, narrowed).** The discovery claim concerns **structural similarity between > states in different fields** and **nothing within a field** (within a specialty everyone already > knows each other). Cf. Swanson 1986 (disconnected literatures jointly entailing a conclusion > neither states) — extended here from published claims to *recorded states, including unresolved > ones*. It depends on a large corpus, so it is a **late property of an adopted arrangement and > supplies no reason for anyone to adopt one**.

Two further boundaries: cross-vocabulary structural matching is an **unsolved L3 research problem**; and **recording an encounter alters it** — the material most worth preserving is the least likely to be produced under observation.

39.1.29 §19 Priority and disclosure timing

The dilemma: circulation is where benefits arise; concealment is where a participant's protection lies. **Asymmetric** — a well-positioned party risks little; a party without position bears the whole risk, and that is the population the diagnosis concerns. Priority answers it in the incumbent system but **attaches at publication**, i.e. after the work is substantially complete — the generative phase is unprotected, and the only instrument is silence. Deployed devices (preregistration, stage-wise publication, preprints) all **require disclosing the thing registered**. > **Def. 19.1 (Sealed registration).** Publication of a value derived from a state's content, from > which the content cannot be recovered and against which it can later be checked, plus the > registering party's identifier and a time. Disclosure is a **separate, subsequent** act. > **Req. 19.2.** Registration is available at the moment the act is performed, at **every** disclosure > class including disclosure-to-nobody. The record shows *that* registration occurred at its time > **without showing what was registered**.

Five limits. Evidences possession, not understanding/capacity/priority. **Generates nothing while sealed** — it buys the possibility of later opening, not the benefits of early opening. No protection against independent arrival. Requires a trusted publisher of the value or a public medium (outside the protocol). **A timestamp is not priority** — priority is a community's recognition, an L1 matter.

39.1.30 §20 Transmissibility — *the strongest single result of Part II*

Collins 1974/2010 (TEA laser): labs failed to build the device from published papers; success followed *contact with people who had built one*. MacKenzie & Spinardi 1995 (nuclear weapons design): same structure where the incentive to record fully was extreme. > **Def. 20.1 (The articulable fraction).** That part of what participants held which they were able > to put into the record. Its complement transmits, if at all, by working alongside them, and **no > property of the record's design recovers it.**

- **Reuse** survives in weakened form: what transfers is the *propositional content of a failure* (an approach was attempted, on what assumption, what obstruction was met) → **redirection of attention**, not transfer of capability. A reader cannot take up another's work where it stopped.
- **Evidence** is bounded to *the acts performed* — a record can be traversed by a modest party working slowly. Claim is that the record **discriminates better than an artefact under present conditions**, not that it measures capacity.
- **Hazard** is bounded by the same fraction: what a hostile reader gets is the propagable part.

> **Proposition 20.2.** The component the artefact omits is **simultaneously** the component carrying value in reuse, evidential force, and hazard. All three scale together with the articulable fraction, and **no design increases one without increasing the others.**

Kills a whole class of proposals: you cannot publish the trajectory *minus its dangerous parts* and retain the benefit. Hence the answer to hazard is disclosure classes + stated grounds (→ Paper III), never selective omission. Same component also carries the **reputational cost** of disclosing failure → exploratory vulnerability (Paper III).

39.1.31 21. The gap, stated once (Claim 21.1)

> No arrangement in the surveyed literatures **(a)** takes the transition between two identified states as its unit of record, **(b)** registers that transition by a party distinct from the proposer, **(c)** attributes content absorbed from one line of work into another, **(d)** bounds the authority of positions by the portability of the record, and **(e)** restricts disclosure on a stated ground that determines what remains disclosable — **specified as an interaction protocol where the standards are description languages.** The elements are severally available; **the conjunction is unoccupied**.

Every element has an ancestor (attestation ← countersigned notebook; attribution ← CRediT + moral rights; portability ← software forking; grounded restriction ← hazardous-research governance; typed relations ← CiTO). Novelty is claimed **for the assembly and the requirements forcing it**, not the parts.

Four findings that withdraw the claim (stated so a reader can look for them): 1. A deployed system/spec whose unit is the transition between identified states, with distinct-party registration → defeats the claim entirely. 2. A spec defining admissible acts + effects on shared state for scholarly work, with conformance → defeats the description-language claim. 3. Evidence that rationale-capture systems failed for reasons **other than capture cost**, or were adopted more widely → removes Req. 8.2, the principal design constraint. 4. Evidence the separating condition has **not** weakened, or that evaluation has already replaced the artefact → removes the premise of the whole argument. *(Empirical; unsettled.)*

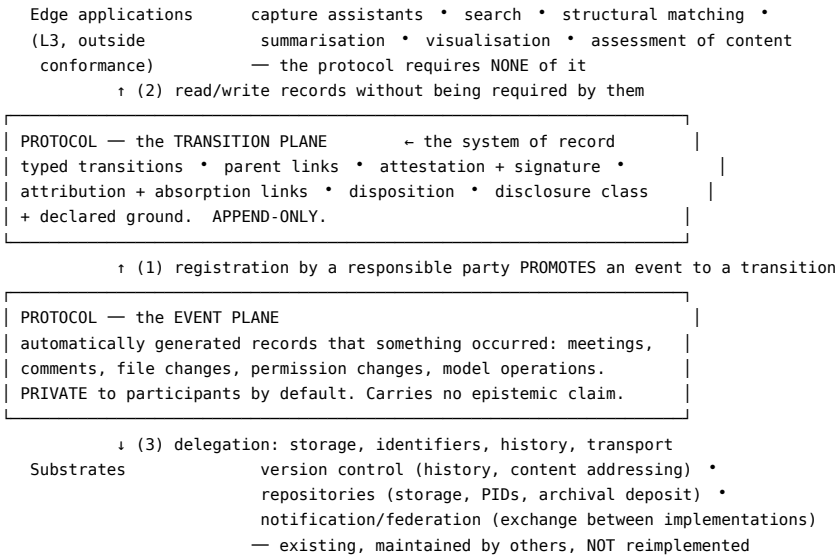
39.1.32 22. The sixteen requirements (the spec is judged against these)

#	Requirement	Derived in
R1	Recording is a **byproduct** of acts performed for their own sake	§8
R2	Deployed vocabularies are **bound, never redefined**	§7
R3	A transition is **registered by a party other than its proposer**	§12
R4	The unit of record is a **transition referencing an identified prior state**	§13
R5	The log is **append-only**; current state is **derived**; edits are **detectable**	§13
R6	**Divergence is recorded; no merge operation is defined**	§14
R7	The complete record is **portable and continuable elsewhere**	§16
R8	An **entry path** exists: cheap to attempt, externally verifiable	§17
R9	**Absorbed content is attributed to its originator, without veto**	§9
R10	**No scalar** quantity over participants or trajectories	§2
R11	Disclosure is **monotone**: scheduled release, **no withdrawal**	§10
R12	Personal content is **separable**, so redaction leaves the log intact	§9
R13	Records are **durable**: plain formats, distributed custody, deposit	§25

#	Requirement	Derived in
R14	The protocol is implementable with **no analytical capability present**	§2
R15	The **core tier is worth adopting by a single participant**	§3
R16	A **release can emit the artefact the incumbent reward system accepts**	§5

The three that constrain most severely: R1 (eliminates the most otherwise-attractive designs — no documentation obligation, no post-hoc structuring stage), **R10** (costs the ability to report progress, rank contributors, or summarise standing), **R14** (costs the ability to require model-assisted capture, matching, or summarisation). Status: **not claimed complete**; **not independent** (R3+R7 both serve credibility; R1+R15 both serve adoption); and this is the table Paper IV is assessed against.

39.1.33 23. The architecture in outline



The event plane is **where the surveillance hazard falls** — a complete log of who attended and whose files changed is a monitoring record by construction. Hence: confined to participants, disclosed only through registration. **Claim 23.1** — the arrangement contributes **the transition plane and the rules governing promotion into it**, and nothing else.

Three tiers (this stratification is what makes R15 achievable): - **Personal** — one participant, transitions with parent links against identified states, append-only log, derived views, three acts. Gets: a searchable record of what was ruled out and why; a standing list of unanswered objections; a release emitting a citable document. Gets **no evidential weight whatever** (attestation impossible with one party). - **Group** — attestation, contributor roles, absorption links, disclosure classes. **Credibility begins.** - **Open** — propagation, distributed custody, deposit, charter reference. Exchangeable with implementations elsewhere.

Left to Paper IV: act vocabulary + factorisation; identifier and signature construction; disclosure classes bound to grounds (→ Paper III); **conformance conditions** (without which the requirements are aspirations). **Claim 23.2** — this establishes the requirements are jointly satisfiable, and **nothing about whether the arrangement works**. Adequacy is settled by use.

39.1.34 24. Two speculative formal models (envisagement — the protocol depends on neither)

The design is **event-based**: state persists until an act occurs; nothing updates on a schedule. **Req. 24.1** — this is a reference to the *class of event-advanced systems* (DEVS, Zeigler et al. 2018; spiking networks, Maass 1997 are another instance). **No property of neural computation is transferred.**

1. **Generalised heterogeneous dynamical network (Def. 24.2)** — nodes each carrying their own state space *and their own law of evolution* (discrete dynamics on a complex; spiking; continuous field; discrete-event automaton), coupled by **propagation operators** Π_{ij} mapping events emitted at v_i to admissible inputs at v_j. Motivation: a knowledge trajectory couples participants whose internal dynamics are not of one kind. Nearest prior art: DEVS multi-formalism coupling; multilayer network dynamics. **Three stated obstacles:** a shared time base + consistent event ordering across dynamics that individuate events differently; coupling semantics across differing state-space types; **closure under coupling**.
2. **Spin-foam-like representation** — a history as a **two-complex**: vertices = events, edges = couplings between elements of an event, faces = primitive elements; the §13 transitions are its one-dimensional shadow. Ancestry: Whitehead 1929 (events as primitive constituents); Kowalski & Sergot 1986 (event calculus). **Three objections recorded and unanswered:** no analogous algebraic structure on the informational side (so the borrowing is figurative); no counterpart to superposition, so the amplitude machinery may be inert; borrowed heavy formalism without its home-domain empirical constraints is a recognised failure mode.

Four conditions for either to become formal: explicit mapping with no ornamental elements; a composition rule gluing histories along shared boundaries (natural candidate: a state of a shared understanding); an interpretation of the weight assigned to a history; and a demonstration that some question about trajectories is answerable in it **and not in the directed graph of §14** — which is the representation the protocol actually uses and which is adequate to everything it requires.

39.1.35 25. Open problems, by what each awaits

- **Legal** — the unprotected position of a party in an ongoing generation; erasure rights vs integrity guarantees (answered by separating content from the attested skeleton, but not adjudicated); cross-border multiplicity of regimes; status of model-assisted contributions.
- **Normative** *(these bear directly on whether the claimed benefits appear)* — whether registration confers priority; **whether disclosed failure can be non-punitive** (the reuse argument depends on it); whether the **labour of registration** is recognised (unpaid work for someone else's benefit — precisely the disparity that killed the §8 systems; answered by making it cheap, not by rewarding it); whether an unresolved disagreement is publishable as a state.
- **Organisational/economic** — decades-long custody with succession; **assessment capacity is subtractable** and rationing without ranking is unsolved (→ Paper II); the **regressive distribution of overhead** (recording falls hardest on those with least time — exactly the population the diagnosis concerns).
- **Technical** — representing a state so structural similarity is computable across vocabularies (undemonstrated; retrieval by topic does not do it); trajectory-graph shape analysis (persistent homology, Carlsson 2009 — applicability unknown); quantum approaches (marked speculative; three obstacles: hardware, unproven advantage, and the representation problem is prior).

None is required for conformance. All sit at L3 so the protocol depends on none of them.

39.1.36 26. Conclusion — five results, three concessions

Results: (1) the evidential function rests on a separating condition and is weakening invisibly; (2) a single-party record inherits the same weakness, so credibility must come from distributed attestation — **hence a protocol, not a platform**; (3) the representational problem was solved repeatedly and failed on **capture cost**, which excludes more designs than any other consideration; (4) value-in-reuse, evidential force, and hazard are **the same component** and scale together; (5) the layer is a **restoration**, not a novelty.

Concessions: the prior art in platforms/standards/representational systems; **no evidence for the encounter motivation** (the best study points the other way); recognition is positional, so nothing here increases the standing available — **attribution redistributes it, which predicts resistance from parties who benefit from the present invisibility of others' contributions**.

> The account's contribution is to take capture cost as its **first constraint** rather than an obstacle to be regretted, and to see what a design looks like when **nothing may be required of a participant that the participant would not do anyway**. The result is smaller than the designs that failed, and whether smaller is enough is a question no argument settles.

39.1.37 Implications for this repository

- README/plans must not promise **progress reports, trajectory health, similarity ranking, contribution scores** as protocol features. Every such thing is **L3** and most are forbidden as scalars (R10). *(The retired* `implementation_plan.md` *had these as Stages 4–5 — see gaps-and-repo-actions.md.)*
- The word **"commit"** should not name the epistemic unit — the paper deliberately says **transition** to avoid collision with git commits in the same repository. The README's "GRA Commit Concept" contradicts the papers.
- The word **"merge"** must appear nowhere in the UI or spec (Claim 14.1).
- Any claim about encounters/serendipity must be marked **envisagement** and carry the Irving et al. 2020 counter-evidence (Req. 3.2).
- The personal tier must be **worth using alone on day one** (R15) — and must be described as carrying **no evidential weight** (§12.4), which is a distinction the README currently blurs.

Related: paper-II-incentives-and-adoption.md ·paper-III-grounds-of-restriction.md ·paper-IV-grrp-specification.md ·glossary.md

40 paper II incentives and adoption

Original source: `applicative_infrastructure/gr_academia_application/notes/paper-II-incentives-and-adoption.md`.

Original source SHA-256: `a2f5599cb6169cd50349756f9d9521191d50071ee8f558c5dd861090188df44a`.

40.1 Notes — Paper II: *Incentives, Collective Action, and Adoption in GRA Infrastructure*

Author: Wanhong Huang ·working draft, 2026 ·CC BY-NC 4.0 ·40 pp, 17 sections Source: papers/GRA-paper-II-…pdf

Role in the series: the *economic and institutional* paper. Paper I says the record is worth keeping; Paper IV says how to keep it. This one asks **whether any of it will actually happen** — and answers, honestly, that nothing here gives reason to expect it will.

> This is the paper that keeps the project honest. **Most of its content is a list of things the project may not claim.** Read it before writing any pitch, README, or grant application.

40.1.1 0. What the paper says it can and cannot secure

> A protocol **can** alter the distribution of costs and make certain acts cheap. It **cannot** create an incentive where none exists, **cannot** dissolve competition for a positional good, and **cannot** supply a norm a community has not adopted.

It also explicitly declines the standard rhetorical move: it does **not** argue that the present arrangement is so defective that any alternative is worth trying. The incumbent performs two functions that must be preserved — concentration of resources on evidenced capacity, and priority as the reward making early disclosure rational.

Requirement 2.3 (evidential marking). Every claim is marked **formal** (follows from stated assumptions) / **empirical** (cited studies, population + strength stated) / **conjecture**. Strength of the literatures used, descending: positional goods + contest theory (formal) → assessment reliability + cost of competition (empirical, reasonably strong) → **what makes research infrastructure adopted (thin, retrospective, selected-on-outcome)**.

> **Requirement 2.4 (Standard for a solution).** A difficulty is treated as *addressed* only where the paper states **a mechanism**, identifies **the party who bears its cost**, and names **the condition under which the mechanism fails**. A mechanism without an identified cost-bearer is recorded as **unaddressed**.

This is stricter than the field's practice, and deliberately: describing an arrangement in which someone does work benefiting others *without saying why they would* is the characteristic failure that produced the non-adopted systems of Paper I §8.

Terms. *Adoption* = begins conducting work under the protocol at a declared tier **and continues**; one trajectory then stopping is not adoption. *Overhead* = effort that would not have been expended without the arrangement, measured against the participant's own purposes. *Private benefit* = benefit accruing to the cost-bearer, at their own scale, **without the participation of others**.

40.1.2 §3 Where the commons dilemma actually is

> **Claim 3.1 (formal).** The **tragedy of the commons has no object in knowledge.** That analysis concerns a rival resource degraded by uncoordinated appropriation; no quantity of reading, citing, absorbing or forking diminishes what a trajectory record holds. Transferring the tragedy imports a mechanism whose precondition is absent.

Not pedantry: misdiagnosing the dilemma as appropriation invites appropriation-type remedies — **restrictions on use** — and Paper III shows restriction is justified only on grounds *none of which is overuse*.

> **Claim 3.2 (formal).** Knowledge is a public good, so the predicted failure is **underprovision, not overuse** (Olson 1965). Remedies that increase the cost of *using* knowledge address a failure that does not obtain and worsen the one that does.

The four subtractable goods (this is where Ostrom's design principles apply — *not* to the knowledge produced from them):

Good	Character
Review / assessment capacity	The time of a party competent to judge. Rival, limited, unpaid. **The one the design most directly strains.**
Maintainer labour	Keeping the record coherent, resolving duplicates, curating the open register, answering newcomers (Eghbal 2016).
The instrument	Rival in the ordinary sense, where the work needs one (→ Paper III).
Community trust	Willingness to extend good faith to unknown contributors. Consumed by bad experiences, replenished slowly. An open entry path draws on it directly.

> **Claim 3.3.** The protocol **lowers the cost of contributing and lowers the cost of assessing by nothing.**

Rationing without a ranking (Claim 3.4). Congestion is ordinarily managed by ranking; the no-scalar rule removes it. Three alternatives, all **charter-level, none supplied by the protocol**: *reciprocal obligation* (no deployed instance at scale) ·*bounded intake* (rations without ordering; displaces the difficulty onto the administrator; wastes arbitrarily) ·*maintainer triage* (what OSS does; efficient; reintroduces exactly the position Paper I §15 governs). **Recorded as unaddressed.**

The inverse risk (Claim 3.5). Fine-grained attribution across many small contributions resembles the biomedical-patent anticommons (Heller & Eisenberg 1998). Answered by **excluding any veto**: an absorption link confers *attribution and no power to prevent, condition or reverse use* — the moral-rights construction. **Complete against legal fragmentation; incomplete against social fragmentation** (a community may treat attribution claims as though they carried veto power whatever the spec says — *conjecture*).

40.1.3 §4 Review capacity — the binding constraint

Claim 4.1 (formal). The protocol shifts the ratio of contributing-cost to assessing-cost toward more demand on assessment. **Congestion is a consequence of the design *working*, not of its failing. Claim 4.2.** Assessment capacity is fixed in the short run, unpaid, provided under a norm rather than a contract, and **already strained**. **Claim 4.3.** The protocol **makes assessment activity visible and provides no assessment capacity.** Visibility is a *precondition* for a community to run a reciprocity norm; it is not such a norm. **> Claim 4.4.** Congestion of assessment capacity is **the difficulty in this series least addressed > by the design and most likely to determine whether a conforming arrangement survives at scale.** > Every available remedy places an **unfunded burden on a small number of parties**.

40.1.4 §5 Maintainer labour

The non-research work: registering others' transitions ·resolving duplicate/near-duplicate states ·curating the open register *so it stays a list of open problems and not a list of everything nobody has closed* ·answering entrants ·maintaining charter, classes, membership ·custody, deposit, succession.

> **Claim 5.2 (empirical).** Open-source is **not** evidence that voluntary maintenance of shared infrastructure is sustainable. It is evidence that such maintenance **concentrates on very few, frequently unpaid parties** and **fails silently until something breaks** (Eghbal 2016; Shaw & Hill 2014). *Usually cited as encouragement; it reads as a warning.*

Two disanalogies, running opposite ways: software has tests, so a maintainer's per-contribution assessment cost is low — **assessing a challenge to a claim has no such shortcut**, so maintenance here is *more* expensive per unit. And software has a large dependent *commercial* user population that sometimes funds maintenance — **a trajectory record has no such population**, so the OSS funding argument does not transfer.

Claim 5.3. No party's interest is proportional to the benefit it would receive (institutions gain evidence of contribution, funders gain selection information, unaffiliated scholars gain visibility — all diffuse, against concentrated cost). Olson's **privileged-provider exception** names both how comparable infrastructure actually gets funded *and* the failure mode: **the paying party's purposes become the arrangement's purposes.**

Protocol's contribution (none of it a solution): makes maintenance **visible** (precondition for compensation, not compensation) ·**bounds the maintainer's authority via portability** *— at a cost to the maintainer, who then holds the burdens of authority and few of its returns* · **permits** the work to be distributed. **Recorded as unaddressed.**

40.1.5 §6 The positional bound — *the section that deletes claims*

Claim 6.1 (formal). The aggregate quantity of standing in a field is **fixed independently** of how much work is produced or how visible contributions are made. Any arrangement making more contributions visible **redistributes standing; it does not increase it.**

> **Claim 6.2 (formal).** The series **may claim** that the arrangement changes *what parties compete for*. It **may not claim** that it reduces competition, dissolves hierarchy, or increases the recognition available to those who lack it — **any passage implying otherwise is an error to be corrected.**

Consequences: attribution mechanisms are **redistributive**, so a party who presently benefits from the invisibility of others' contributions **is made worse off** — *a reason to expect resistance, not an argument against the mechanism*. Openness alters *who may enter*, not *what is competed for*.

Two dimensions actually open to alteration: (1) **the basis of comparison** — artefact counts vs recorded contribution to changes in understanding; available *because* the artefact has weakened as evidence (Paper I §11); (2) **the visibility of contribution** — but standing rises only if the community counts it, which returns to (1).

Claim 6.4 — the objection that this proves too much fails. What is fixed is the *aggregate of standing*. What is **not** fixed: which activities produce it, who may compete, what evidence is admissible, and **what is lost when work is not recorded**. Retention, reuse of abandoned material, and interpretability of a decision years later **are not bounded by the positional argument at all**. Keep the two sets of claims apart.

40.1.6 §7–8 Selection, dissipation, and the absorption test

Definition 7.1 / Claim 7.2 (formal). An open selection is an **all-pay contest**: effort is sunk whether or not the entrant wins. Opening it to more entrants **increases aggregate**

dissipation — and disproportionately burdens those for whom preparation is a larger share of available time. *An arrangement where many develop proposals in the open and the rest are discarded is the incumbent arrangement with a wider entrance and a higher aggregate cost.* Neither standard rebuttal closes the gap (**Claim 7.3**): the *learning* response identifies a gain that is **private, unrecorded, and lost when the entrant moves on** — precisely the condition this series exists to address; the *signalling* response is bounded by the evidence on assessment reliability.

> **Definition 8.1.** An arrangement is **competitive** where the work of unselected entrants **leaves no trace** in the work that proceeds. It is **generative** where content originating in unselected work **enters the work that proceeds and is attributed to the party who produced it.**
>
> The definition turns on **what becomes of unselected work** — not on openness of entry, number of participants, or manner of decision. *An open arrangement discarding losing proposals is competitive. A closed arrangement that takes up and credits a rejected proposal's method is generative.*
>
> **Requirement 8.2 (The absorption test).** Examine the record of the work that proceeded and count the transitions whose content originated in work that was **not selected**, with attribution to the originating party. **Where such transitions are absent, the arrangement is competitive whatever its constitution states.**

Three properties make it usable: **checkable** from the absorption links the spec already requires (no new instrument); **falsifiable against the proposal itself** — any conforming arrangement may be examined and found to absorb nothing; and **applicable to existing arrangements** without the protocol (laboriously — a funding programme, a lab, a journal can be asked whether the work that proceeded took up content from what it declined).

Claim 8.3. The absorption test is **the folding criterion of the companion papers applied at the point of selection** — *the series employs one criterion at four positions, not four criteria.* (Value returning to the relation that produced it = generative; value accruing to an attractor outside that relation = not.)

Four limits (Claim 8.4). Absorption is **necessary, not sufficient** (an arrangement may absorb diligently and produce nothing of value). It may be **performed badly** — content taken up in a way that misrepresents what the originator held, recording a debt they would not recognise (hence the spec's **contested attribution** provision). **Counting is forbidden** — an absorption count is a scalar, farmable within a season by nominal absorptions; the test is applied *by a reader reaching a judgement*, never computed or displayed. And it says nothing about **generative capacity** — two arrangements may absorb identically while the relations differ entirely.

40.1.7 §9 Staged selection and backward induction

The natural design: (1) open work, no ranking, diversity encouraged → (2) collective development with objection and revision → (3) selection and allocation.

> **Claim 9.1 (formal).** Where a later stage allocates a scarce resource and everyone knows it, the earlier stages **are not unranked — they are ranked with a delay.** A declaration that a stage is non-competitive does not make it non-competitive. *(Robust: it suffices that some participants anticipate the selection; their behaviour imposes the same pressure on the rest.)*

Two predicted behaviours (Claim 9.2): - **Withholding** — a participant with a strong idea discloses late. **The exploration stage therefore fills with the material participants are least concerned about, which is the material least worth having.** - **Adversarial objection** — improving a rival's line raises the probability the rival is selected, so the rational act is **to object in ways that damage rather than in ways that improve** — and objection is exactly the mechanism the arrangement relies on for its generative benefit.

> **Claim 9.3 — the repair.** Where content absorbed into a selected line is **attributed** to its producer, and the attribution is **recorded durably and recognised**, contributing to a rival's line carries a **positive expected return**, and improving objection carries a return that damaging objection does not. **Attributive absorption is the condition under which a staged design survives backward induction — not a courtesy extended to unselected parties.**

Notes: it operates more strongly on **development** than exploration (an improving objection is credited immediately; an early-disclosed idea is protected only by registration, which converts exposure into a dated claim *and generates nothing*). And it **requires the attribution to be worth something** — a community counting only selected outcomes leaves the repair inoperative.

> **Claim 9.4.** Staged selection without attributive absorption is **worse than an undisguised competition**, since it obtains the appearance of openness while producing the behaviour of a contest.

40.1.8 §10 Sparsity and plurality of selection criteria

Claim 10.1. Any criterion applied **often enough and singly enough** becomes the description under which participants organise their work. *The problem is frequency and singularity, not the choice of criterion.* > **Definition 10.2. Sparsity** = the interval between selection events, measured against the > interval over which a line of work develops. **Plurality** = the number of applied criteria **that > cannot be combined into a single ordering.**

Claim 10.3. Sparse → weak optimisation pressure between events. Plural → no single ordering forms. **Frequent + single-criterion = worst case. Claim 10.4 (conjecture). Plurality is not preserved under frequent application** — participants infer the operative criterion from repeated outcomes. **So sparsity is a *condition* of plurality, not an independent parameter.**

Three costs. Sparse selection **concentrates risk** on those with short horizons — again the least-standing population. It is **administratively unattractive** (frequent small allocations are easier to justify and correct, and produce a steady record of activity). Plural criteria are **contestable** — the decision cannot be defended as following mechanically from the criteria, so the decision-maker's judgement becomes visible. *A cost by ordinary standards; an advantage under this series' analysis, since a visible judgement is attributable to a party.*

Claim 10.5. Both are **charter parameters, not protocol parameters**. The protocol makes their values visible after the fact and supplies no means of setting them. **Unaddressed at the level of the design.**

40.1.9 §11 Overhead and its incidence

Claim 11.1. Overhead concentrates in **acts requiring articulation**, specifically **the decision act**. Typing and registration are cheap by construction (a small number of narrow choices under the factorisation; a single affirmative action). **Recording *why* a direction was abandoned, at the moment of abandoning it, is not — and no property of an interface reduces that cost.**

> **Claim 11.2 (formal).** Overhead falls hardest on participants with **the least time and the least standing — the population the series' diagnosis concerns.** The arrangement is **regressive in the dimension the series most cares about, whatever its intentions.**

The byproduct principle, restated economically: an objection is raised because the objector wants a claim changed; a release is declared because the author wants something citable; a connection is recorded because the connector wants the relation known. > **Strongest form:** the arrangement records **what participants already produce and discard** — > weekly progress reports, supervision notes, meeting summaries are *compressed accounts of a > trajectory produced routinely under present conditions*. Adding a little structure to work already > performed imposes far less than asking for new work.

Claim 11.3. The byproduct principle reduces the overhead of every act **except the decision act**, whose purpose for the performer is weakest. A participant abandoning a direction gains little from recording why; the party who gains is a stranger years later. **This is the disparity that defeated earlier systems, surviving in one act after the design removed it from the others.**

Requirement 11.4 (Private-benefit sufficiency). An arrangement is adoptable **only where its minimal form is worth adopting by a single participant with no other participants present.** An arrangement whose benefits appear only at scale is never adopted, since no party is ever in a position to obtain them.

Historical analogue: **version control was adopted by programmers working alone, for private reasons**; the collaborative benefits followed. *Nobody adopted it out of commitment to a social model of software production.* (Claim 11.5 — conjecture by analogy, and the analogy is to a case with a **far more favourable cost structure**.)

Claim 11.6. Residual **regressivity is unaddressed**: the private-benefit condition addresses the *timing* of benefits, not their *distribution*. A senior party adopting the personal tier loses little; a precarious party obtains the same record and loses time they cannot spare. Compensating it would require a funding party no analysis identifies.

40.1.10 §12 Selection pressure on adopting groups — the strongest argument against

Claim 12.1 (formal, the dominance argument). In an environment rewarding output rate, a group adopting an arrangement that imposes **any net cost** is disadvantaged relative to groups that do not, **irrespective of the arrangement's epistemic merits**. Sustained, adopting groups are **selected against.**

Hence adoption is not a matter of persuasion: *a group persuaded of the value and situated in this environment is a group persuaded to accept a competitive disadvantage, and persuasion of that kind does not survive a funding cycle.* And that collective benefits exceed collective costs is **not in dispute and not relevant** — no group receives the collective benefit; every adopting group bears its own cost.

Two escapes only: 1. **Net private benefit** at the adopting party's own scale. Candidate components, stated as an economic claim rather than a feature list: *time recovered in preparing progress reports and presentations from an existing record ·effort saved in not repeating an abandoned approach ·faster onboarding of a new member from the record instead of from conversation*. **Whether these exceed the overhead is an empirical question nobody has measured.** 2. **Insulation** from output-rate selection — theory groups with secure funding, nonprofit research bodies, interdisciplinary institutes, retired scholars, unaffiliated researchers.

Claim 12.2. Adoption is predicted to **begin among insulated parties** and spread to others only where net private benefit is demonstrated. **The prediction is uncomfortable for the series, since insulated parties are peripheral to the fields whose practice the arrangement would have to change.**

Claim 12.4 (the honesty condition). The series **may not argue for adoption on the ground that the arrangement benefits scholarship collectively.** That argument is available to no individual party, and **its repetition is the characteristic error of proposals in this field.** What may be argued: that a particular party, at a particular scale, obtains more than it gives up — **and that argument requires evidence this series does not have.**

40.1.11 §13 Network externalities and the tier structure

Claim 13.1. Benefits rising with participation → a coordination problem where **the return to the first adopter is lowest**; where the benefit is *entirely* of this kind, the arrangement

has no first adopter and does not begin. *This is a second, independent explanation for the non-adoption of the 1970– systems: a party constructing an argument map alone obtains a map, and the promised value lay in a network that never formed.*

Three ordinary remedies, all unavailable: **subsidy** (needs a funding party whose interest is proportional — §5 established there is none) ·**mandate** (converts the arrangement into a compliance requirement, and the mandating party's purposes become the arrangement's) · **bundling with an already adopted good** — *the most promising, and layering over version control and repositories is the attempt; success unknown*.

> **Claim 13.2.** Where benefits are **stratified so each tier returns something at the scale of that tier**, the coordination problem decomposes into a sequence of decisions **a party can take alone**. The strict condition: **each tier must return something at its own scale**; a tier returning nothing until the next is reached collapses the decomposition. *The personal tier is where this is most doubtful.*

> **Definition 13.3 / Claim 13.4 (Minimum viable adopting unit).** The smallest set of parties for which benefits exceed costs **without participation by anyone outside the set**. **Group tier = two parties who register each other's transitions. Open tier = one community with an implementation and a charter.** *A design whose minimum unit was a discipline requires an agreement nobody can broker. A design whose minimum unit is a seminar requires a decision two people can take on a Tuesday.*

Claim 13.5. The tier structure addresses **the coordination problem and not the cost problem**, and the two are independent. Also: **cross-field matching is not decomposable** — it needs a multi-field corpus, belongs to no tier, returns nothing to any adopting party, and **must play no part in any adoption argument.**

40.1.12 §14 Compatibility with the incumbent reward system

> **Requirement 14.1 (Compatibility).** An arrangement is adoptable only where a participant can obtain, **from a conforming record and without additional work**, an artefact of the kind the incumbent reward system accepts.

Mechanism: a `release` emits a document containing the released state, **the chain of transitions leading to it**, the parties with their CRediT roles, the absorption links with attributions, and **the objections standing at release**. Two economic properties: it requires **no additional work** (assembled from records created in the course of the work); and it carries **an appendix no other process can produce**.

Claim 14.2. Compatibility converts the decision from *a choice between two systems* into *an addition to one*. **Three effects:** removes the sacrifice ·supplies an immediate return **in the currency that binds** (time recovered assembling a paper) ·**defers organised opposition** (Olson: opposition organises when a threat becomes visible).

The objection that compatibility concedes too much — participants keep publishing, publications keep being counted, and the trajectory record becomes an unread appendix. **Answer is partial and honest (Claim 14.3):** the objection is correct that the appendix may go unread indefinitely; what it misses is the alternative — demanding abandonment of publication means accepting the dominance argument's cost in full, so **the comparison is between an arrangement that may be ignored and one that will not exist.** *That the first is preferable is a position, not a result.*

> **Claim 14.4 (the terminus).** Compatibility **postpones the conflict and does not remove it**, and **the conflict returns at exactly the point at which the arrangement begins to succeed.** A proposal claiming to threaten nobody while proposing to change what counts as evidence is **either naive or evasive** — this series states the terminus rather than claiming the conflict away.

40.1.13 §15 What the empirical record actually shows

Claim 15.1. No systematic study exists of a defined population of research infrastructures assessed against adoption outcomes. Available evidence = retrospective accounts of individual systems, written mostly by associated parties, selected for attention because they succeeded or failed conspicuously. **Infrastructures quietly built and quietly unused generate no literature at all — so the population is unobservable exactly where the account makes its prediction.**

Pattern the discussed cases suggest (**Claim 15.2, conjecture**): infrastructures that **supplied a tool researchers needed for their own work, with sharing as a byproduct of using the tool**, were taken up (simulation/analysis platforms). Infrastructures **whose proposition was sharing** — the contribution was the point and the return arrived through others — were built and **largely unused** (workflow-sharing repositories). **Claim 15.3 (conjecture).** Funding + institutional expectation are **sufficient to build** shared research infrastructure and **not sufficient to produce voluntary use** — a mandate alters what a participant must be *seen* to do, not the cost they bear. **Claim 15.4.** No evidence that infrastructure increases productive unplanned encounters; the strongest qualitative study reports **avoidance** (Irving et al. 2020).

> **Claim 15.5.** The empirical record **supports this paper's negative claims and none of its positive ones.** It gives reason to expect that arrangements without private benefit fail, and **gives no reason to expect that an arrangement with private benefit succeeds.**

40.1.14 §16 Ten predictions (with refutations) — *the project's own evaluation plan*

Adoption: P1 begins among parties insulated from output-rate selection, and among those whose reporting burden is high relative to output ·**P2** proceeds tier by tier — a substantial personal-tier population **precedes** any group-tier population ·**P3** arrangements adopted for a private benefit persist; those adopted for a collective one do not. **Behaviour: P4** where selection is present and absorbed content is *not* attributed, objection is disproportionately destructive and strong material is disclosed late ·**P5** where absorption is attributed *and recognised*, contribution to others' lines rises ·**P6** where selection is frequent, plurality of criteria decays ·**P7 assessment capacity, not contribution volume, becomes the binding constraint on any arrangement that succeeds. Distribution: P8** overhead falls disproportionately on participants with least time, visible in participation rates by career stage ·**P9** maintenance concentrates on a small number of parties whose number does not grow with adoption ·**P10** attribution mechanisms are resisted by parties benefiting from present invisibility, and **the resistance appears as objection to the mechanisms' *accuracy* in place of objection to their *purpose*.**

Refuting observations are given for eight (e.g. adoption concentrated among parties under strong output-rate selection without demonstrated private benefit refutes P1 *and the dominance argument with it*; contribution volume rather than assessment capacity binding refutes P7 *and the location of the commons dilemma*).

Four measurement difficulties, all against the account's interest: non-adoption is unobservable (P1/P3 testable only among adopters); attribution recognition happens in non-public appointment and funding decisions; destructive objection is surface-identical to rigorous objection; and **every prediction concerns an arrangement that does not exist.**

> **Claim 16.1 — the prediction the account is most exposed on: P2.** If a substantial **personal-tier population appears and no group-tier population follows**, the tier decomposition will have delivered private utility **without the attested records on which every evidential claim in the series depends**, and the arrangement will have become **a note-taking convention**. This outcome is consistent with everything the account asserts and **would defeat the purpose the series was written for.**

40.1.15 §17 Conclusion

Five results: location of the commons dilemma (four subtractable goods, not knowledge) · the positional bound and the claims it forbids ·open selection as a dissipating contest with the absorption test as the distinguishing criterion ·attributive absorption as the condition on staged selection ·private benefit as the condition on adoption.

Four difficulties recorded as unaddressed (no mechanism with an identified cost-bearer for whom bearing it is rational): **assessment congestion ·maintainer labour ·the regressive incidence of overhead ·the recognition of attributed contribution**.

Three arguments declined: that the incumbent's defects justify any alternative ·that adoption follows from collective benefit ·that the empirical record supports the proposal.

> The account is compatible with an outcome in which the arrangement is adopted by a small number of insulated parties, delivers private utility, never reaches the scale at which its evidential claims mean anything, and **is remembered as one more proposal of a kind that has been made since 1970. That outcome is stated here because the account predicts it, and because a paper that concealed it would exhibit the failure it spends its length diagnosing.**

40.1.16 Implications for this repository

- **Never argue for adoption on collective grounds** in README, site copy, or applications (Claim 12.4). Argue: *this particular party, at this scale, gets back more than it gives up.*
- **Delete/never write:** "makes scholarship less competitive", "democratises recognition", "dissolves hierarchy" (Claim 6.2). Permitted: "changes what competition rewards".
- **Cross-field matching / similar-trajectory search must not appear in any adoption argument** (Claim 13.5) — it is a late corpus property that returns nothing to an adopting party. *This is why the retired plan's Stage 5 was struck.*
- **P2 is the project's own risk register entry:** ship the personal tier, but treat "personal tier adopted, group tier never" as the named failure mode, not a success.
- The **absorption test** should be a stated evaluation criterion for the project itself — and must **never be implemented as a counter or score** (Claim 8.4).
- The **release → citable document with lineage appendix** (Req. 14.1) is the single most adoption-critical feature. It belongs in M1, not a later stage.
- Roadmap items that add contribution volume without adding assessment capacity make P7 worse.

Related: paper-I-design-and-requirements.md ·paper-III-grounds-of-restriction.md ·paper-IV-grrp-specification.md ·glossary.md

41 paper III grounds of restriction

Original source: `applicative_infrastructure/gr_academia_application/notes/paper-III-grounds-of-restriction.md`.

Original source SHA-256: `0fffff54a377419b4d39bbe73dc4b8fb88ca10c5686b67c29f042fe338bfc6c6`.

41.1 Notes — Paper III: *Grounds of Restriction and the Governance of Disclosure*

Author: Wanhong Huang ·working draft, 2026 ·CC BY-NC 4.0 ·38 pp, 15 sections Source: papers/GRA-paper-III-…pdf

Role in the series: the *disclosure governance* paper. An arrangement that records how understanding changes **must be able to withhold**. The question is never *whether* but **on what ground — and what follows from the ground**.

> Its single operative idea: **a ground determines an object and leaves a residue.** What a ground leaves *disclosable* is what distinguishes an arrangement that withholds **for a reason** from one that withholds **because it can**.

41.1.1 Why ownership cannot supply the answer

Three reasons, inherited from the companion papers: 1. Legal instruments protect **finished products** — copyright/fixed expression, patent/completed invention *with disclosure*, trade secret/concealed information. A party's position **within an ongoing generation** is protected by none (Boyle 2008; Scotchmer 1991; Lemley 2012). 2. Rights to exclude, multiplied across fine-grained contributions, produce the **anticommons** (Heller & Eisenberg 1998). 3. **The design's own criterion runs the other way** — an arrangement in which value converges on a party *outside* the relation that produced it is exactly what the series diagnoses; exclusive rights over trajectory content would install that.

So **withholding is justified by a reason, never by a title.** And the reason must do work.

41.1.2 §2 The instrument

- **Definition 2.1 — disclosure class.** A value attached to a record governing the set of parties to whom it may be disclosed. Classes are **ordered by inclusion**. Their identity and membership are settled by a community's **operating charter (L1)**, not by this account (Ostrom 1990, collective-choice arrangements).
- **Definition 2.2 — ground.** The declared reason a record is disclosed at less than the widest class available. **A ground is a property of a restriction, not of a record** — the same content may be restricted on different grounds in different arrangements, with different consequences.
- **Definition 2.3 — residue.** What remains disclosable at the widest class while a restriction on that ground is in force. **A ground with an empty residue licenses total silence.**

  Requirement 2.4 (What a ground must state). Four things: **(i) the condition** under which it obtains; **(ii) the object** it restricts; **(iii) the residue** it leaves disclosable; **(iv) the failure** produced by applying it where its condition does not obtain.

  (iv) is what makes the instrument useful. A ground stated without its failure mode **is a licence** — any party may assert the condition and no party can say what has gone wrong when the assertion is false.

  Requirement 2.5 (Closed set). The set of grounds is **closed**. A community **may not declare a new ground** in its charter; a restriction fitting none of the four is **inadmissible**. *Cost stated: a reasonable restriction fitting none of the four cannot be imposed — so the account may be wrong by omission. §14 invites exactly that observation.*

Requirement 2.6 (Disclosure of the residue) — the operative requirement of the paper. Where a restriction is imposed on a ground, **the corresponding residue is disclosed at the widest class available.** A restriction withholding material its ground does not cover is **inadmissible, whatever the ground's condition.** *Without it every ground collapses into the same thing — silence with a justification attached.*

Requirement 2.7 (Assessment). Three questions: **does the condition obtain? is the object restricted the object the ground identifies? has the residue been disclosed?** Failing any → the restriction is **misapplied**. Applied **by readers, not by the protocol** (the spec records the declared ground and enforces the class; it cannot assess whether the condition obtains). Applied **to a restriction, not to a party** — a party may restrict properly once and improperly the next time, and no inference runs from one to the other.

41.1.3 §3–6 The four grounds

41.1.4 The comparison table (Table 7.1)

Ground	Condition	Object restricted	Residue	Named failure on misapplication
Rivalry	a resource admits limited simultaneous use (instrument, facility, compute, clinical population, budget line)	**access to the resource**	**the trajectory in full** — questions, methods, decisions, failures, interpretations, results	a restriction on **access** is converted into a restriction on **knowledge**
Hazard	propagation of the content creates risk of serious harm — the risk arises from the content **being known**, not from use of a resource	**the propagable content of the method**: the sequence by which a capability is obtained, the constraints discovered, the parameters that matter, the practical technique	existence of the work, questions pursued, decisions and their reasons, interpretations, **results that do not convey the method**	the **widest restriction on the strongest justification**, and it is **unfalsifiable from outside the restricted class**
Exploratory vulnerability	exposure at this stage would suppress or distort the work (premature criticism, appropriation, the participant's reluctance to record what may be read)	**the timing of exposure**	**everything, at the scheduled time** — the ground justifies delay and **no permanent withholding**	postponement converted into permanent withholding (schedule extended, or never set)
Appropriability	the work is funded by an arrangement requiring **excludability**	the content whose disclosure **would destroy the excludability the funding depends on**	existence, questions, decisions and their reasons, **and negative results**	**rent-seeking secrecy** — general secrecy obtained on an economic justification that does not apply

41.1.5 §3 Rivalry — the conversion that is "routine"

Claim 3.1 (formal). Rivalry justifies selectivity **in access to the resource** and **no restriction on the record**. A record is non-rival, so the ground's condition does not obtain of it.

Labs with restricted instruments routinely restrict the surrounding record too — **and the practice has reasons: appropriability, hazard, or vulnerability. Those are different grounds with different residues, and they must be declared as themselves.**

> **Claim 3.3 — the paper's principal positive contribution on this ground.** Where an instrument is scarce, **the deciding process may be opened without opening the instrument.** Proposals, the reasoning behind them, the objections raised, the decision and its stated reason are all inside the residue, and disclosing them costs **nothing in the resource**. **What is opened is the direction of the work, not the capability to perform it.**

Two consequences: allocation decisions become inspectable; and **unsuccessful proposals become available — which is the condition under which the absorption test (Paper II §8) can be satisfied at all.** *An arrangement whose declined proposals are unrecorded cannot absorb from them.* **Claim 3.4 — three limits.** It does not reduce dissipation (it converts dissipated effort into a retained record, which is worth less than not dissipating it). It **exposes unsuccessful applicants** (a declined proposal is a record of a judgement that did not persuade). And it is costless in the *instrument* but **not costless** — it consumes **assessment capacity**, the binding constraint.

41.1.6 §4 Hazard — where the design's central tension lives

> **Claim 4.1 (formal).** Where the hazard lies in **propagation of a method**, restricting access to an **instrument accomplishes nothing** — the instrument is frequently replaceable and often widely held. Rivalry and hazard restrict **different objects** and are **not substitutes**.
>
> This **disposes of the design the source discussion for this series proposed at length**: *restrict the instrument, open the reasoning.* That is correct under rivalry and **exactly wrong under hazard, since the reasoning is where the hazard lives.** (Bostrom 2011: the hazard attaches to **knowing**, not to **holding**.)

Claim 4.2 — the residue is larger than practice usually allows. That a line of work exists, what question it pursues, what obstacles it met, what directions it abandoned and why, what its participants take their results to mean: **none of these conveys a capability.** Withholding them on the hazard ground is **misapplication**. Practical arrangement for restricted work: **the trajectory is visible in its structure and its reasoning; the propagable method is held at a narrow class.**

Claim 4.3 — conditional access. Following structured access (Shevlane 2022): a party **uses a capability without receiving the artefact that confers it**, under conditions enforced by the supplying party. Here: a party is **admitted to the restricted class under a charter's assurance requirements, with the admission and its ground recorded.** This **converts a binary question (disclose or not) into a question of whom to admit and under what commitments** — and the conversion is what makes work under this ground possible at all.

Four limits. Hazard assessment **is not a competence a protocol has, and frequently not one the participants have either** (hence institutional review). **Misapplication is undetectable from outside** — a party outside the class cannot assess whether the restricted content is in fact propagable, so the §2 standard is available only to parties inside the class or to a body a charter empowers. The hazard is bounded by the **articulable fraction** — which bounds the benefit identically. And: > **Claim 4.4 — hazard has no natural terminus.** Rivalry ends when the instrument is free. > Appropriability ends when the funding purpose is served. Vulnerability ends when the work matures. > **Hazard does not end.** So **scheduled release is unavailable**, and the class must be maintained > indefinitely by **parties who must continue to exist**. Where the community ceases, the material is > held by nobody under any charter — **and the account offers no treatment of that case.**

41.1.7 §5 Exploratory vulnerability — the timing ground

> **Claim 5.1 (Monotonicity).** Disclosure **may widen and cannot narrow** — a party who has read a record retains what they read. An arrangement offering the ap-

pearance of withdrawal **misdescribes to its own participants a state of affairs obtaining outside it.**

Two consequences: **the default must be restrictive** (an error toward openness is uncorrectable, and defaults are where such errors occur); and **a schedule may be shortened and must not be extended** — *this asymmetry is the substance of the ground.*

Claim 5.2 — the observer effect (conjecture). Recording alters what is recorded. **The material this series most wants preserved — half-formed ideas, real disagreement, the remark someone makes before they are sure of it — is the material least likely to be produced under observation.** The degradation falls precisely on the content the arrangement most values. Mitigations, all partial and stated as such: narrowest default class, scheduled rather than immediate release, participant-marked exclusions. *None removes the effect; an arrangement claiming otherwise claims people behave identically observed and unobserved.* **Structural mitigation = the unit of record.** What is preserved is *that an objection altered an assumption* — **not that a particular party expressed it clumsily at a particular moment.**

Claim 5.3 — the two populations. A **well-positioned** party is exposed to criticism but not to appropriation (standing protects the association of an idea with its author); delay serves them **weakly**. A party **without position** is exposed to both, and **appropriation is the exposure that matters**; delay serves them **strongly**, as does sealed registration. **So a charter setting short delays uniformly imposes the exposure on the population least able to bear it.**

Three limits. Delay costs the work **the objections it would have received** — protected from appropriation *and* from improvement, and the arrangement cannot supply the second without the first. No objective terminus (a party may in good faith judge indefinitely that the work has not matured). And it is **the easiest of the four to assert** — its condition concerns the state of a piece of work, which only its participants can assess, so misapplication is detectable **only from a pattern of schedules over time.**

41.1.8 §6 Appropriability — legitimate, and most often declared as something else

Claim 6.1. The condition is **legitimate and not a regrettable concession**. Some work is not performed unless somebody pays, and some funding requires excludability. Where that obtains, **insisting on disclosure does not produce a disclosed trajectory; it produces no trajectory, because the work does not occur.** (Arrow 1962 supplies the general form.)

Claim 6.2. The residues of hazard and appropriability **coincide in shape and differ in content** — hazard asks *what does not convey a capability*; appropriability asks *what does not destroy excludability*. **A negative result may be commercially harmless and hazardous; a question may be commercially revealing and entirely safe.** Declaring one ground while applying the other's residue is misapplication. **Two residue items practice withholds routinely and shouldn't:** *the existence of the work* (rarely what destroys excludability, and its disclosure is what lets others avoid duplicating effort) and **negative results** (rarely what a competitor would have paid for — *and their disclosure is the principal contribution the series claims for the reuse of abandoned material; this is the residue item the series presses hardest*).

Claim 6.3. A party **holding a patent has exchanged disclosure for exclusion and may not invoke appropriability over the disclosed matter.** Trade secret is the corresponding instrument. Copyright is irrelevant (protects expression, not the excludable content). *The account adds nothing to what the law permits and constrains what a party may declare within a conforming arrangement.*

Claim 6.4 — the strongest argument in the paper for the residue requirement. Appropriability is **unverifiable from outside**, so misapplication is detectable **only through the residue**. **A party declaring appropriability and disclosing the residue has made a claim that costs them something; a party declaring it and withholding the residue has made a claim that costs nothing — and the second is the observable signature of misapplication.** *Where residues are disclosed, a false declaration is expensive; where they are not, it is free.*

Three limits: the terminus exists in principle and **rarely in practice** (nothing obliges release once the funding purpose is served); the ground is **available only to parties with funding arrangements**, so it is asymmetric **in favour of the well-resourced — a direction the series generally resists and cannot resist here**; and assessment reduces to one question a reader can answer — *was the residue disclosed?*

41.1.9 §7 Irreducibility, composition, and how restrictions end

> **Claim 7.1 (Irreducibility).** No ground reduces to another. **Rivalry restricts a resource; the others restrict content. Hazard restricts what a *reader* could do; appropriability restricts what a *competitor* could sell — and the two select different content from the same trajectory. Vulnerability restricts a *time*; the others restrict a *set of parties*.**

Consequences: a restriction **must declare which ground it invokes** (object and residue follow from the ground, not from the content); and **an arrangement using one ground for everything has either misapplied it or is operating under a condition that does not obtain** — most commonly, declaring *commercial sensitivity* over material that is actually restricted because it is dangerous, or early, or because the instrument is booked.

> **Requirement 7.2 (Composition).** Where several grounds obtain, **each is declared separately, and the residue disclosed is the *intersection* of the residues of the grounds declared.** A party may not declare one ground and withhold on the strength of another. **Claim 7.3 — declaring more grounds is not free:** it narrows the residue **and raises the number of conditions the party asserts**, each of which can be assessed and found false.

(Example of genuine composition: pharmaceutical development — funded by excludability, produces material whose propagation carries risk, and involves early work exposure would distort.)

> **Claim 7.4 — how each ground ends. Vulnerability** ends on a *recorded schedule* (shortenable). **Rivalry** ends when the resource is no longer contended — observable, unenforced. **Appropriability** ends when the funding purpose is served — *known to the declaring party alone*. **Hazard does not end.** Therefore **an arrangement resting mostly on the other three accumulates restricted material indefinitely**, and **a community that wishes its record to open over time must prefer the ground that ends.**

Claim 7.5 — what the apparatus achieves (stated modestly): a restriction becomes a **dated, attributable assertion** where present practice makes it a default that asserts nothing; misapplication becomes **describable** (each ground has a named failure, giving a reader a vocabulary); and the **residue becomes the object of attention** — the informative question is not *was something withheld* but **does what was disclosed match the ground declared**. **No enforcement is supplied.**

41.1.10 §8 Simulation displaces the governance problem — it does not remove it

Claim 8.1. Where a simulated environment is faithful enough for exploration, the **rivalry ground contracts to the validation stage**, and earlier stages open to any party with computation. *(Genuine, with instances: community simulation → shared fabrication in hardware design; open computational exploration → experimental validation.)*

> **Claim 8.2 — the displacement. A simulated environment is a selection environment.** What it admits, rewards, renders visible, and cannot represent determines which explorations succeed — so **the party who specifies the model and the benchmark occupies the position the party allocating the instrument**

previously occupied. The displacement is unfavourable in one respect: allocation is **visible, episodic and contestable** (a decision is made, a party is refused, the refusal can be challenged); **benchmark specification is continuous, technical and rarely contested, and its effects appear as properties of the field rather than as decisions anyone took.**

Claim 8.3. Opening the benchmark is insufficient — **an open benchmark is a public attractor.** Parties optimise for what it measures and the categories it recognises become the categories the field maintains; inspectability of its assumptions does not prevent this. **Openness of a selection environment makes its criteria visible and does not prevent them from governing.** *(Therefore a simulated exploration stage is subject to Paper II's sparsity/plurality analysis — and a single widely adopted benchmark applied continuously is both the worst case for reactivity and the arrangement a field finds most convenient.)*

Claim 8.4 — validation dependence. A simulation's fidelity is established against the physical apparatus, so **the open layer inherits a dependence on the closed one**; the parties who validate hold a position over what the open layer may take as fidelity, **and the validation itself consumes the scarce resource the proposal claimed to economise on.**

Claim 8.5 — effect on hazard runs both ways. Simulation **lowers** hazard where the hazard lies in **execution** (exploration produces no dangerous artefact; the dangerous stage is confined and supervised). It **raises** hazard where the hazard lies in **design** — an environment letting many parties explore a design space cheaply lowers the cost of arriving at a dangerous design (*the biological case is the one usually named*). **A proposal to displace exploration into simulation must state which kind of hazard the domain carries.**

Claim 8.6 — the qualification, and it is real. Displacement **widens participation** in exploration from parties with instrument access to parties with computation — a far larger and differently distributed population. **This is the strongest reason to pursue the proposal, and the displacement does not defeat it.**

41.1.11 §9 The shared component — *the result that governs every restriction*

Definition 9.1 (The omitted component). What a finished artefact does not contain: the approaches attempted and abandoned, the reasons for abandoning them, the constraints discovered, the parameters that mattered, **the practical technique by which a result was obtained.**

Proposition 9.2. The omitted component carries **three properties at once**: **value in reuse** (what transfers is the record of what was tried and what obstruction was met) ·**evidential force** (a record of a completed result is cheap to fabricate; a record of the path is costly in proportion to the parties who attested it) ·**hazard** (a propagable method is a sequence of steps and constraints, not a statement of a result).

Claim 9.3. No design achieves the epistemic benefit of an open trajectory while withholding the parts that carry risk, since the parts are the same parts. A proposal to publish the trajectory minus its dangerous content is a proposal to publish the record minus what makes it worth publishing.

This is why the account is a typology of grounds rather than a filtering rule: the design cannot separate the valuable from the dangerous within the component, so it separates the *parties to whom the component is disclosed*.

Per ground: under **hazard**, the residue lies *outside* the component, so a hazard restriction **genuinely costs the commons something**. Under **appropriability**, same shape, different boundary — **negative results usually fall outside the excludable content while remaining inside the omitted component**, which is why the series presses them hardest. Under **vulnerability**, the component is disclosed **later rather than never** — *which is why that ground costs the commons least*.

Claim 9.4 — bounded together as well as carried together. All three scale with the **articulable fraction** (Collins 1974/2010; MacKenzie & Spinardi 1995). **A domain in which little of what matters can be written produces records of little use, little evidential**

weight and little danger; a domain in which much can be written produces records of much use, much weight and much danger. No design alters the ratio. *Practical use for a charter: where participants find little can be recorded, the arrangement will deliver little and its restrictions may be correspondingly relaxed.*

> **Claim 9.5.** Conditional access preserves the component **for a class**; delay **postpones** it; and **the residues, being outside the component, are disclosable without touching the trade-off at all.** *This is why the residue requirement is the paper's operative rule:* ***it is the only part of the design that gains something without giving something up.*** *An account attending only to the component would find no room to move; the residue is where the room is.*

41.1.12 §10 Downstream use — the structural gap

Claim 10.1. A record of how understanding changed, at scale, is an object of interest to parties who did not produce it: **training material** (a corpus of recorded reasoning with typed transitions and attached outcomes is precisely what a system learning to model reasoning would want) ·research material for the study of science ·evaluation material for institutions · commercial material for services. **The interest is proportional to the qualities the series claims — so the design's success creates the interest.**

> **Claim 10.2. The four grounds govern *to whom* a record is disclosed and do not govern *what a party may do* with a record disclosed to them.** The account is therefore **incomplete with respect to downstream use, and the incompleteness is structural rather than an oversight.**

Claim 10.3. The labour of producing the record is borne by participants; the value of a corpus assembled from many such records accrues to whoever assembles it. Where the assembler is well-resourced and the producers are the population the series concerns, **value transfers from those with least to those with most — which the design's own folding criterion marks as extractive, and which the design supplies no mechanism to prevent.**

> **Requirement 10.4 (Terms of downstream use).** A charter **must state the terms** on which records disclosed under it may be reused by parties other than their producers, and **must state separately whether consent to disclosure constitutes consent to inclusion in a corpus assembled for purposes unrelated to the work. A record must carry the identifier of the charter under which it was disclosed**, so a party obtaining it can determine the terms.

Three matters a charter must decide (the account decides none of them): whether reuse *for study of the work's own subject matter* differs from reuse *for training a system*; whether participants may withhold consent to corpus inclusion while consenting to open disclosure — **and what a record looks like where some have and some have not**; and whether a licence attaches, given that **licences designed for finished works apply awkwardly to a graph of attributed transitions**.

Claim 10.5 — three limits, the first defeating most of the attempt. Terms attached to a disclosed record are hard to enforce, and **the producing parties are least placed to bring the action**. Consent to corpus inclusion is **not meaningfully separable in practice** — a term forbidding one use of openly available material is a term whose breach is undetectable. And **restricting disclosure to prevent assembly is not available**: it is a restriction on a ground the account does not admit, and it would **impose the cost on the commons in order to withhold a benefit from a third party. Unaddressed.**

41.1.13 §11 Who may restrict — the authority is itself a position

Claim 11.1. The authority to restrict **is a position** in the series' sense: constituted by acts the arrangement requires, its holder determines what other participants may see, and others' capacity to act depends on its exercise. *An arrangement designed to resist concentration cannot exempt the one authority that determines what participants know.*

> **Requirement 11.2 (Recorded exercise).** Every **imposition, alteration and release** of a restriction is recorded as an **operation** carrying: the performing party, the **ground declared**, the **class imposed**, the **schedule** where one applies, and the **time**. *Cheap, and the whole of what the design can do here. It does not prevent improper restriction; it makes a party's pattern inspectable — the only basis on which misapplication can be detected at all.*
>
> **Requirement 11.3 (Separation of restricting from recording authority).** The party who **registers transitions** and the party who **determines disclosure classes** should be distinguishable in the record; a charter concentrating both must **state that it does so**. *A party holding both holds the record and its visibility together — and the record then evidences nothing about the party who produced it.*
>
> **Claim 11.4 — the series' general answer is weakest where the stakes are highest.** Portability bounds this authority **weakly**, because **a departing party can take the record they can see and cannot take what they were never shown.** The bound here is **charter and community, not exit.**
>
> **Requirement 11.5 (Charter statement of restricting authority).** A charter must state **which parties may restrict, on which grounds, at which classes, and whether any party may restrict without a schedule. A charter that leaves the authority unstated has left it with whoever operates the implementation.** *Authority not allocated is not absent; it is held by the operator — the party the series has least reason to trust.*

Claim 11.6 — applied to the author. An arrangement in which the proposing party maintained the charter, operated the implementation, **and** held the restricting authority **would be an instance of the concentration the series diagnoses**. Declaring that conflict is *a condition of the account's coherence, not a courtesy.*

41.1.14 §12 Detecting misapplication

> **Claim 12.1. Detectability of misapplication is inversely related to the width of the restriction the ground supports.** Ordering, most to least detectable: **Rivalry** (residue = trajectory in full, so any withholding is visible on its face) → **Vulnerability** (visible over time: extended schedules, or restrictions with no schedule) → **Appropriability** (detectable only through the residue) → **Hazard** (least detectable — the condition cannot be assessed without the content, and the content is what is withheld).
>
> **So hazard restrictions cannot be policed by readers.** A community relying on them must place the assessment with a **body it constitutes for the purpose — and must accept that the body then holds a position of the kind §11 treats.**
>
> **Claim 12.2 — the residue is the universally available observable.** For every ground, the question a reader can answer is **whether the residue was disclosed**. This **turns an unfalsifiable condition into a checkable one**: a party declaring hazard *and* disclosing existence, questions, decisions and interpretations **has behaved as a party with a genuine hazard would**; a party declaring hazard and disclosing nothing **has behaved as a party would who wanted silence and reached for the strongest available reason.**

Claim 12.3. Individual restrictions are frequently ambiguous; patterns are not. A party whose restrictions are *always* on the same ground, *always* without a schedule, *always* at the narrowest class, *always* without a residue, has a practice visible in the record even where no single restriction can be faulted. **This is the design's principal contribution to disclosure governance — and it is a contribution to visibility, not to control.**

Claim 12.4 — three limits. Detection is not remedy (the account supplies no procedure by which a restriction is overturned). **Detection depends on someone looking** — and *the parties best placed to look are frequently those with the least reason to.* And **a community that does not care will not be made to care by a record**: every mechanism here produces information for parties who wish to use it, and **none produces the wish.**

41.1.15 §13 Jurisdictional variation

Claim 13.1. Law is described and never encoded. A specification encoding any jurisdiction's rules would be **wrong somewhere immediately and obsolete everywhere within a few years. Claim 13.2. Law reaches the design negatively, through structural incapacity — and that is the only channel.** A data model incapable of expressing redaction forecloses lawful operation in every regime with a right of erasure, and no charter repairs it (Reidenberg 1998; Lessig 2006).

Four capacities that follow (design properties, not legal conclusions): 1. **Separability** — personal content separable from the attested skeleton, so removal leaves the structure and its verification intact (Finck 2018; GDPR). 2. **Expressibility of redaction** — record *that* content was removed, when, by whom, on what ground, **without removing the record of the removal**. 3. **Consent as a recorded object** — a record concerning a person can reference a consent whose scope and date are recorded. 4. **Locality of storage** — record where material is held and restrict where it may be replicated.

Claim 13.3. These are **capacities, not rules.** An arrangement possessing them may still operate unlawfully; one lacking them **cannot** operate lawfully where they are required. *The design's obligation is to possess the capacities; lawfulness lies with implementers and their advisers.*

> **Requirement 13.4 (Charter statement of legal operation).** A charter must state: the **jurisdictions**, the **consent** required before a record concerning a person is created, the **retention** applying to each class, the treatment of **erasure requests**, and any restriction on **where material may be held**. Unstated → left to the operator. An arrangement spanning regimes holds several charters or one with regime-specific provisions, and **a record must identify which charter and version governed it when it was created.**

Four limits (Claim 13.5). Federation **distributes** the compliance burden and does not remove it — *an implementation receiving records from another inherits obligations it did not create.* **Conflicting obligations are not resolved** (retention vs erasure of the same material is a real conflict; the implementation resolves it in a way it records, with no support from the spec). **Records already propagated are not reached** — a redaction notice reaches implementations that receive it and no copy held by a departed party. And **an arrangement cannot make its participants' own obligations disappear.**

41.1.16 §14 Predictions and falsification

P1 hazard restrictions withhold more than the ground covers, more often than the other three (← Claim 12.1) ·**P2** where residues are required *and inspected*, appropriability declarations **fall** (← 6.4) ·**P3** arrangements **accumulate restricted material over time** (← 7.4) ·**P4** communities will **declare vulnerability where appropriability obtains** — it is the easiest ground to assert and carries no admission of commercial interest (← §5 limits) ·**P5** displacement into simulation is followed by **contestation over benchmarks**, concerning technical specification in place of allocation (← 8.2) ·**P6** third-party corpus assembly occurs wherever a substantial corpus exists, **without compensation** (← 10.1, 10.3) ·**P7** where restrictions are

recorded and **nobody inspects them**, restriction practice will **not differ** from arrangements that record nothing (← 12.4).

Refuting observations given for all seven (e.g. *appropriability declarations unchanged in frequency where residues are required and inspected refutes P2 — and with it the argument that the residue requirement does any work*).

> **Claim 14.1 — what would show the set incomplete.** A restriction that **a competent and disinterested reader judges reasonable and that fits none of the four**. *The account invites the observation, since a typology whose exhaustiveness cannot be challenged is not a typology but a stipulation.*
>
> **Two candidates examined:** - *Protecting a third-party research subject* (medical/social research) — treated here as **hazard with an identified party** rather than a general one. A reader who finds that reading forced has a candidate. - *Honouring a confidentiality undertaking given to a supplying party* — fits appropriability **only with strain**, since the excludability may protect the **supplier**, not the receiver. The account's provisional answer (the receiving party declares appropriability on behalf of the supplier's condition) is **strained, and this is the stronger candidate.**

Three measurement difficulties: restrictions in non-recording arrangements are unobservable; **whether a residue was *disclosed* is observable, whether it was *complete* is not**; and misapplication concerns a relation between a declaration and a condition only the declaring party can assess, so it is testable **in aggregate patterns, not individual cases**.

41.1.17 §15 Conclusion

Six results: restriction justified by **reason, not title** ·**four irreducible grounds**, each determining an object and a residue ·**the residue requirement** as the barrier against a ground operating as a licence *and* the only universally available observable ·simulation **relocates** governance from allocation to specification, unfavourably ·**the shared component** of value, evidence and hazard ·**downstream use is governed by none of the four grounds.**

Five unsettled: closure of the set (confidentiality undertakings) ·assessment of hazard · absence of a terminus on three of four grounds ·the weak bound on the restricting authority · enforcement of downstream terms.

Three claims declined: that the four grounds are the *correct* set ·that the apparatus *prevents* improper restriction ·**that openness is preferable to restriction** — each ground states a condition under which restriction is legitimate, and appropriability is treated as *a condition of some work existing at all* rather than as a concession.

> The contribution is **a discipline rather than a mechanism**. A reason, once declared, determines an object and leaves a residue, so a restriction becomes a dated attributable assertion whose adequacy a reader checks by asking **one question: was what the ground leaves disclosable in fact disclosed?**
>
> The account **stops at visibility, states that visibility without inspection changes nothing**, and leaves the inspecting to communities that may or may not perform it.
>
> **What the paper is most confident of is negative.** No design separates the valuable from the dangerous within a trajectory, since they are the same material. No ground supports a restriction wider than its object. **And no arrangement that withholds its residues is withholding for the reason it declares.**

41.1.18 Implications for this repository

- Disclosure in the tool is **never a bare `--private` flag**: every restriction carries **a ground**, and grounds are a **closed set of four** (`rivalry | hazard | vulnerability | appropriability`) — which is exactly what `grrp disclose --class <c> --ground <g>` implements (Paper IV / M3).

- **Monotone disclosure (R11)** is a hard rule: **no `unpublish` operation exists**, and a schedule may be **shortened, never extended**. Enforce the direction, not just the field.
- **Vulnerability is the only ground with a recorded terminus** → `--release-at` applies to it naturally, is unavailable for hazard, and is unenforced for the other two. A UI that offers a schedule uniformly across grounds misrepresents the model.
- **Residue disclosure is the operative rule and should be surfaced by the tool**: when a ground is declared, prompt for / display *what the ground leaves disclosable* — this is the single highest-value affordance the account identifies, and it is the only thing that costs nothing.
- **Redaction must keep the record of the redaction** (Req. 11.2, §13 capacity 2) — matches the GRRP acceptance test "after `grrp redact`, the chain still verifies, the graph is unchanged, and the record of the redaction is present."
- **Records must carry the identifier of the governing charter and version** (Req. 10.4, 13.4) — the `charter.yaml` reference in `.grrp/` is doing this job; it must be **per-record-resolvable**, not just a repo-level file.
- **Downstream/corpus terms are a charter obligation and a known unaddressed gap.** If GRA ever publishes an aggregated corpus, Claim 10.3 says the design's own criterion marks uncompensated assembly as **extractive** — including if *we* do it.
- **Do not build "restrict the instrument, open the reasoning" as a general policy** — Claim 4.1 says it is exactly wrong under hazard.

Related: paper-I-design-and-requirements.md ·paper-II-incentives-and-adoption.md · paper-IV-grrp-specification.md ·glossary.md

42 paper IV grrp specification

Original source: `applicative_infrastructure/gr_academia_application/notes/paper-IV-grrp-specification.md`.

Original source SHA-256: `5dc611f310210c12346199690d8279620d0e5f6eadbfbf8d941fab1f0b1f647f`.

42.1 Notes — Paper IV: *Specifying the Generative Relational Research Protocol*

Subtitle: Architecture, Conformance, and Deployment over Existing Repositories **Author:** Wanhong Huang ·working draft, 2026 ·CC BY-NC 4.0 ·63 pp, 24 sections Source: papers/GRA-paper-IV-…pdf

Role in the series: the **normative specification**. Discharges Paper I's sixteen requirements and fixes conformance. **Published as GRRP v0.1** — explicitly unfinished, with an amendment procedure, *because a specification published as finished would contradict the account it specifies.*

> This is the paper the implementation is built against. plans/implementation-plan.md is its builder-facing restatement — **the specification governs where the two differ.**

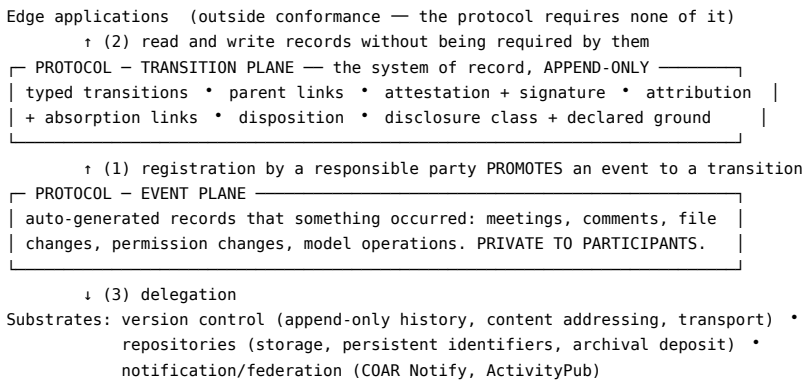
Conformance vocabulary: RFC 2119 `must / must not / should / may`. A `should` may be departed from where the implementer **states a reason**.

42.1.1 The four standing exclusions (§1)

Stated up front so absences are not read as omissions: 1. **No quantity over participants or trajectories, and no total order over either.** An implementation may compute one — outside conformance, on its own account. 2. **No analytical capability required.** Every conformant operation is performable **with a text editor and a version-control system**. Model-assisted capture is a convenience whose absence changes nothing about conformance. 3. **No merge operation.** 4. **No rules of conduct, membership criteria, retention periods or consent requirements.** These belong to a community's **operating charter**, which the protocol references and does not interpret.

> **Requirement 2.6 (Capacity and content).** The protocol fixes **the capacity and never the content.** A field whose values an implementation *enforces without interpreting* belongs to the protocol; the meaning assigned to those values belongs to the charter.

42.1.2 §3 Architecture: three planes over delegated substrates



> **Requirement 3.1 (Privacy of the event plane).** Event-plane records are disclosed **to participants of the trajectory by default and to no other party**. An event reaches wider disclosure **only through a transition that references it**, and an implementation **must not export, index or publish the event plane as such.** *(This is the plane where the surveillance hazard falls — a complete log of who attended, who commented and whose files changed is a monitoring record by construction.)*

Claim 3.2. The protocol contributes **the transition plane and the rules governing promotion into it — and nothing else.** Reimplementing storage/identifiers/history/transport would inherit their maintenance and compete with their installed base.

> **Requirement 3.3 (Substrate independence).** The specification **names capabilities, never products.** No conformance condition is expressed in terms of a particular VCS, repository service, identifier scheme or federation protocol; an implementation **must state which system supplies each**. *Cost, stated plainly:* no prescribed file layout or wire format — **interoperability rests on the record model and the bindings**, not on byte-level agreement (see the exchange minimum, §16).

> **Requirement 3.4 (Resolution and content addressing) — two properties commonly assumed and commonly absent, both load-bearing:** 1. **Every reference to a state or artefact must use an identifier that resolves independently of the implementation that created it.** *An identifier resolving through the original operator's service stops resolving when participants leave — and portability becomes nominal.* 2. **Every transition must carry an identifier derived from its content and from its parents' identifiers**, so altering an early transition invalidates everything after it.

42.1.3 §4 The event / transition / artefact model

Definition 4.1. An **event** records that something occurred and asserts nothing about an understanding. A **transition** records that an identified state became another, through a typed act performed by a party and registered by a party. An **artefact reference** records that a produced object exists, with a resolving identifier. *The division carries the economics of capture:* events are generated by systems participants already use, so **near-zero cost, possibly large volume**; transitions require a human judgement **and a registering party**, so **non-zero cost, small volume**; artefact references fall out of deposit.

> **Requirement 4.2 (Recording as byproduct).** Every act must be one a participant performs **for a reason of their own**. An implementation **must not require any act whose only purpose is that a record should exist**, and must not make conformance depend on such an act. *The requirement that determined the whole design.*

> **Requirement 4.3 (Promotion).** A transition enters the log **only by the act of a party who accepts responsibility for it.** An implementation may propose candidates by any means — **including analysis of the event plane by a model** — and a proposal becomes a transition only when a responsible party registers it. The record **must show which party registered**, and **must record that a proposal originated from an automated analysis where it did.**

Three consequences spelled out for implementers: - **Cheap confirmation is permitted; reflexive confirmation is not.** One affirmative action is fine; **a default that registers unattended proposals violates the requirement**, because the record's credibility rests on registration meaning something. - **Volume on the event plane is harmless.** A two-hour meeting altering no state produces events and no transitions — *nobody decides what deserved keeping, because the recording unit decides it.* - **A model may occasion a transition and may not author or register one.** The origin is marked, which lets a later reader weigh it and keeps the arrangement compatible with authorship rules excluding non-human authors.

Requirement 4.4 (Append-only log and derived state). The transition plane is append-only; a recorded transition **must not be altered or removed** — a correction is a further transition referencing the one corrected. **The current state must be derived from the log on demand and must not be stored as an authoritative object alongside it.** *The second sentence is the one most often violated, because a stored current state is convenient and fast. Where a stored snapshot is authoritative, the log becomes a secondary artefact that may drift from it or be edited to match it — and* ***every claim the protocol makes about credibility fails at once****. Caches are permitted if reconstructible from the log and marked as derived.*

Requirement 4.5 (Granularity). A transition **must** reference a **specific identified prior state**. A record attached to a project, repository, document **or person** as a whole **is not a transition, and an implementation must not admit one.**

Requirement 4.6 (Separation of administrative operations). Operations on the record itself (class changed, permission altered, attribution recorded, fork declared) **must be recorded, must carry the performing party, and must be distinguished from transitions by a mandatory `kind` field.** *Two reasons:* administrative activity would otherwise **inflate the apparent generativity** of a trajectory (the protocol computes no quantity, but **readers will nonetheless count**); and the admissibility condition on positions requires the acts constituting a position to be recorded — *a disclosure holder who could alter a class without leaving a record would occupy a position no participant could inspect.*

42.1.4 §5 States and identifiers

Definition 5.1. A **state** is an identified condition of a shared understanding — its recorded content plus the identifier under which that content is addressed. **Created by a transition and never modified**; a change is a further state produced by a further transition. > The **content of a state is deliberately unspecified** — paragraph, formal statement, diagram, claim > with qualifications, or a pointer to a section held elsewhere. **A specification prescribing the form > of a scholarly claim would be prescribing research practice.**

Requirement 5.2 (State identifiers). Unique within the trajectory ·resolves to content for a party permitted to read it ·**continues to resolve when the record is held by another implementation**. **An implementation must not use an identifier whose resolution depends on a service it alone operates.** Two satisfying constructions, named without preference: **content-derived** identifiers, and **repository-issued persistent identifiers**. Where both are used, **record the correspondence**.

Requirement 5.3 (Derivation of views). Any view — **including the current state** — must be computable **from the log alone**. Caches permitted if reconstructible. *Consequence: a view whose computation depends on information held only by the implementation (e.g. a proprietary ordering)* ***cannot be presented as part of the record*** *— it is an application output.*

Requirement 5.4 (Trajectory boundary). A trajectory carries an identifier, **a statement of the question or undertaking it concerns**, and the identifiers of parent trajectories where created by divergence. **A state may belong to more than one trajectory** — the protocol records the sharing and asserts nothing about which trajectory it principally belongs to (same reason it designates no principal branch).

Requirement 5.5 (External references). Persistent identifier where one exists, **with the scheme recorded**; otherwise enough descriptive information to identify the work, **plus the date the reference was made**. *The date addresses a failure that accumulates silently: a reference to a changed or vanished resource is uninterpretable without knowing when it was made — and a trajectory whose value appears years later will contain many.*

42.1.5 §6 The act vocabulary and the factorisation — *the part with no counterpart in any standard*

Requirement 6.1 (Factorisation). A transition is typed along **five independent dimensions**, each with a **small closed vocabulary**: **act ·target ·relation ·trig-**

ger ·disposition. **An implementation must not define a single enumerated type combining these dimensions.** *Ground: agreement between parties classifying the same occurrence declines as categories rise, and a vocabulary requiring deliberation re-introduces capture cost.*

Implementer's test when tempted to add a value: *a distinction that two competent participants would classify differently more than occasionally belongs in a community's charter, not in the protocol.*

42.1.6 Definition 6.2 — the eight acts

Act	What it does
question	opens a line of inquiry, or introduces a new question within one
claim	states a position as the content of a state
challenge	raises an objection against an identified state
transformation	alters a state in response to something, producing its successor
decision	records that a direction was **taken or abandoned, with the reason**
connection	relates a state to another state or to an external work
verification	reports the outcome of a check performed on a state
release	declares a state published at a class, **with the objections standing against it**

Three carry more weight than their brevity suggests: - **decision** is what makes an abandoned line **interpretable later**. *A path recorded as abandoned without a reason cannot be revisited by anyone* — and reuse of abandoned work is one of the two concrete benefits claimed for the design. - **release is a declaration and never a judgement.** It asserts a state is published and records which objections stand unresolved at that moment. **An implementation must not present a release as a certification of quality.** - **challenge** produces a transition when registered, **and does not thereby alter the state it challenges**. Where accepted, a *subsequent transformation* produces the successor, and the two are linked by parent references.

Contribution is not an act — it types a party's *part in* an act, and binds to CRediT (§7).

42.1.7 The other four dimensions

- **target** — question ·assumption ·hypothesis ·concept ·theory ·method ·path ·artefact. *Community-extensible.*
- **relation** — extension ·modification ·replacement ·refinement ·generalisation ·specialisation ·transfer. **Bound to a citation-typing vocabulary (CiTO); not defined here.**
- **trigger** — reflection ·literature ·experiment ·simulation ·observation ·discussion ·objection ·prior failure ·**automated suggestion** ·**entry of a new party**. *Where the trigger refers to something recorded, the reference is included.* **Community-extensible.**
- **disposition** — **exactly three values:** `accepted`, `contested`, `unresolved`. **> Requirement 6.3.** The disposition vocabulary is **fixed by the protocol and must not be extended > or reduced.** `unresolved` is required: most objections in theoretical work are never resolved — > they stand, and the work proceeds beside them. **A record admitting only acceptance and rejection > would be systematically false about the fields this protocol most concerns, and would exert > pressure toward fabricated closure.**

Requirement 6.4 (Extension per dimension). Communities may extend **target** and **trigger** by declaring values in a charter (identified in the record). **The act and disposition vocabularies must not be extended.** An implementation meeting an unrecognised target/trigger **must retain the record and must not reject it.** *Asymmetry is deliberate: targets and triggers are domain-specific (a mathematics community wants obstruction types; a laboratory wants deviation types).* ***Acts and dispositions are what interoperability rests on.***

Requirement 6.5 (Availability of the open register) — the entry path. An implementation **must make available, at each disclosure class, the set of states within that class whose disposition is `unresolved`**, and **must permit a party holding no prior position** to reference such a state in a **challenge, connection or verification**. *The protocol supplies the addressable problem and the admissible act — and **no obligation to accept anything**. Acceptance is decided by the parties holding the state, on the content of the act.*

42.1.8 The transition record (Figure 6.1)

```
id                content-derived, over payload + parents
kind              transition | administrative operation      ← mandatory
parents           identifiers of prior transitions (≥1; none only for the opening transition)
prior_state       identifier of the state altered
posterior_state   identifier of the state produced
── the factored type ──────────────────────────────────
act               one of eight                          (fixed)
target            what the act operated on              (charter-extensible)
relation          posterior to prior                    (bound vocabulary)
trigger           occasion, + event/artefact ref        (charter-extensible)
disposition       accepted | contested | unresolved     (fixed)
──────────────────────────────────────────────────────
performer         party identifier, with contributor role
registrar         party identifier + signature — DISTINCT (Req. 4.3 / 8.1)
absorption        links to states elsewhere, with attribution (no veto)
disclosure        class, declared ground, release schedule
artefacts         references to produced objects
```

An **administrative operation** uses **the same envelope** with `act`, `target`, `relation`, `dispositio n` **absent** and an `operation` field in their place.

42.1.9 §7 Bindings — four, and the protocol's own vocabulary is what remains

Requirement 7.1. Where a deployed standard defines a needed vocabulary, **bind by identifier and do not restate its terms.** New terminology is defined **only** for the act vocabulary, the disposition vocabulary, and the record structure. *Three reasons, the third decisive:* restating acquires an obligation to track revisions; conformance becomes cheaper for existing users; and **a specification that reinvents a deployed vocabulary is dismissed by the community that maintains it — the ordinary fate of standards written in isolation.*

Capability	Bound to
relations between states	**citation-typing vocabulary (CiTO)** — applied to relations between *states* rather than works
contributor roles	**contributor taxonomy (CRediT)** — *also serves the compatibility requirement*
agents, activities, derivation	**provenance model (PROV)** — export makes records readable by tooling that knows nothing of GRRP
anchored commentary	**annotation model (W3C Web Annotation)** — selectors carry the anchor; **the GRRP act type is carried in the annotation's `motivation`**

Claim 7.2. Under these bindings **the protocol's own terminology reduces to: the eight acts, the three dispositions, the record structure, and the disclosure + attestation fields.**

Requirement 7.3 (Recording of bindings). A record must identify, **for each bound vocabulary, the vocabulary and the version**. **A value drawn from a bound vocabulary must be recorded as an identifier in that vocabulary and not as a display label.** *Storing the word `extends` rather than the vocabulary's identifier is uninterpretable once a second vocabulary uses the same word differently — translation then depends on a guess.*

Three failure cases: a bound vocabulary is **revised** → the recorded version makes it detectable; records referring to an earlier version **remain valid and must not be rewritten**. A vocabulary is **withdrawn** → the identifiers in existing records **remain the authoritative statement of what was meant**; a community may declare a replacement with a mapping, **and the mapping need not be complete** — *a partial mapping preserving what can be preserved is better than a rewrite that silently changes what records assert.* A vocabulary **lacks a needed value** → declare a charter extension. **Requirement 7.4. Local values must be marked as local** and identify the defining charter; an implementation **must not present a local value as though it were bound.**

42.1.10 §8 Registration, attestation, signature

> **Requirement 8.1 (Attestation).** A transition **must record the party who performed the act and the party who registered it.** Where distinct, the transition **is attested**. The registering party's identifier **and a signature over the transition's content and parents** must be recorded; **registration by an unidentified party is forbidden.** *Satisfied by an act that costs the registrar very little — reading a proposed transition and confirming it. **The cheapness is required, not convenient**, since the registrar performs work whose benefit accrues to someone else.*
>
> **Requirement 8.2 (Independence of the registrar). No automatic registration on behalf of a party**, and **no party may hold another's credentials for the purpose of registration.** Where a transition is registered under a standing arrangement with the performer, **the arrangement must be recorded.** *Addresses the ordinary case of a supervisor routinely registering a student's transitions: the arrangement is legitimate and its effect on independence is real, **so it is recorded rather than forbidden.***
>
> **Requirement 8.3 (Signature coverage) — the single most likely implementation error.** A signature **must cover** content, parent identifiers, prior and posterior state identifiers, and disclosure class. A signature **must not cover fields a later lawful operation may alter**, and the implementation **must state which fields those are.** *Otherwise ordinary operation — scheduled release widening disclosure, redaction removing content — invalidates signatures, and implementations then either forbid the operation or ignore the invalidation. Both defeat the purpose.*
>
> [warning] *Note the tension:* `disclosure class` *is listed as covered here, while §12/§21 require class to widen without invalidating signatures. §21.5 resolves it in the git deployment by holding the class **in a separate file the signature does not cover** — the implementer must notice this. The implementation plan's field note ("Signature coverage **excludes** `disclosure`") follows §21.5.*

Claim 8.4. An attestation asserts that an identified party registered a transition at a time. It asserts **nothing** about whether the change was an improvement, whether the claim is true, or whether the registering party understood it. *Stated in the specification because implementations will be tempted to present an attested transition as a verified one, and readers will make the inference unaided.*

Three limits, recorded here because implementers must know them: credibility needs **≥2 parties**; **collusion is made costly, not impossible**; and **counting is forbidden**: > **Requirement 8.5 (No aggregation over attestations).** No **counts, depths, ratios or derived > scores** over attestations may be computed, stored or presented as part of a conformant record. > **Attestation is a property of an individual transition with two values.**

> **Requirement 8.6 (Marking of unattested transitions).** A transition whose performer and registrar are the same **must be recorded as unattested** and **presented as unattested wherever attested transitions are presented.** An implementation **must not describe a wholly self-registered trajectory as verified, corroborated or independently recorded.** *Protects the mechanism's meaning exactly where it would be diluted — **the personal tier is the tier most people will use first.***

Requirement 8.7 (Withdrawal of an attestation). An attestation must not be deleted. A registrar who wishes to withdraw records a further **challenge** referencing the attested transition and stating the ground; **the original remains in the log with the withdrawal linked to it.** *A reader sees both the original act and its withdrawal — more informative than a deletion or a silent correction, and it places the dispute in the record where later readers can weigh it.*

42.1.11 §9 Attribution and absorption — credit without exclusion

Requirement 9.1. A transition **must record the performing party**; where several parties contributed, **each with a CRediT role**. No contribution without a party; no party without a role where more than one is present. > **Attribution attaches to an act, not to a finished work.** *A contributor statement says a person > contributed to a paper.* ***This record says which change in the content of a claim a person > produced.***

Definition 9.2 / Requirement 9.3 (Absorption). Taking content from a state in one trajectory into a transition in another. The **absorption link records: the identifier of the state absorbed from, the identifier of the party who produced it, and the transition into which content was taken. Implementations must present absorption links alongside the transition wherever it is displayed.** > *This is what makes the difference between arrangements* ***visible in the record****: in an open > competition unselected proposals are discarded and their content, where used, is used without trace; > here it appears as an absorption link naming the party who produced it.* ***Whether a given arrangement > absorbs or discards is checkable from its record — and the check is performed by readers, not by the > protocol.*** (= Paper II's absorption test.)

> **Requirement 9.4 (No veto).** An absorption link confers **attribution and no right to prevent, condition or reverse the use of the content.** An implementation **must not provide a mechanism by which the named party can block a transition, require approval before absorption, or withdraw content already absorbed.** *Model: the moral-rights side of IP. Ground: avoiding the anticommons.* **Consequence for implementers:** *a party who does not wish their state absorbed has* ***one instrument — the disclosure class of that state****. Absorption operates on what has been disclosed to the absorbing party, and a party who discloses to a class has accepted that members of the class may build on the content with attribution.*

Requirement 9.5 (Contested attribution). A party holding that an attribution is wrong, or that an absorption occurred **without a link**, records a **challenge** stating the ground. The disputed record **must not be deleted or altered**; the challenge must be **linked to it and presented wherever either is presented. The protocol supplies no procedure and no party empowered to resolve it** — the record's contribution is that **both positions are visible with their dates.**

Three limits fixed as constraints on what an implementation may claim: attribution records that a party **performed an act — not that they originated the idea** (independent arrival is not adjudicated); an absorption link records **that content was taken, not how much it mattered** — **no measure of influence may be computed or displayed**; and **the presence of absorption links does not establish that the arrangement was generative** (necessary, not sufficient).

42.1.12 §10 The graph: parents, divergence, synthesis, no merge

Requirement 10.1 (Parent links). ≥1 parent, except the trajectory-creating transition. **The graph must be acyclic**; a transition whose parents include a descendant of itself **must be rejected.** *Not a formality — cycles admit a history in which a state precedes and follows itself, and every derived view, including the current state, becomes ill-defined.* > **Ordering follows from the graph and not from timestamps.** Two transitions with no path between > them are **unordered, whatever their recorded times**, and an implementation **must not**

present > unordered transitions as though one preceded the other. *Recorded times are evidence about when > parties acted; they are not the structure of the history.*

Definition 10.2 / Requirement 10.3 (No principal branch). An implementation **must not designate any branch principal, default, canonical or current**, and **must not order branches by any property of content, size or activity.** Where a reader needs a single view, **the implementation must require the reader to select a branch.** *It may of course display branches in some order on a screen. What it must not do is* ***record or export an ordering****, or present one branch with the marks of authority.*

Definition 10.4 (Synthesis). A transition carrying **≥2 parents from distinct branches**, producing a state whose content the performer **composed** from what those branches reached. An ordinary **transformation** with several parents. **The branches it draws on continue to exist and are not closed by it** — a synthesis is a further state, not a resolution of the divergence.

> **Requirement 10.5 (No merge operation).** The protocol defines **no operation combining two states automatically.** An implementation **must not compute a combined state, must not present such a computation as a transition, and must not use the term *merge* for synthesis or for absorption.** *Ground: version control merges because changes to distinct text regions compose, a conflict can be localised, and a test decides whether the result works.* ***Two revisions of a concept satisfy none of the three.*** The terminological clause is practical: the substrate uses *merge* for an operation that does exist, and borrowing the word would make every implementer expect behaviour the protocol does not have.

Requirement 10.6 (Identity is recorded, not adjudicated). An implementation **must not determine whether the states reached by two branches are versions of the same object.** Asked whether a later state is a version of an earlier one, **it must answer with the chain of transitions connecting them — and must not answer with a judgement.** *Two consequences: a trajectory may hold several live branches indefinitely,* ***a normal condition and not an unfinished one****; and a reader must choose among branches with no basis supplied —* ***a cost stated here and not concealed.***

42.1.13 §11–12 Disclosure

Definition 11.1. Classes **must exist, must be ordered by inclusion, and must be enforced**; their **identity and membership are declared in a charter**. Two protocol-fixed properties: **ordering by inclusion** (without it scheduled release has no meaning) and **opacity** — the implementation enforces class values **without interpreting them**. *A community with two classes and one with six are both conformant.*

Definition 11.2 / Table 11.1 — the four grounds (fixed, not extensible; see paper-III for the full analysis):

Ground	Object restricted	Residue remaining disclosable
rivalry	access to the instrument or resource	**the trajectory in full**
hazard	the propagable content of a method	questions, decisions, interpretations, negative results
exploratory vulnerability	the timing of exposure	**everything, at the scheduled time**
appropriability	content whose disclosure destroys excludability	existence, questions, decisions, negative results

> *The* ***rivalry row is the one implementers most often get wrong****: an instrument admitting one user at a time supplies* ***no reason to restrict the record of what was done with it****. Conditional access (structured access) is the mechanism the hazard row assumes.*

Requirement 11.3 (Declared ground). Any record disclosed at less than the widest class available in its trajectory **must carry a declared ground**; an implementation **must reject a restriction that declares none**, and **must present the ground wherever it presents the restriction**. **Requirement 11.4 (Residue).** The corresponding residue **must be disclosed at the widest class available**; a ground **must not be used to withhold material it does not cover**. > *This is what makes the grounds do work.* ***A design without the residue rule would permit any ground > to justify total silence — which is the present arrangement with a label attached.*** Misapplication > is named (rent-seeking secrecy; hazard-where-no-propagable-risk). **The protocol cannot detect > either** — the requirement that the ground be declared and displayed is what lets a reader raise the > question.

> **Requirement 11.5 (Per-record disclosure).** A class attaches to an **individual record**. **Disclosure must not be a property of a repository, project or trajectory as a whole**, and records within one trajectory **must be able to carry different classes.** *This is the second point at which the version-control analogy fails: in a VCS openness is a property of a repository chosen by its owner. Research requires that a single line of work carry states disclosed to everyone, to a group, and to nobody, with the differences declared and grounded.* **Consequence for views:** a view must be computed **over the records that reader may see**, and an implementation **must not disclose the existence of a record by omission, ambiguity, or a gap in numbering** where the charter requires existence to be concealed.

Left to the charter: which classes exist and who belongs ·consent and retention ·**who may change a record's class** (the change is an administrative operation; *who may perform it is a charter question, and the record makes the answer visible after the fact*).

42.1.14 §12 Monotone disclosure and release

Requirement 12.1 (Monotone disclosure). Disclosure may widen and must not narrow. No operation reducing the class of a disclosed record, **and no representation that such a reduction occurred.** *Ground: a reduction* ***cannot be effected*** *— a party who has read a record retains what they read, so an operation appearing to withdraw disclosure* ***conceals from the record's own participants a state of affairs obtaining outside it****, and the implementation would then be trusted with material that should never have been entered.* Two operations that resemble narrowing and are distinguished: **redaction** (removal from the store, not a change of class — §13) and **revocation of a party's class membership** (a charter matter about *future* disclosures; it does not alter what was already disclosed).

Requirement 12.2 (Restrictive default). Records are created at **the most restrictive class applicable under the declared ground** and widen **only by an explicit act**. **No widening as a side effect of any other operation.** *Where disclosure cannot be undone, an error toward openness is uncorrectable — and defaults are where such errors occur.*

Definition 12.3 / Requirement 12.4 (Scheduled release). A recorded commitment that a record will be disclosed at a stated wider class at or after a stated time; **the schedule is part of the record and is disclosed at the record's current class.** An implementation honouring it **widens the class at the stated time without a further act by any party. A schedule may be shortened; it must not be extended or cancelled**, and **any attempt must be recorded as an administrative operation with its ground.** *The asymmetry is the substance: vulnerability justifies delay and not permanent withholding, and a schedule extendable indefinitely is a permanent withholding made to look temporary. The attempt is recordable because a charter may sometimes allow it — and it must be visible.*

Definition 12.5 / Requirement 12.6 (Release). A release records the state identifier, the class, the time, **and the identifiers of every transition referencing that state whose disposition is `unresolved` at that moment.** It **must enumerate the standing objections**; an implementation **must not omit them, must not permit a release conditional on their resolution, and must not present a release as certifying, validating or approving the state.** > *The point at which this specification differs most visibly from publication as practised.* ***A > release asserts that a state is published and that these objections stand.*** *It asserts nothing about > their merit — and a community treating an enumerated objection as a defect will produce releases with > the objections suppressed,* ***which is a failure of the charter and not of the protocol.*** A release is also **what serves priority** (it carries a time and a registrant) — *the protocol supplies the record and cannot supply the recognition.*

Requirement 12.7 (Emission on release) — discharges the compatibility condition. An implementation **must be able to emit, from a release, a document containing: the released state, the chain of transitions leading to it, the parties with their contributor roles, the absorption links with their attributions, and the objections standing at release.** The emitted document **must carry the identifier of the release it was generated from.** *A participant obtains, **without additional work**, an object of the kind the incumbent reward system accepts, **carrying an appendix no other process can produce**. **Adoption does not require anyone to abandon publication.***

42.1.15 §13 Separability, redaction, integrity

Resolves the conflict that defeated comparable systems: an append-only log with content-derived identifiers cannot admit deletion, and a record holding personal data must.

Definition 13.1. Skeleton = identifier, kind, parent links, state references, typed fields, parties, signature, disclosure class and ground. **Content** = the material referred to: the text of a state, a recording, a transcript, an annotation body, a deposited file. **Requirement 13.2 (Separability). Content stored separately, referenced from the skeleton by a content-derived identifier. A skeleton must remain valid and verifiable when the content it references has been removed.** *The signature covers the skeleton, which includes the content identifier; removing content does not alter the skeleton, so the chain of identifiers and signatures stays intact and every later record remains verifiable.*

Definition 13.3 / Requirement 13.4 (Redaction). Removal of content while the skeleton remains. **A redacted record continues to assert that a transition occurred, by whom, of what type, at what position in the graph — and no longer supplies what was said.** The redaction **must be recorded as an administrative operation** carrying the redacted record's identifier, the time, the performing party, and the ground. **A skeleton must not be removed. The record of a redaction must not be removed. Redacted content must not be represented as never having existed.** *The last clause is the substance: a system erasing the trace of an erasure would leave a record that **misdescribed its own history**, making every later reader's inference unreliable in a way they could not detect.*

Three things survive and must all be presented: the fact of the transition with its type, graph position and date ·**the parties**, unless the ground requires their removal — *in which case the skeleton records that a party field was redacted, and the signature over the skeleton is preserved with the party identifier replaced by its own content-derived identifier* ·**the fact that a redaction occurred, with its ground**, so a reader finding an unreadable antecedent knows why. **Requirement 13.5 (Structural preservation). A redaction must not alter the graph.** Parent links, state references and the induced ordering **survive unchanged**; a record **must not be removed because its content was removed.**

Requirement 13.6 (Propagation of redaction). An implementation that received records **must accept and act on a redaction notice** for them and **must forward such notices onward**, and **must record notices received and forwarded. Two honest limits:** *a copy held by a departed party cannot be reached, and no protocol reaches it*; and derived objects (emitted documents, cached views) may embed content a later redaction removes — the implementation **must reconstruct affected caches and must record which emitted documents referenced redacted content**, so a party can pursue them outside the system.

Three further limits. Possibility is not lawfulness. Content-derived identifiers of removed content remain in the skeleton — where content is short and its space small, the identifier may permit **reconstruction by exhaustive search**, so an implementation handling such content **must apply a per-record secret before computing the identifier.** And **a redaction is visible** — a participant who removes their material leaves a record that they did so, with a ground. *This is the price of a tamper-evident log; it cannot be avoided within one; **and participants should be told before they enter rather than after they attempt a removal.***

42.1.16 §14 Identity

Definition 14.1. A **party** is an entity capable of performing and registering acts, **identified within the protocol by a public key.** Nothing requires that a party correspond to a natural person, that a natural person hold one identifier, or that an identifier connect to a legal name. **What is required is continuity. Claim 14.2.** Attestation and attribution **require continuity of identity and do not require legal identity.** A key pair establishes that the registering party is distinct from the performing party, and that the same party acted last week — **which is the whole of what §8 and §9 depend on.**

> **Requirement 14.3 (Pseudonymous participation).** An implementation **must permit a party to participate under a key not bound to any external identifier, at every conformance tier**, and **must not require a legal name, telephone number, institutional affiliation or government identifier** as a condition of holding a party identifier. *Three reasons, the second the one the series cares about:* the mechanisms don't need it; **a universal identity requirement excludes exactly the population the companion papers concern** — unaffiliated scholars, parties in jurisdictions where a phone number is a state-linked identity document, parties whose participation carries risk — **and the entry path would be closed at the door**; and the empirical record for real-name policies is **exclusion without the improvement in conduct they were introduced to secure.**

Definition 14.4 / Requirement 14.5 (Optional bindings). A **binding** is a recorded, verifiable association between a party identifier and an external identifier (researcher ID, institutional account, domain, attested legal identity), recorded as an **administrative operation** carrying the attesting party. Bindings **must be visible wherever the party identifier is presented, must record who attested and when, and must be revocable by a further recorded operation.** An unbound identifier **must not be presented as bound**; a revoked binding **must not be presented as current.**

> **Requirement 14.6 (Assurance by class and not by gate).** A charter may require a stated assurance level **for participation in a given disclosure class or for acts of a given kind**. An implementation **must enforce it at the point of the act** and **must not apply it as a condition of holding a party identifier or of reading records disclosed at the widest class.** *A community handling hazard-restricted material may reasonably require a verified institutional identity for that class.* ***The same community must not require it of a stranger who wishes to challenge a publicly disclosed claim*** *— that is the act by which parties without position enter, and gating it reproduces the bootstrap failure the design exists to avoid.*

Requirement 14.7 (Key lifecycle). Rotation: an administrative operation **signed by the old key** nominating the new one; both identifiers then refer to the same party and **prior records remain valid under the old identifier**. **Loss:** a new identifier plus a **charter-defined procedure**; the implementation **must record which procedure was used and must not represent such an association as equivalent to one signed by the old key** — *recovery procedures are necessary and weaker than a signature, and a record presenting them identically would misdescribe the strength of its own evidence.* **Compromise = revocation with a date**; registrations made before it **remain in the log, marked with the compromise** — *removal would alter the graph and conceal the history the record exists to hold.*

42.1.17 §15 Sealed registration

Definition 15.1. A record carrying the **content-derived identifier of a state**, the registering party identifier, a time, and a signature — **with the content disclosed to no party.** It asserts that the registering party **held content with that identifier at that time.** > *Requires nothing the specification does not already have: a sealed registration* ***is the skeleton of > a record whose content has not been disclosed****, not a new kind of object.*

Requirement 15.2. Registration **must be available at every disclosure class, including the class disclosing to no party beyond the performer.** A party **must be able to**

record a trajectory from its first state without disclosing any content, and **disclosure must not be a condition of registration. Definition 15.3 / Requirement 15.4 (Opening).** A transition disclosing previously sealed content, recording the sealed registration's identifier and the content, so **any party may verify from the record alone that the content yields the identifier registered earlier.** Verification failures **must be recorded, and neither record removed.** *Opening is optional and may never occur — a party may seal a trajectory and abandon it, and the sealed registrations remain as evidence of what was held and when, unopened and unverifiable by anyone.*

Claim 15.5. It **converts the choice between disclosing early and recording nothing into a choice about when to disclose.**

Five limits. Evidences **possession, not understanding** (a party may register a state they do not comprehend). **Generates nothing** — a sealed state attracts no objection, no connection, no encounter; *it protects a participant during precisely the phase in which the arrangement's benefits are unavailable to them, and it purchases the possibility of opening later.* **Adjudicates nothing against independent arrival. > Requirement 15.6 (No inference from precedence).** An implementation **must not present an earlier > sealed registration as establishing that a later party derived their work from it**, and **must not > rank, order or annotate parties by the times of their sealed registrations. > Requirement 15.7 (Statement of the limit).** An implementation **must not describe sealed > registration as establishing priority**, and **must describe it as recording that a party held a > content at a time.** *Where a community honours registration for priority, the honouring is recorded > in the charter and not in the protocol.*

Dependence outside the protocol (easy to overlook): a sealed registration is evidence **only if its time is credible to a party who does not trust the registrant.** An implementation **must anchor sealed registrations in a manner a third party can check** — publishing identifiers at intervals in a medium it does not control, or obtaining a timestamp from an independent party (Haber & Stornetta 1991) — **and must record which method was used.**

42.1.18 §16 Propagation

Definition 16.1. Lateral propagation = an objection raised against one trajectory entering another, and absorbed content moving across a divergence with its attribution. **Inter-implementation propagation** = exchange of records between implementations sharing no operator (COAR Notify, ActivityPub). **Dissemination of finished artefacts is excluded from the term** — repositories and indexes do it adequately and nothing here concerns it.

> **Requirement 16.2 (The exchange minimum).** Two implementations exchanging records **must agree on**: the **record structure** (§6) ·the **act and disposition vocabularies** ·the **identifiers of bound vocabularies in use and their versions** ·**the construction of content-derived identifiers** ·**the signature scheme. They need agree on nothing else** — not storage, transport, interface, or serialisation. *The identifier-construction and signature-scheme clauses **cannot be relaxed**: two implementations computing identifiers differently produce records that cannot be verified across the boundary, and **the record's credibility does not survive the crossing.***

Requirement 16.3 (Declaration of profile). An implementation **must declare, machine-readably**: protocol version, conformance tier, identifier construction, signature scheme, bound vocabularies with versions. **A receiving implementation must record the declaration under which records were received.**

> **Requirement 16.4 (Continuation) — portability is not export.** A participant **must be able to obtain the complete record** (transitions, skeletons and signatures, attributions, absorption links, parent structure) **without the permission of any position holder**, and **must be able to continue it under an implementation the original operator does not control. Transitions appended after continuation must reference the obtained transitions as parents, so the continued**

trajectory is one graph and not two. Two consequences: identifiers **must continue to resolve** (*a continuation whose references have become unresolvable is an archive, not a trajectory*); and **restricted content does not travel unless the receiving implementation can honour the class** — transfer the class and ground and honour them, **or transfer only the skeleton and record that content was withheld.**

Requirement 16.5 (Received records). Verify what can be verified; retain what cannot, marked unverified; never alter received records. Unrecognised vocabulary values are **retained unchanged**. > *The prohibition on alteration **extends to normalisation**. An implementation rewriting received > records into its preferred form would invalidate their signatures and destroy the property that makes > propagation worth having.* Redaction notices are the one exception (§13).

Four failure cases. Version mismatch — retain, do not process as own version; where versions differ only in additions, process recognised fields **and record that it did so**. **Vocabulary drift** — each record carries its own version; **no reconciliation by the protocol**. **Partial records** — retain the subgraph, **mark missing parents as unresolved references**, **do not synthesise missing transitions or present the subgraph as complete**. **Divergent continuation** — two parties continuing the same obtained record independently is **a divergence and is treated as one**: both retained, neither principal, shared ancestry visible in parent links. **No reconciliation is required and none is provided.**

42.1.19 §17 Durability

Requirement 17.1 (Self-describing formats). The **authoritative** form of a record **must be a plain, self-describing serialisation readable without the software that produced it**, in a publicly specified format. **It must not be held only in a database, index, or proprietary container.** *Any internal representation is permitted for speed — what is forbidden is that the internal representation **be** the record, since a record recoverable only through a running system is lost when the system stops running, **and systems stop running.*** **Requirement 17.2 (Field documentation).** Publish, alongside the records, the **vocabularies and versions used and the construction of identifiers and signatures**, in a document readable **without access to the implementation.** *Addresses a failure visible only after it is irreparable: a serialisation that is readable but uninterpretable, because the meaning of its fields lived in a codebase, is **a durable record of nothing.***

Definition 17.3. Custody is held by a party and not by a system. Requirement 17.4 (Distributed custody). At the **group and open tiers**, a record **must be held by at least two parties who do not share an operator** (LOCKSS-style replicated independent custody); the implementation **must record which parties hold copies** and make the record obtainable under Req. 16.4. *What makes portability meaningful in practice — a right to obtain a record from a party who has ceased to exist is a right without an object.* **Requirement 17.5 (Archival deposit).** At the **open tier**, **released states and the transitions leading to them** must be deposited with an **independent** archival service with stated preservation commitments; **the deposit identifier is recorded in the trajectory.** *Restricted to **released** material deliberately — **depositing sealed or restricted content with a third party would place material outside the disclosure regime governing it.*** **Requirement 17.6 (Succession).** An organisation-operated implementation **must publish what becomes of its records if it ceases to operate** — to whom custody passes, with which archival service material is deposited, or how participants may obtain the records. **An implementation must not claim durability without publishing such an arrangement.**

Three limits: a specification **cannot fund preservation**; **cannot compel a departed party** to keep a copy; and format stability is a matter of degree — *what is secured is that the difficulty is one of **interpretation** rather than of **recovery**.*

42.1.20 §18 Operating charters — the Level-1 interface

Definition 18.1. An identified, **versioned** document adopted by a community, which **the protocol references and interprets nothing in. > The charter is where everything contested lives:** which classes exist and who belongs ·consent > before a record concerning a person is created ·retention ·conduct and consequences of breach ·> identity assurance per act ·**whether registration is honoured for priority** ·review templates ·> declared target/trigger extensions.

Requirement 18.2 (Minimum charter content) — a condition of legibility, not a normative demand. A charter referenced by a conformant record **must state**: the disclosure classes and their ordering ·the parties/roles belonging to each ·the assurance level required per class and per act kind ·any extended target/trigger values with definitions ·**the procedure by which the charter itself is amended. An implementation must reject a record referencing a charter that does not state these.** *It obliges a community to have decided its own questions and settles none of them.*

Requirement 18.3 (Charter reference). A trajectory **must record the charter identifier and version**; any record whose class, assurance requirement or extended vocabulary value derives from a charter **must record that charter's identifier and version. Requirement 18.4 (Amendment is prospective).** An amendment **applies to records created after it and must not alter the interpretation of earlier records.** Earlier versions must be retained or locatable. > *One case implementations will handle badly:* **where an amendment removes a disclosure class, > records already carrying it retain it, and the implementation must continue to enforce the class as > the earlier charter defined it.** Reclassifying would either widen without an act (forbidden by 12.2) > or narrow (forbidden by 12.1).

Three refusals: no model charter, no default charter, **no minimum standard of conduct** (*a specification supplying one would be a specification of governance, and communities rejecting the model could not conform*) ·**no enforcement of charter provisions beyond the fields the protocol carries** (classes are enforced because they are protocol fields; conduct rules are not) ·**no adjudication between a charter and law.**

42.1.21 §19 Amendment and versioning — *the specification applied to itself*

Definition 19.1. A version is **compatible** with an earlier one where every record valid under the earlier is valid under it **and carries the same meaning**; otherwise **incompatible**. **Requirement 19.2.** Every record **must carry the protocol version under which it was created**. An implementation **must not alter the version identifier of a record it did not create, and must not upgrade records to a later version.** *A record created under one version asserts what that version's fields meant; rewriting it would silently change what it asserts.* **Protocol versions, implementation versions and charter versions are distinct** and must not share a numbering.

> **Requirement 19.3 (Recorded amendment).** An amendment to the specification is **proposed, discussed and adopted through a record conforming to the specification**: *a proposal is a **state**; objections are **challenges**; revisions are **transformations**; adoption is a **release at the widest class**.* **The trajectory of the specification must be publicly readable and must remain so.** *Practical effect beyond the reflexive demonstration: a reader can see which objections were raised against a provision, which were answered, and **which stood unresolved at adoption** — Req. 12.6 obliges the release to enumerate the last.*

Requirement 19.4 (Custodial separation). The party maintaining the specification **must not be the operator of any implementation for which conformance confers advantage — or must record the conflict and the arrangements limiting it.** The specification **must be licensed so any party may fork it, and conformance to a fork must be expressible in the version identifier. Requirement 19.5 (Declaration).** Declare the versions readable and the version records are created under; on exchange, **each records the other's declared versions. > Negotiation is minimal by design: no translation, no negotiation of a common subset, no downgrade** > — each would produce records asserting something other than what their creators asserted.

Three limits. Procedure **does not confer quality**. **The procedure is itself capturable** — a party controlling participation in the specification's trajectory controls the specification, and **no clause within it prevents this**; the bound is **the licence to fork and the portability of the specification's own record — the same partial bound placed on every other position.** And **an amendment cannot repair a record** — for each incompatible change the specification **must state what a reader should understand about records created earlier.**

42.1.22 §20 Conformance tiers

Cumulative: conforming at a tier satisfies every requirement of the tiers below.

Tier	Adds	Available to its adopter
Personal	transitions with parent links + identified prior states ·append-only log with derived views · **three acts minimum:** `claim`, `challenge`, `release` ·content separable from skeleton	a searchable record of what was ruled out and why ·a list of objections not yet answered ·**a citable release with its chain**
Group	attestation by a distinct party ·contributor roles ·absorption links ·disclosure classes with declared grounds ·administrative operations recorded	**evidence — credibility begins where a second party registers** ·visible attribution of changes ·onboarding a new participant from the record
Open	propagation with declaration of profile ·distributed custody · archival deposit of released material ·charter reference ·identifier resolution independent of the operator	exchange with parties elsewhere ·continuation beyond the operator ·**entry of strangers through the open register**

Requirement 20.2 (Minimal implementation). The personal tier **must not require** attestation, contributor roles, disclosure classes, charters or propagation. **Requirement 20.3 (Marking of the personal tier). Every transition marked unattested**, and the absence of attestation **stated wherever a record is presented or exported. Must not describe a personal-tier record as verified, corroborated or independently recorded.** > *The honest position:* ***the personal tier delivers utility and no evidential weight****, and the two must* > *not be confused at the point where most participants meet the protocol first.*

42.1.23 The three conformance tests (for the exclusions most likely to be violated in good faith)

Requirement 20.4 — scalar test. Fails where it **computes, stores, displays or exports any total order or numeric measure over participants or over trajectories**, including counts of transitions, counts of attestations, contribution shares, activity indices and derived scores. **Counts of records within a single trajectory, presented without comparison across participants or trajectories, do NOT violate this.**

Requirement 20.5 — independence test. Fails where any conformant operation cannot be performed without an analytical capability. **The test: can the record be created, registered, read, verified, exported and continued using a text editor and a version-control system?**

Requirement 20.6 — byproduct test. Fails where it requires an act whose only purpose is that a record should exist. **The test: does each required act have a purpose *for the party performing it* that is stated in the implementation's documentation?**

Requirement 20.7 (Self-declaration). Publish a declaration stating protocol version, tier, identifier and signature constructions, bound vocabularies with versions, the substrates supplying storage/identifiers/transport, and (at open tier) the succession arrangement. **Readable without access to the implementation. > Conformance is self-declared and checkable from the record. No certification body is established > here and none is required** — a doubting party obtains a record under the continuation requirement and > verifies signatures, identifier construction, and the presence of required fields.

Three limits on a conformance claim: it concerns **the implementation and not the records it holds** (*a conformant implementation may hold a fabricated trajectory*) ·it concerns **structure and not quality** ·at the open tier it establishes **capability, not that exchange has occurred.**

42.1.24 §21 A deployment over version control (NON-NORMATIVE — Requirement 21.1)

*Included because a specification with no worked deployment invites the reply that it cannot be implemented; excluded from the normative text because **a deployment ages faster than a specification and should not date it.***

The mapping. A **trajectory is a repository**. A **transition is a commit**; its **skeleton is a plain text file** added by that commit. **Content is in separate files**, referenced by the VCS's own content identifiers — *so the separation required for redaction is the substrate's ordinary behaviour*. **Parent links are the commit's parents; acyclicity is the substrate's.** A **synthesis is a commit with several parents and is not a merge in the substrate's sense** — no automatic combination is performed. **Signatures are commit signatures**; **attestation is expressed by a commit whose signer differs from the skeleton's `performer` field**, and the implementation enforces the distinction by **refusing commits where the two coincide at group tier and above. Event plane:** held **outside** the trajectory repository, in the systems participants already use (calendar, meeting recorder, message archive, working code repo). The implementation reads them, proposes candidates, **and writes nothing to the trajectory until a party registers one**. *The privacy requirement is satisfied by the arrangement rather than by a mechanism — the event plane is never copied in, so publishing a trajectory discloses no event record.* What is disclosed is a **trigger reference** in a registered transition. **Disclosure: one repository per class**, with restricted records held in narrower-access repositories and **referenced from the wider ones by identifier alone** — a reader at a wide class sees *that* a record exists without seeing its content. **Propagation** is clone and fetch; **the profile declaration is a file in the repository**. **Deposit** is transferring an archive of the repository at a release to a service issuing a persistent identifier, **recorded in a subsequent administrative operation**.

42.1.25 The four weaknesses (stated because a reader will otherwise assume the mapping is clean)

1. **Disclosure is per repository; the spec requires per record.** One-repo-per-class **approximates and does not meet** Req. 11.5 — a record whose class changes under a scheduled release **must be moved rather than relabelled**, and the movement is visible in a way relabelling would not be. **The movement must be recorded as an administrative operation.**
2. **Identifier resolution depends on hosting.** The substrate's content identifiers are stable and **not resolvable by a party who does not hold a copy** — so **resolvable identifiers must be obtained from a repository service for every state referenced from outside**, with the correspondence recorded.
3. **Redaction is available and not simple.** Removing a content file from the working tree **leaves it in the history** — so redaction needs history-rewriting, **or** a design in which **content files are held outside the versioned tree and referenced by identifier. The second is preferable and is what the mapping above assumes.**
4. **Signature coverage is fixed by the substrate.** Commit signatures cover the commit content, **including the skeleton file with its disclosure class — so the class cannot**

be widened by a scheduled release without invalidating the signature. The workable arrangement **records the class in a separate file the signature does not cover**, which satisfies Req. 8.3 **and requires the implementer to notice the problem.**

42.1.26 §22 Three worked examples (constructed, not observed — they establish nothing empirical)

Mathematics (Case 22.1) — an obstruction and an entering stranger. question → claim → transformation (trigger `reflection`) → verification recording the failure (an independence assumption does not hold) → **decision abandoning the approach, with the reason** → a state recording the current obstruction, disposition `unresolved`. Months later, **a party with no prior act finds it through the open register** and records a **connection** to a construction in another field where the same obstruction was met; the participants accept; a **transformation** follows, **registered by a party other than its performer**; the entering party is recorded as performer of the connection with a contributor role. *Exercises: the open register, the entry path, attestation, the decision act.* **Shows what the decision act is for** — the abandoned approach is interpretable years later **only because the reason was recorded with it**, and the connection was possible **only because the obstruction was addressable as a state**. *At the personal tier the same trajectory is recordable, carries no attestation,* ***and the entering party has nothing to find.***

Machine learning (Case 22.2) — an evaluation failure and a restricted method. Hypothesis + method state → verifications (trigger `experiment`), one with an unpredicted outcome → **challenge registered by a member who did not propose the hypothesis**, disposition `accepted` → transformation, relation `modification`. **Part of the method is held at a restricted class on the appropriability ground**; the **residue is disclosed at the widest class**: existence, question, decisions, **the evaluation outcomes that failed**, and the revised hypothesis. A **scheduled release** is recorded for the restricted state. **A second group absorbs the abandoned first hypothesis with its recorded failure, and the absorption link credits the originating party.** *Shows the residue rule doing the work it exists for:* ***the group withholds what excludability requires and discloses everything the ground does not cover — which is what makes the abandoned hypothesis available to the second group at all.***

Philosophy (Case 22.3) — a divergence that is not resolved. trust-between-individuals → challenge (omits institutional power), accepted → transformation → **a third party challenges the revised state on different grounds; neither accepted nor rejected — disposition `unresolved`, and work proceeds → two transformations diverge**: one narrows to institutional settings, one keeps general scope and weakens the claim; **neither designated principal** → a later **synthesis** references both as parents, **and the branches continue** → a **release on the narrowed branch enumerating the unresolved challenge as standing**, with an emitted document carrying state, chain, contributors and the standing objection. *> The case where the specification differs most sharply from publication as practised:* ***the released > document declares an objection its author has not answered.***

Three findings common to all three: every act has a purpose for its performer — *nobody documents in order to document* ·**the requirements exercised differ by field and the tiers accommodate the difference** (philosophy needs no classes; ML needs classes and the residue rule; mathematics needs the open register and entry path) ·**the demanding part is the same in all three: recording a decision with its reason at the moment of abandoning a direction.** *It is work with no present incentive, on which the reuse of abandoned material nevertheless depends.* ***The specification makes the act cheap and cannot make it attractive*** *— a limit of a protocol.*

42.1.27 §23 Failure modes and attacks

Of the record. Collusive fabrication — cost rises with the number of independent registrars and the visibility of their other work; **not eliminated; an implementation must not**

describe an attested record as proof of authenticity. Retroactive alteration — content-derived identifiers over payload and parents invalidate every descendant, **so detectable by any holder of a copy**; where a party holds the only copy, detection requires a second custodian (Req. 17.4, group tier and above). **Backdating — signatures do not establish time**; the §15 anchoring moves the question to a party the registrant does not control; **without anchoring, recorded times are assertions. Flooding** — no rate limit and no quality condition; the bearing mechanisms are indirect (attestation requires recruiting a registrar; the scalar exclusion removes the reward for volume); **rationing of attention is a charter matter.**

Of position. Registrar gatekeeping — the protocol records the declining party's other registrations and **supplies no remedy**; the charter responds, and **portability bounds the position**. **Custodial capture — the continuation requirement is the test**, and an operator refusing it is non-conformant; **the protocol cannot compel compliance**, and recourse is the copies under distributed custody. **Capture of the specification — no clause prevents it**; bounds are the licence to fork and the portability of the specification's record, **which are partial.**

Of disclosure. Misapplied grounds — declared and displayed, **not assessable by the protocol**; detectable by readers, corrected (where it is) by the community. **Disclosure by inference** — *a record's existence revealed by a gap, an identifier sequence or the shape of a derived view.* **Implementations must compute views over the records a reader may see and must not disclose existence by omission where a charter requires concealment. A genuine implementation hazard, easy to introduce accidentally. Redaction that cannot reach** a departed copy. **Reconstruction from an identifier** — answered by the **per-record secret**, applied before the identifier is computed, **which an implementer must decide in advance.**

Of the arrangement. > Surveillance through the event plane. *The plane that makes capture cheap is a monitoring log.* > The privacy requirement confines it to participants and forbids export and indexing, and an > implementation violating it **would produce exactly the instrument the design exists to avoid. > This is the failure with the largest consequence for participants and the one an implementer is most > likely to introduce while improving a feature.**

Scores at the edge — the protocol **forbids the implementation from computing one and cannot forbid third parties**; a widely adopted external score would reintroduce the dynamic the exclusion prevents. *The protocol's only contribution is that* ***it supplies no such quantity itself and no privileged basis for one.*** **Reflexive confirmation** — registration becomes a habitual click; **the affirmative-act requirement is the answer and is weak**; what strengthens it is a charter under which registering carelessly is a recognisable failure, **and the record shows who registered what.**

Three failures with no technical answer (*stated so that no reader mistakes the specification's silence for a solution*): 1. **A community that punishes disclosed failure will produce records with the failures removed** — and the reuse of abandoned material, one of the two concrete benefits claimed, **will not occur.** 2. **A community that does not honour registration** leaves sealed registration supplying evidence to parties with no forum in which it counts. 3. **A community in which nobody registers another party's transitions will operate at the personal tier under a group-tier declaration** — records whose marking is correct and **whose evidential value is absent.** *The protocol makes the condition visible and does nothing further.*

42.1.28 §24 Boundaries and open issues

Five refusals. It does not **assess content** ·does not **measure capacity** (a trajectory records what occurred, not what the relation could have produced, and what it records is the articulable fraction alone) ·does not **resolve disputes** (contested attribution, withdrawn attestation, disputed grounds are all recorded, and **no party is empowered by the specification to decide any of them**) ·does not **guarantee lawfulness** (it makes lawful operation *possible* where an unredactable record would foreclose it) ·**does not produce encounters** — *it records them and makes states addressable so a party elsewhere may find one;* ***whether such finding occurs is a matter of adoption, scale and community behaviour, on which the available***

evidence is discouraging.

Four open engineering questions: per-record disclosure over per-repository substrates (*a substrate supporting per-object access with cryptographic enforcement would settle it*) ·**resolvable identifiers at state granularity, cheaply** (presently expensive) ·redaction across implementations that no longer communicate ·**representation of a state for structural matching across vocabularies** (*the capability the cross-field claim depends on; the specification supplies a substrate and claims nothing about it*).

Three open normative questions no specification can settle: whether **registration is honoured for priority** ·whether **disclosed failure can be non-punitive** — *on which the reuse argument depends entirely* ·whether **the labour of registering another party's transitions is recognised** — *unpaid work for another's benefit, the disparity that defeated every comparable system.*

> **Four findings that would show the specification inadequate:** 1. **Personal-tier adoption without progression to the group tier**, over a substantial population and period → the arrangement supplies private utility and **does not produce the attested records on which every evidential claim rests.** 2. **Records in which the `decision` act is rare while transformations are common** → the act on which reuse depends is not being performed, and **making it cheap was insufficient.** 3. **Group-tier declarations alongside registration patterns of pairs who register only each other → attestation operating as a formality.** 4. **A widely used external score computed over conformant records → the exclusion of scalar measures displaces the dynamic rather than preventing it.**

Status: version 0.1. **No implementation, no deployment history, no evidence of use, and every requirement in it is a proposal about what such use would need.**

42.1.29 Implications for this repository

- **The tool's UI vocabulary must follow the eight acts, not invented ones** — and must never say "commit" for a transition or "merge" for a synthesis/absorption (Req. 10.5).
- **Every command's `--help` must state the purpose it serves *for the person running it*** — this is literally the byproduct conformance test (Req. 20.6), and the implementation plan already encodes it as an acceptance test.
- **`grrp check` should implement Req. 20.4/20.5/20.6 directly** as the three conformance tests, plus the append-only, signature-coverage, redaction, attestation and portability tests already in the plan.
- **Signature coverage is the named "single most likely implementation error"** — spec §8.3 vs. deployment §21.5. Follow §21.5: hold the disclosure class in a separate, uncovered file.
- **The personal tier must mark everything unattested and say so on every export** (Req. 20.3) — a plain requirement the current README does not reflect.
- **Emission on release (Req. 12.7) is not a "later stage" nicety** — it is the compatibility mechanism that makes adoption possible at all. It belongs in M1.
- **`grrp open` implements Req. 6.5** (the open register). It is the entry path, and Paper I §17 makes it the answer to the bootstrap failure.
- **The four "findings that would show the specification inadequate" are this project's evaluation plan.** In particular: *watch the ratio of `decision` acts to transformations*, and *watch for register-only-each-other pairs*.

Related: paper-I-design-and-requirements.md ·paper-II-incentives-and-adoption.md · paper-III-grounds-of-restriction.md ·glossary.md

43 design nodes time and occasions

Original source: `applicative_infrastructure/gr_academia_application/plans/design-nodes-time-and-occasions.md`.

Original source SHA-256: `b36a18d36aa8e5275c8e062bcb4475bea9cab07e736c57b863827d9450bae2e8`.

43.1 Design note — node panels, per-node files, calendar, meetings

Written before building, at the point where four proposals arrived at once and three of them touch a constraint. Nothing here is implemented yet.

The short version: **all four are buildable, none needs a new vocabulary, and two of them have a version that would quietly break the design.** The difference is worth writing down before it gets decided by whichever screen was easiest to draw.

43.1.1 1. The node panel — safe, and the dead space is already there

Clicking a node opens a modal today. That is wrong for something you want to keep open while you read the graph. A bottom panel that fills on selection, and stays, is better; it also uses the space below the drawing that is currently empty.

Tabs inside the panel:

tab	what it holds
Details	act, target, relation, trigger, disposition; performer; whether it is attested and by whom; the identifier, in full and copyable
Material	the artefacts this node cites, by hash — see §2
Bearing	what it follows, what follows from it, and what it crosses to under other questions
Provenance	contributions (CRediT), absorption, and the registration signature

No constraint touches this. It is presentation of fields that already exist.

One rule: **the panel shows what is in the record, and nothing computed.** No "influence", no "downstream count", no "centrality". A node with many edges is not more important; it is a node with many edges.

43.1.2 2. Per-node files: nodes cite, they do not own

The request was a small file system per node. The honest version is close but not the same, and the difference is C3.

A transition is never edited (C3, append-only). If a node owned a mutable folder, the node would mean something different tomorrow than it meant when it was signed, and the signature would still verify — which is worse than it failing, because nothing would tell you.

So:

- Material lives in the **project's** file store.
- A transition **cites** material by the hash of its bytes, through the `artefacts` field the skeleton already carries.
- The node panel shows *the material this node cites*. That reads as a per-node file list and is true.
- Adding material to a node after the fact is **a new transition** citing it — ordinarily a `connection`. That is what append-only means in practice.

Two changes worth making to the project file store:

- **Allow folders.** `files/` is flat today and rejects `/` in a name. Nested paths are fine as long as traversal is still refused; the guard becomes per-segment instead of whole-name.

- **Keep showing the digest.** It is the only thing that makes a citation possible, and it is what a reader elsewhere checks.

43.1.3 3. Calendar — and the version of it that is forbidden

There is a legitimate calendar here and an illegitimate one, and they look alike until you ask what is being plotted.

43.1.4 Forbidden

A contribution graph. Activity per day, per person, per project. This is C6 without disguise: a quantity over participants, and the one every forge has trained people to read as worth. It would also be the most-copied screen in the product, so it is worth naming now: **there will be no activity heatmap, no streak, no per-person timeline.**

43.1.5 Legitimate, and already in the record

The record already contains dated commitments that nobody can currently see:

- **Scheduled disclosure.** `release_at` on a restriction. The protocol allows a schedule only under *exploratory vulnerability*, and `grrp disclose` refuses to extend one — a schedule may be shortened, never lengthened, and a refused extension is itself recorded. A calendar of these is a calendar of promises the record is holding you to. That is worth showing.
- **Embargo expiry** under the other grounds, where one was stated.
- **A chronology of one project.** `performed` is on every transition. Shown within a project, in order, without comparison to another project — the same rule that makes a per-trajectory count permissible.

So: **a calendar of commitments and chronology, never of activity.** If the question a screen answers is "how much has this person done", it does not get built.

43.1.6 4. Meetings — where the real trap is

A meeting node that "associates with any node it wants" is easy to build and is one short step from the thing this project exists to refuse.

`actions.initialise` already says it, about the local event plane:

> A complete log of who attended, who commented and whose files changed is a monitoring record by construction, and it is the failure with the largest consequence for participants.

That is why `.grrp/events/` is gitignored and never exported. A meeting node carrying attendance, exported with the record, is that log — rebuilt on the front of the system instead of the back, and portable.

43.1.7 What a meeting is, in this model

A meeting is an **occasion**. Occasions enter the record through what they produced, and the protocol already carries every part:

the meeting	in the record
that it happened, and what kind of occasion it was	`trigger: discussion` on each transition that came out of it
the meeting itself, as one shared node	its minutes as an **artefact**, cited by every transition arising from it — same hash, so one node, many edges

the meeting	in the record
who did what in it	`contributions`, bound to CRediT — a role in an act, not a presence at an event
what came out of it	the transitions themselves: a decision, a challenge, a changed position

That gives exactly “one meeting node connected to everything it touched”, without a new record type and without an attendance list.

43.1.8 The case it does not cover, and what to do about it

A meeting that produced nothing recorded. Under C1 — byproduct only — that is not a record entry, and writing one is recording for the record’s sake, which is the adoption failure Paper II predicts. It is a **calendar** entry.

So the split is:

- **Calendar**: meetings scheduled and held. Local, not exported, not part of any bundle. It may live in the event plane, where this kind of thing already belongs.
- **Record**: what the meeting changed. Artefact + trigger + contributions.

A meeting becomes visible in the graph exactly when it changed something. If that feels like it is losing information, the information it is losing is attendance, and losing it is the point.

43.1.9 5. What is actually missing, ranked

All four proposals are **views over a record the browser still cannot write to**. That should be said plainly before any of them is built.

1. **Recording acts from the page.** claim, challenge, transform, decide, verify. Until this exists the site is a viewer with a good drawing.
2. **Attestation.** Two accounts exist; nothing lets one register the other’s act. C2 is the entire credibility mechanism and it is unreachable from the interface. This is the one that makes the system mean anything.
3. Node panel (§1) — cheap, and improves everything above.
4. Per-node material (§2) — small, once §1 exists.
5. Calendar of commitments (§3) — needs `disclose` to be reachable first, or it has nothing to plot.
6. Meetings (§4) — is mostly §2 plus a workflow, once §2 is there.

Suggested order: **1, 2, 3, 4, then 5 and 6 together.**

43.1.10 Decisions this note is asking for

- Per-node files: **cite, not own**. Confirmed by C3, unless there is an argument against.
- Calendar: **commitments and chronology only**. No activity view, ever.
- Meetings: **occasion + artefact + contributions**, with scheduling in the local plane and out of every bundle. Not a new record type.
- Build order: acts and attestation before any further views.

44 README

Original source: `applicative_infrastructure/gr_academia_application/plans/design-pass-graph-model/README.md`.

Original source SHA-256: `be2bb8bfbcc95c51a2d8a9fee5f60aeb93d0dab5547c9f4c28abbebd99083f53`.

44.1 Design pass records — the graph model specification

Raw output of the structured design pass behind ../spec-graph-model.md. Kept because this project is itself about recording how understanding changes — including its own.

file	what it is
`draft-practice.md`	design from the working-researcher lens: occasions, materials, scenarios
`draft-architecture.md`	the component/action machinery, incl. the **kind-manifest sketch deferred from v1** (three worked examples: meeting, instrument calibration, dispute edge)
`draft-conformance.md`	47-item feature gauntlet ruled against the constraints, + 12 audit findings on the skeleton
`verify-audit.json`	17 constraint leaks found *in the drafts themselves*
`verify-missing.json`	28 gaps; the load-bearing ones are answered in the spec §10
`verify-cuts.json`	22 cuts and the v1 kernel the spec adopted

Where a draft and the specification disagree, the specification governs.

45 draft architecture

Original source: `applicative_infrastructure/gr_academia_application/plans/design-pass-graph-model/draft-architecture.md`.

Original source SHA-256: `7bc9b72f3b1eb4ef1038933383bca308ca3cfdd9042b08047a0279f49424c1f5`.

45.1 The component/action machinery — modularity specification

Scope: the entity-component model for GRA. Node kinds and edge kinds are **presentation kinds over protocol facts** — the machinery below lets a community add kinds without touching protocol code, and guarantees that a record made under a community kind is still readable as plain GRRP anywhere.

45.1.1 0. Two invariants everything below obeys

1. **Kinds are lenses, not types.** No manifest ever adds a field to a transition, changes what `grrp` writes, or mints a new record type. A kind is a way of *reading* protocol facts (act, trigger, relation, artefact scheme) plus a bundle of applicative affordances. Delete every manifest and the record is untouched.
2. **Writes go through `grrp`.** A recording action is an argv template for the reference implementation, never a skeleton constructed by the UI (this is already the rule in `web/packages/server/src/records.ts`). Manifests can therefore never produce an unlawful record: `grrp` refuses, and the refusal is surfaced verbatim.

45.1.2 1. What a component IS

A **component** is a named facet of a subject (a node or a reified edge), belonging to exactly one of four **classes**. The class — not the manifest — fixes where its data lives, who may write it, and whether it travels.

class	data lives at	written by	mutable?	travels in a bundle?	in git?
`record-facet`	signed transition YAML (`trajectories/<t>/transitions/*.yaml`), state files, `files/` digests	`grrp` only, via recording actions	never (C3)	**yes — it *is* the record**	yes
`sidecar-facet`	disclosure sidecar beside the skeleton	`grrp disclose` / `grrp redact` only	widens only (C7)	yes	yes
`workspace-facet`	`nodes/<subject>/⋯` (per-subject) or `files/⋯` (project)	any authenticated party, through the app	freely; deleting costs nothing	**never**	yes (ordinary files)
`local-plane-facet`	`.grrp/events/`, `.gra/calendar/`	the host application	freely	**never**	**no — gitignored, never exported**

`<subject>` is the last segment of the subject's identifier (`nodeArea()` already does this), so it works identically for a transition id and for an artefact hash — which is what lets material nodes and reified edges get workspaces with zero new machinery.

45.1.3 1.1 Component *types* are a closed application registry; manifests *instantiate* them

Communities configure instances; they never define new classes and never define new storage semantics. The registry:

type	class	what it shows / holds
`identity`	record-facet	the id, in full, copyable
`details`	record-facet	act, target, relation, trigger, disposition, performer, attested-by
`bearing`	record-facet	parents / children / crosses (from `parents`, reverse index)
`material`	record-facet	artefacts cited by hash; digests shown
`provenance`	record-facet	contributions (CRediT), absorption, registration signature
`projection`	record-facet	**configurable, community-definable**: a read-only field selection (§1.2)
`disclosure`	sidecar-facet	class, ground, `release_at`; widen-only controls
`workspace`	workspace-facet	the `nodes/<subject>/` folder: list, upload, delete, digest per file
`note`	workspace-facet	one named markdown file in the workspace, e.g. `nodes/<subject>/agenda.md`
`form`	workspace-facet	one named YAML file in the workspace with a declared schema, e.g. `calibration-setup.yaml`
`schedule`	local-plane-facet	a calendar entry (when/where/link). Never exported. **No attendee list field exists in its schema.**
`commitments`	record-facet	dated promises already in the record (`release_at`, embargo expiry) — read-only calendar

45.1.4 1.2 The `projection` mini-language (how communities get custom read-only facets safely)

```
- use: projection
  id: certificate
  title: Calibration certificate
  select:
    - field: artefacts
      where: { scheme: state }        # filter by exact field equality only
    - field: trigger
    - field: performed
```

`select` permits **field selection and equality filtering only**. No arithmetic, no `count`, no `sum`, no sort-by, no cross-trajectory reach. C6 is enforced structurally: the language cannot express a scalar over participants because it has no aggregation forms at all.

45.1.5 1.3 How the UI discovers a subject's components

Resolution, at render time, per subject:

```
subject (transition | artefact | reified edge)
  → collect candidate kinds whose `match` block fits (§3)
  → pick the most specific (most match fields); charter kinds beat builtins at equal specificity
  → components = universal set (§5) ∪ family defaults ∪ the kind's declared list, in declared order
  → no kind matches → family fallback (generic transition / generic artefact / generic connection)
```

The panel's tabs are exactly the resolved component list. Nothing computed is ever added by resolution — a kind can add facets, never metrics.

45.1.6 2. What an action IS

An **action** is a declared affordance on a kind, in one of three classes:

class	records?	via	example
`recording`	**yes** — exactly one `grrp` invocation	argv template over a declared input form	*reply to this dispute* → `grrp record --act challenge --relation repliesTo …`
`applicative`	**no** — touches workspace or local plane only	app code (file write, calendar write)	*add to calendar*, *edit agenda note*
`bridge`	**yes** — promotes workspace material into the record by citing its hash	`grrp connect`/`record` with `--artefact state:sha256:…`	*cite these minutes*

An action declaration:

```
- id: reply
  class: recording
  label: "Reply"
  inputs:
    - { name: body, type: markdown, required: true }
  grrp: ["record", "--act", "challenge", "--relation", "repliesTo",
         "--parent", "{subject.id}", "--body", "{inputs.body}"]
  preconditions:
    - has-open-question            # C4: an identified prior state exists
    - registrar-differs            # C2, applies at group tier+
```

Preconditions come from a closed vocabulary owned by the app (manifests may only cite them): `has-open-question`, `registrar-differs`, `tier: {personal|group|open}`, `subject.act|trigger|relation|disposition in […]`, `artefact-hashed` (bridge only), `charter-declares: <value>` (the extended trigger/target is actually in the project's charter), `disclosure-permits`.

What an action produces: `recording` and `bridge` produce exactly one transition (its id comes back from `grrp`, never computed by the app); `applicative` produces file/calendar state and **a test-enforced nothing** in `transitions/` (the existing upload test generalises: *every applicative action leaves the transitions directory byte-identical*).

Refusals surface at four distinct layers, and the layer is part of the design:

1. **Never offered.** Constitutive refusals are enforced by the manifest *loader*, not by absence: a denylist rejects any manifest declaring merge/combine, edit/delete-transition, mark-resolved, attendance, weight, score, count-across, or person/project kinds (§4.3). A bad manifest fails to load *entirely*, with the reason; it is never partially honoured.
2. **Disabled, with the reason shown** — a precondition unmet (`registrar must differ from per former at this tier`). The button stays visible: the affordance exists, the condition doesn't.
3. **Refused by `grrp` at execution** — stderr surfaced verbatim, nothing written. One implementation owns lawfulness.
4. **Refused and recorded** — where the protocol itself records refusals (e.g. a refused extension of a disclosure schedule), the app shows the recorded refusal as a fact of the record, not as an error.

45.1.7 3. The kind manifest

One YAML file per kind. Locations (resolution order, most local wins only on *equal specificity*):

```
web/packages/server/kinds/*.kind.yaml           # builtin, ships with the app
~/.gra/kinds/<charter-id>/<charter-version>/    # community kinds, installed from the charter package
```

Community kinds are **distributed with the charter** (the charter is already an identified, versioned, locatable document — Req 18.1/18.3), cached by charter id + version. They are applicative material: **never inside `.grrp/`, never in a bundle.** A project's trajectory already records its charter id+version, which is how a host knows *which* kind package to fetch — and the record is complete without it.

Common header:

```
kind: <namespaced id>        # gra.* reserved for builtins; charter kinds use <charter-id>/<name>
family: act | occasion | material | edge
version: 1                   # integer; bump on any change. Kind versions are NOT protocol
                             # or charter versions and never share a numbering (Req 19.2)
title: <label>
charter: null | { id: <charter-id>, version: <v> }
match: { ⋯ }                  # protocol facts only — never workspace state
degrades-to: transition | artefact | connection   # what a manifest-less host shows (§4.2)
components: [ ⋯ ]
actions: [ ⋯ ]
```

`match` may test only: `subject` (transition/artefact), `act`, `trigger`, `relation`, `target`, `artefact-scheme`, `cited-with-trigger` (for artefact subjects: the trigger on citing transitions). Nothing mutable, nothing computed.

45.1.8 3.1 Example — builtin occasion-kind: `meeting`

```
kind: gra.occasion.meeting
family: occasion
version: 1
title: Meeting
charter: null
match:
  subject: artefact                 # the meeting node IS the shared minutes artefact —
  cited-with-trigger: discussion    # same hash, one node, many edges (settled design)
degrades-to: artefact
components:
  - use: identity
  - use: note                       # workspace-facet
    id: agenda
    file: agenda.md                 # lives at nodes/<hash>/agenda.md — mutable, unbundled
  - use: material                   # record-facet: the minutes bytes, digest shown
  - use: bearing                    # record-facet: every transition that cites this hash
  - use: schedule                   # local-plane-facet: when/where/link. .gra/calendar/,
                                    # gitignored. Schema has no attendee field.
actions:
  - id: add-to-calendar
    class: applicative
    label: "Add to calendar"
    writes: local-plane             # transitions/ provably unchanged
  - id: join-meeting
    class: applicative
    label: "Join"
    opens: "{schedule.link}"        # opens the link from the local plane; records nothing (C1)
  - id: cite-minutes
    class: bridge
    label: "Cite the minutes from an act"
    inputs:
      - { name: act, type: enum, values: [claim, challenge, decision, transformation] }
      - { name: body, type: markdown, required: true }
    grrp: ["record", "--act", "{inputs.act}", "--trigger", "discussion",
           "--artefact", "{subject.id}", "--body", "{inputs.body}"]
    preconditions: [has-open-question, artefact-hashed]
```

Note what is *absent*: no attendance component, no `mark-held` recording action. A meeting that produced nothing recorded is a calendar entry (C1) — the `schedule` component alone, in the local plane, is that entry.

45.1.9 3.2 Example — community occasion-kind: `instrument calibration` (no protocol code touched)

The community's charter declares an extended trigger `calibration` (triggers are charter-extensible; `grrp` stores it as `local:calibration`, accepted and flagged, per `vocab.py`). The charter package ships this manifest:

```
kind: metrology-lab-charter/instrument-calibration
family: occasion
version: 2
title: Instrument calibration
charter: { id: "charter:metrology-lab", version: "3.1" }
match:
  subject: artefact
  cited-with-trigger: local:calibration
degrades-to: artefact
components:
  - use: identity
  - use: form                       # workspace-facet: structured setup notes, mutable
    id: setup
    file: calibration-setup.yaml
    schema:
      instrument: string
      reference-standard: string
      environment: string
  - use: projection                 # record-facet, read-only, no aggregation (§1.2)
    id: certificate
    title: Certificate
    select:
      - field: artefacts
        where: { scheme: state }
      - field: performed
      - field: performer
  - use: schedule                   # next calibration due — a commitment, not activity
actions:
  - id: schedule-calibration
    class: applicative
    label: "Schedule"
    writes: local-plane
  - id: record-calibration
    class: recording
    label: "Record calibration outcome"
    inputs:
      - { name: outcome, type: markdown, required: true }
      - { name: certificate, type: workspace-file, required: true }
    grrp: ["record", "--act", "verification", "--target", "method",
           "--trigger", "calibration",
           "--artefact", "{inputs.certificate.digest}",
           "--body", "{inputs.outcome}"]
    preconditions:
      - has-open-question
      - charter-declares: "trigger:calibration"
      - registrar-differs
```

The lab got: a recognisable node kind, a structured workspace form, a certificate facet, a due-date calendar, and a one-click lawful recording path — from one YAML file and one charter line. `grrp` was not modified; the act is `verification` (closed vocabulary), only the *trigger* is extended.

45.1.10 3.3 Example — edge-kind: `dispute` (a reified semantic edge)

A semantic edge is already a node: a `connection` transition carrying a CiTO relation, with the cross-question parent edge. The kind matches the transition, and the graph draws it as an edge while the panel opens it as a node.

```
kind: gra.edge.dispute
family: edge
version: 1
title: Dispute
charter: null
match:
  subject: transition
  act: connection
  relation: cito:disputes
degrades-to: connection
components:
  - use: identity
  - use: details                    # relation shown with its CiTO binding, disposition shown
  - use: endpoints                  # record-facet (edge-family default): the two states it joins,
                                    # each openable — from parents + the connection's own reference
```

```
  - use: workspace                 # inherited universal (§5): nodes/<transition>/ — the dossier
                                   # of the disagreement lives HERE, on the edge itself
actions:
  - id: annotate
    class: applicative
    label: "Add working notes"
    writes: workspace
  - id: reply
    class: recording
    label: "Reply"
    inputs: [ { name: body, type: markdown, required: true } ]
    grrp: ["record", "--act", "challenge", "--relation", "repliesTo",
           "--parent", "{subject.id}", "--body", "{inputs.body}"]
    preconditions: [has-open-question]
  - id: cite-evidence
    class: bridge
    label: "Cite evidence bearing on this dispute"
    grrp: ["record", "--act", "verification", "--relation", "supports",
           "--parent", "{subject.id}", "--artefact", "{inputs.file.digest}",
           "--body", "{inputs.body}"]
    inputs:
      - { name: file, type: workspace-file, required: true }
      - { name: body, type: markdown, required: true }
```

Note the absences again: no `resolve` action (dispositions are closed; a dispute's standing changes only when a later transition changes it), no `weight`, no `strength`. **Structural edges** (`follows`/`crosses`/`cites`) get none of this machinery at all: they are facts read off `parents` and `artefacts`, have no identity of their own, take no components, take no actions, and appear in no manifest. Only *claims* — connections — are reifiable, because only claims have content to hold.

45.1.11 4. Versioning, extension, and travel

45.1.12 4.1 What may be extended, and by whom

dimension / thing	extensible?	by	mechanism
`act` (8)	**never**	—	interoperability rests on it; a manifest naming a ninth act fails to load
`disposition` (3)	**never**	—	`unresolved` is the point; no manifest may add, remove, or alias one
grounds of restriction (4)	**never**	—	free invention of grounds makes withholding free
`target`	yes	charter	value + definition in the charter (Req 18.2); stored as `local:` until/unless bound
`trigger`	yes	charter	same
`relation`	the three named locals only, plus charter-defined `local:` values	charter	CiTO stays the binding for everything CiTO covers (C12); locals flagged, never presented as bound
kinds, components-instances, actions	yes	charter package or builtin	manifests, this spec

Amendment is prospective (Req 18.4): a kind manifest at version *N+1* changes how *future* screens render; it never re-interprets records, because it never interpreted them — it lensed them.

45.1.13 4.2 A record made under a community kind, arriving at a host without the manifest

The record must read as plain protocol, and it does, because the kind contributed nothing to it. The calibration transition on disk:

```
## trajectories/tq7/transitions/<id>.yaml — this is ALL that travels
id: trn:sha256:9f2a…
act: verification            # closed vocabulary — understood everywhere
target: method
relation: null
trigger: local:calibration   # retained unchanged, flagged as local (Req 16.5, vocab.py)
disposition: accepted
parents: [trn:sha256:1c44…]
prior_state: state:sha256:77b0…
posterior_state: state:sha256:e01d…
performer: key:ed25519:…
performed: 2026-08-14T09:12:00Z
artefacts:
  - { scheme: state, ref: "state:sha256:ab31…" }   # the certificate bytes, by hash
registration: { registrar: key:ed25519:…, attested: true, signature: … }
charter: { id: "charter:metrology-lab", version: "3.1" }
```

A manifest-less host: verifies the signature; renders it with the **family fallback** (generic transition node: `verification` of a `method`, trigger shown as `local:calibration` — `charter-defined, charter:metrology-lab@3.1`, artefact by digest); offers only the universal components and generic actions. Nothing is missing *from the record* — what is missing is a nicer tab layout and a pre-filled form. The host may fetch the charter package by the id+version the record itself carries and gain the lens; it must never rewrite the record to fit a lens it has (no normalisation — Req 16.5).

45.1.14 4.3 The manifest loader's denylist (constitutive refusals, enforced at load)

A manifest is rejected in full, with the reason, if it declares: a kind matching persons or parties (person-centric graph → C6/monitoring) ·a project-level kind (C4) ·any component named or shaped as attendance, presence, activity, streak, progress, importance, score, rank, weight, or count-across-trajectories (C6) ·any action whose `grrp` template edits or deletes (C3) ·any merge/combine action, under any name (C5) ·any action setting or adding a disposition value outside the closed three ·a `projection` using forms outside §1.2 ·a `schedule` schema extended with people fields.

45.1.15 5. Composition rules

1. **Universal components** — every node kind and every edge kind, non-removable, prepended automatically: `identity`, `workspace` (the brief's premise: storage is common to all nodes *and edges*), `provenance` where the subject is a transition.
2. **Family defaults**, added unless the kind is a stricter match that already covers them:
   - *act-family*: `details`, `bearing`, `material`, `disclosure`
   - *occasion-family*: `material`, `bearing`, `schedule`
   - *material-family*: `bearing` (who cites it), digest display; external works (doi/arxiv/url) get a resolver link, no workspace upload of other people's bytes
   - *edge-family*: `details`, `endpoints`
3. **Reified-edge inheritance**: an edge kind's subject is a transition, so it inherits the full universal set *as a node* — same workspace path scheme (`nodes/<transition>/`), same provenance, same disclosure sidecar. The manifest may **add** edge-specific components; it may never remove a universal one. One subject, one component set, two renderings (drawn as an edge in the graph; opened as a node in the panel).
4. **Additivity**: resolution unions components; conflicts on `id` resolve to the more specific kind's instance. Actions never union across kinds — exactly one kind's action list is offered (the resolved one), so a community cannot *shadow* a builtin recording action with a differently-wired one at equal match specificity: builtins win ties on actions, charters

win ties on components (a lens may be enriched; a recording path may not be quietly swapped).

5. **Class discipline is per-instance and static**: a component's class comes from its type, fixed in the app registry; no manifest field can move data between classes, which is what makes "does it travel?" answerable by grep.

Relevant files: `c:\Users\Micro\Desktop\relational_being_infrastructure\research\projects\Generative-Relational-Academia-Application\grrp\src\grrp\vocab.py` (closed vocabularies the denylist mirrors), `web\packages\server\src\records.ts` (the `nodeArea`/`runGrrp` seams the component classes and recording actions attach to), `notes\paper-IV-grrp-specification.md` §§16–19 (travel and charter rules §4 binds to), `plans\design-nodes-time-and-occasions.md` (the meeting/occasion precedent §3.1 encodes).

46 draft conformance

Original source: `applicative_infrastructure/gr_academia_application/plans/design-pass-graph-model/draft-conformance.md`.

Original source SHA-256: `ffb1649808f2d4609eb4805cdd0145852107b549b7d4ef5f700bb9542266e9cd`.

46.1 Adversarial conformance review — feature gauntlet + skeleton audit

Rulings key: **(a)** safe as-is ·**(b)** safe only under the stated reformulation (layer named) ·**(c)** must be refused (constraint named, with a reason a user would accept). Layers: *record-facet*, *sidecar-facet*, *workspace-facet*, *local-plane-facet*; action classes: *recording*, *applicative*, *bridge*.

46.1.1 Part I — 38 things people will predictably ask for

46.1.2 (a) Safe as-is

1. **Node detail panel showing signed fields** (act, target, relation, trigger, disposition, performer, attestation, identifier). Record-facet, read-only projection. Already settled in the design note. Nothing computed may appear beside it.
2. **Cite-this-transition / export citation.** Emits identifier + CiTO term. Serves C10 and C12 directly. Record-facet + applicative copy action.
3. **Color/shape nodes by act or disposition.** Both vocabularies are closed and part of the signed payload; a legend over 8 acts and 3 dispositions is a projection, not a judgment. Record-facet.
4. **Vocabulary validation on entry** (reject unknown relation, flag `local:` as unbound). `resolve_relation` already does this; presenting unbound values as bound is the violation, refusing them is not. Recording-action plumbing.
5. **Counts inside one open trajectory's detail view** ("this question has 4 challenges, 2 unresolved"), shown only when that trajectory alone is open. Explicitly permitted by C6's carve-out — but see skeleton finding S8 for the badge trap.
6. **Bundle export / take-the-record-and-leave.** C10 is not just permitted, it is owed. Any friction added here is itself a finding.

46.1.3 (b) Safe only under reformulation

7. **Meeting RSVP.** Reformulation: a personal *add-to-calendar* entry in the requester's own local plane (`.grrp/`-adjacent, never exported). Refused variant: any shared roster of who intends to come — a pre-attendance list is an attendance list with a tense change. Layer: local-plane-facet.
8. **Activity feed.** Reformulation: *chronology of a single project*, ordered by `performed`, no per-person facet, no cross-project merge, no recency badges — exactly the design note's "calendar of chronology." Refused variant: any feed filterable by performer or unioned across projects (C6, per-person timeline). Layer: record-facet.
9. **Notifications.** Reformulation: local-plane alerts derived from record changes the user can already read ("a new transition took your state as parent"), computed client-side, never stored, no delivery/read receipts anywhere. Refused variant: server-side notification log or "seen" state — that is the event plane exported. Layer: local-plane-facet.
10. **Importance stars / pins.** Reformulation: a *private pin*, local-plane only, invisible to every other party, no count, never exported. Refused variant: shared or aggregated stars (C6 scalar over trajectories). Layer: local-plane-facet.
11. **Search.** Reformulation: filtering plus deterministic orderings (chronological, lexical); per-query text match may order results but the score is ephemeral, never displayed as a number, never persisted as an index, never applied to performers, and must work offline (C9, C11 — the search cache is rebuildable from files). Refused variant: "relevance" as a standing ranking over trajectories (C6 in a trench coat). Layer: applicative, rebuildable cache.

12. **Task lists.** Reformulation: notes in a *workspace* folder — mutable, unbundled, self-maintained; a person may write "I will address the objection." Refused variants: assignment of tasks *to* other people with tracked completion status (an obligations ledger is C6-adjacent accountability plumbing and pressures fabricated closure), and any rollup of open/closed tasks. Layer: workspace-facet.
13. **Deadlines.** Reformulation: the calendar of commitments already sanctioned — `release_at`, embargo expiry, shorten-only (sidecar-facet); plus private local-plane reminders. Refused variant: a deadline attached to a challenge or question ("resolve by Friday") — the vocabulary keeps `unresolved` precisely so that closure is never owed on a date.
14. **"Mark resolved."** Reformulation: a *recording action* — "record a `decision` (or `verification`) that addresses this challenge," a full new transition with content, citing the challenge's state (C3, C4). The disposition of the old transition never changes; the graph shows the answer standing next to the objection. Refused variant: any state flip on an existing node (C3 + closed dispositions).
15. **Approval workflow.** Reformulation: approval-as-record is an `agrees`/`supports`/`confirms` connection transition by the approving party, or attested registration (C2) — visible endorsement, never a gate. Refused variant: approval as a precondition for recording or publishing — C10 says nobody's permission is required to continue the record, including yours. Layer: recording.
16. **Private comments.** Reformulation: workspace notes — mutable, unsigned, never bundled; they enter the record only via the bridge (cited by hash inside a real act). Refused variant: a private thread stored *in* the record with narrowed visibility — disclosure widens only (C7), so the record cannot carry content that is secret-by-audience. Layer: workspace-facet.
17. **Comment threads on a transition (public).** Reformulation: threads are a *presentation* of `repliesTo` chains — connection transitions with content, signed, ordinary nodes. Refused variant: a lightweight unsigned comment table beside the record — that is a parallel, unattested record of scholarly speech (C1, C2, C12). Layer: record-facet over recording actions.
18. **Delete.** Reformulation: three honest deletions exist — (i) anything applicative, freely (that layer "costs nothing to delete"); (ii) *content* removal via redaction with a stated ground from `REDACTION_GROUNDS`, skeleton and signatures staying valid (C8); (iii) *standing* removal via a `retracts` transition (C3). Refused variant: deleting a transition (C3, no exception).
19. **Project archiving.** Reformulation: record-side closure is a `release` act or simply stopping; UI-side, hide the project from *my* workspace list (local-plane). Refused variant: unpublishing — C7, disclosure never narrows; see item 30.
20. **AI involvement.** Reformulation: `trigger=ai_suggestion` on a transition performed and signed by a human — the vocabulary already says a model "may occasion a transition and may not author or register one." Refused variant: model-as-performer or model-as-registrar (C2 — attestation between a person and their own tool is theater). Layer: recording.
21. **Auto-summaries.** Reformulation: optional, offline-capable, regenerable applicative caches, visually marked as unsigned derivations, never bundled, never the default face of a node (the signed content is the identity; a paraphrase presented as the node misattributes words to a signature). System must be fully usable with the feature off (C9). Layer: applicative cache under C11.
22. **Watch lists.** Reformulation: a private local-plane bookmark list — my attention, on my machine, visible to no one. Refused variants: "followers of X," follower counts, "who watches this" — a directory of attention is a monitoring record whichever direction you read it (C6 + the event-plane ruling). Layer: local-plane-facet.
23. **@mentions.** Reformulation: a mention inside content is just content; a mention in a workspace note may raise a *local* notification for the mentioned party's own client. Refused variant: mention analytics or a who-mentions-whom graph (C6, person-centric graph).
24. **Transition templates / prefill.** Reformulation: applicative prefill of vocabulary fields for a real act the user is already performing. Refused variant: template-driven prompting that solicits transitions ("weekly update template") — an operation whose purpose is that a record exist (C1).
25. **Draft transitions.** Reformulation: a draft is a workspace file — mutable, unsigned,

invisible to the record — until the moment of recording; there is no "draft" status in the record, because an unsigned record state would let signatures attest to things that later changed (C3, C8). Layer: workspace-facet → recording.

26. **Undo.** Reformulation: applicative undo freely; record undo is `retracts` (cito:retracts) — a new transition that says so, forever (C3).
27. **Sync/backup service.** Reformulation: transport of plain files and bundles (git, rsync, sneakernet); the service is a courier, never the system of record, and everything works with it absent (C9, C11).
28. **Duplicate / "related question" suggestions.** Reformulation: optional applicative aide, offline-degradable; acting on a suggestion is a human-performed `connection` with `trigger=ai_suggestion` if a model surfaced it. Refused variant: auto-created connection transitions (C1 + performer must be a person).
29. **Onboarding tutorial.** Reformulation: the tutorial drives a disposable demo repository, never the user's real record — practice transitions in a real trajectory are records manufactured so records exist (C1). Layer: applicative.

46.1.4 (c) Must be refused

30. **Unpublish.** C7. *"Others may already have continued from what you shared; the protocol promises them the ground under their work cannot be pulled back — redaction of content is available, retraction of standing is available, un-happening is not."*
31. **Person/profile node.** C4 + C6 + the monitoring ruling. *"The moment a person is a node, everything they did aggregates to them, and the graph becomes a dossier; the record attaches to states, and a performer is a key on a transition, not a place things pile up."* (The one survivable residue — a key-fingerprint verification panel — is applicative and is not a node.)
32. **Attendance lists.** Settled outright: the event plane is never exported. *"A log of who was present is a monitoring record by construction — the single failure with the largest consequence for participants — so presence is never written down, anywhere, in any layer that travels."*
33. **Progress bars.** C6, and the disposition design. *"A progress bar is a scalar over a trajectory and a promise of completion; this record exists to say honestly that most objections stay unresolved, and a bar stuck at 80% punishes exactly that honesty."*
34. **Kanban states.** Closed dispositions + C12 (parallel vocabulary) — the brief's own instinct is right. *"A column is a disposition vocabulary in disguise: 'done' is a fourth disposition the protocol deliberately refused, and dragging a card is an unsigned, unattested reclassification of a signed event."*
35. **Edge weights.** C6, plus reification. *"A semantic edge is already a signed transition; a weight would be an unsigned number ranking relations against each other, which is exactly the scoring the record refuses."*
36. **Reactions/emoji.** C6 + C2 + C1. *"A reaction is an endorsement with no content and no attestation that exists to be counted; the protocol's version of [approval] is an `agrees` transition where you say why, under your key."*
37. **View counts.** C6 + monitoring. *"Counting reads requires logging readers — a record of attention on both sides of the number — and no count over participants is ever shown."*
38. **Contributor leaderboards.** C6, verbatim. *"Any ranking of participants converts the record into the metric it was built to escape; there is no screen that answers 'who did most.'"*
39. **Merge/combine of branches.** C5, including the word ban. *"Divergent states both remain true records of what was understood; a transition may take both as parents and say, in content, what it makes of the divergence — but nothing collapses them, and no interface surface ever offers the word."*
40. **Edit-in-place on record content.** C3. *"The signature covers the bytes; a corrected understanding is a new transition with `modifies` or `replaces`, so the record shows both that you were wrong and that you noticed."*
41. **Cross-project dashboard.** C6. *"Two projects' numbers on one screen is a comparison whatever the labels say; projects are opened one at a time, and each shows only its own chronology."*
42. **Per-person timeline / filter-by-performer view.** C6 + design note's explicit ban. The files are portable and grep-able (C10) — anyone *can* compute this — but the application

must not offer the affordance. *"The record cannot stop you from studying a person; it can decline to be an instrument built for it."*

43. **"You haven't recorded in N days" nudges, streaks, badges.** C1 (and C6 for streaks). *"An operation that exists so that a record exists is the definition of the failure; the record is a byproduct of work, and silence is a permitted state of work."*
44. **"Last active" / presence dots.** Monitoring + C6. *"Presence indicators are attendance streamed live."*
45. **Graph-metric overlays** (centrality, node size by degree, influence). C6; design note: "a node with many edges is a node with many edges." *"Any computed prominence is a ranking over trajectories with extra steps."*
46. **Color-by-performer on the canvas.** C6/monitoring: it converts the graph into a per-person activity map at a glance. Performer stays where it is — in the detail panel of one node at a time.
47. **Time tracking.** C6 + monitoring + C1. *"Hours are a scalar over a participant, gathered by watching them."*

46.1.5 Part II — Audit of the skeleton itself

S1. Occasion-kinds risk violating C1 at the constructor. If "meeting" is a node kind, someone will build a *create meeting node* button — a node existing so the occasion is on record, with zero acts behind it. The precedent already decides this: a meeting that produced nothing recorded is a calendar entry. The spec must state that occasion-kinds are **derived** groupings (transitions sharing a cited artefact + trigger), never directly creatable, and that an occasion with no transitions does not exist in the graph.

S2. Occasion rollup = attendance by reconstruction. CRediT contributions per act are legitimate (C12), but an occasion-kind view that unions contributors across its transitions into a "participants" panel has rebuilt the attendance roster from signed parts. The occasion view may list its *transitions*; it must never present a merged roster of people. This is the single most likely quiet violation in the whole skeleton.

S3. The user's own example, "join-meeting action," is a trap the skeleton doesn't defuse. Join must be a pure launcher (open URL, add to own calendar) that writes nothing anywhere — the moment joining leaves a trace, it is presence logging. Name this explicitly in the action spec, because "join" naturally suggests membership state.

S4. "Bridge" cannot be a free-standing action class. The precedent says the bridge *is an act*: material joins the record only when a transition cites it. If bridge exists as its own button producing a bare citation-transition with no other content, that transition exists solely so a record exists (C1) and cites nothing specific in the sense C4 demands. Fix: bridge is a *parameter of recording actions* (an `artefacts` picker inside a real act), not a sibling class — or the spec must require that every bridge rides on a genuine act with content.

S5. Administrative operations have no home. `vocab.py` defines `OPERATIONS` (disclosure_changed, redaction, key_rotation, fork_declared, attribution_contested, binding_recorded, deposit_recorded) and `REDACTION_GROUNDS`. The skeleton's three action classes (recording / applicative / bridge) cover none of these: they are not acts, not applicative (they have record-plane consequences), not bridges. Either add a fourth class — *administrative* (sidecar/operations plane, widen-or-remove-content-only, grounds required) — or the redaction path (C8's whole point) will get bolted on ad hoc.

S6. Presentation names over acts strain the vocabulary's own rule. "Act-kinds as they read to a person" is fine until a friendly label drifts ("Objection" for `challenge`, "Answer" for `decision`) and becomes a de facto parallel vocabulary (C12; vocab.py: never present a value as something it isn't). Rule to add: presentation labels map 1:1, the protocol term is always inspectable one gesture away, and labels are never persisted into anything that travels.

S7. Structural edges "no identity, no components" needs its justification stated, or it will be reverted. Someone will want to *challenge a parent link* ("this doesn't actually follow from that") and will ask for edge identity to do it. The right answer exists and should be written in: the parents list is part of the child's signed payload, so you challenge the **child transition** (C4 gives you the specific state). Without this paragraph, edge identity gets added "just for commenting" and reification leaks into structural edges.

S8. The C6 carve-out will leak through badges. “Counts within one trajectory, shown without comparison” — but a canvas showing many trajectories, each node wearing a “3 challenges” badge, *is* comparison by juxtaposition. The spec must scope counts to the single-trajectory detail context (panel of one selected thing), never to decorations rendered simultaneously across the graph.

S9. Semantic edges inherit “every component a node gets” — including local-plane calendar. Mostly free and correct (reification pays off), but audit the inheritance rather than granting it wholesale: a calendar facet on a relation is meaningless surface area, and unused surfaces are where the next feature request lands. Grant components per kind, by argument, not by inheritance.

S10. Material-kinds referencing doi/arxiv/url must degrade offline. C9: an external-work node may *hold* a resolvable reference but must render fully (identifier, citing transitions) with no network. Live metadata fetch is an optional applicative enhancement, cached under C11.

S11. The refusal list is incomplete and asymmetric. It refuses “mark-answered” without naming the legitimate neighbor (a `decision`/`verification` transition citing the challenge — item 14), which invites implementers to conclude challenges are dead ends. And it omits refusals this review found load-bearing: no view counts or read logs, no per-person filter/timeline (already banned in the design note but absent here), no reaction counts, no relevance-as-standing-index, no presence indicators, no occasion roster (S2). A refusal list that undersells is a refusal list that gets “extended” by whoever draws the next screen.

S12. One wording nit with teeth. The brief says semantic edges get workspace storage “for free.” Nothing near C1–C12 is free; each inherited component either survives the same twelve tests independently or it doesn’t ship. Recommend the spec’s own language never uses “for free” — it is how the applicative layer’s mutability gets mistaken for a general license.

47 draft practice

Original source: `applicative_infrastructure/gr_academia_application/plans/design-pass-graph-model/draft-practice.md`.

Original source SHA-256: `10c69911abad9a95efeb96cc99aa38d0cd22b257808898241122f871dc64e6c3`.

47.1 GRA from the bench: node kinds, edge kinds, components, actions for working researchers

Lens: a small lab / theory group / field team, day to day. Every item below is tagged **[P]** protocol (in the signed record) or **[A]** applicative (mutable, never signed, never bundled), and mapped to the exact protocol mechanism — act / target / relation / trigger / disposition / artefact / field — or refused with the nearest lawful alternative. Nothing here proposes a new record type: node kinds are *presentation kinds* over the five-dimensional transition vocabulary; occasion and material kinds are realised by trigger + shared cited artefact, per the settled meeting precedent.

47.1.1 1. Node kinds

47.1.2 1.1 Act-kinds (presentation of the 8 closed acts) — all [P] facts, [A] rendering

Node kind	Protocol realisation	Researcher reading
Question	`act: question`, origin of a trajectory	"what we are asking"
Claim	`act: claim`	a stated position or result
Challenge	`act: challenge`	an objection, anomaly, counterexample
Transformation	`act: transformation`	a reformulation, revision, derivation step
Decision	`act: decision`	a chosen path, an abandoned one
Connection	`act: connection`	a reified semantic edge (see §2)
Verification	`act: verification`	replication, check, confirmation
Release	`act: release`	disclosure event: preprint, dataset publication, talk

No further act-kinds may exist (closed vocabulary). Every research-life "event node" below must resolve to one of these eight or be applicative.

47.1.3 1.2 Occasion-kinds — [A] grouping over [P] facts; never a record type

Realised uniformly as: shared cited artefact (same hash ⇒ one node, many edges) + `trigger` on the resulting transitions + CRediT `contributions` per act. An occasion that produced no transition is a calendar entry only (C1).

Occasion kind	Trigger	Shared artefact (by hash or scheme)	Typical resulting acts
Lab meeting	`discussion`	minutes	decision, challenge, claim
Seminar / invited talk	`discussion` or `literature`	slides, abstract, recording hash	question, connection, challenge
Reading group / journal club	`literature` + `discussion`	the paper (`doi:`/`arxiv:`) — the external work itself is the shared node	challenge, connection, claim
Supervision meeting	`discussion`	meeting note	decision (student), with supervisor's part typed `credit:Supervision` in `contributions` — a role in an act, never a status

Occasion kind	Trigger	Shared artefact (by hash or scheme)	Typical resulting acts
Whiteboard session	`discussion`	photo of the board (hash)	transformation, claim
Experiment run	`experiment`	run log, raw output (hash)	claim, challenge (anomaly), verification
Simulation / parameter sweep	`simulation`	config + output hashes	claim, challenge, verification
Field trip / observation session	`observation`	field notes, GPS-stripped-as-needed media (hash)	claim, question, challenge
Failed attempt	`failure`	whatever evidenced the failure	decision (abandon path), challenge
Conference attendance	`literature`/`discussion`	the talk's paper or notes	connection, question
Onboarding of a newcomer	`entering_party`	the material absorbed (see §6.14)	question, claim, connection with `absorption` filled
AI-assisted analysis session	`ai_suggestion`	model output artefact	any act — model may occasion, never perform/register

Occasion detection is derived, not stored: the UI clusters transitions sharing an artefact hash + trigger + time window. No occasion identifier enters the record.

47.1.4 1.3 Material-kinds — [P] when cited, [A] while in workspace

A material node exists in the graph **only because at least one transition cites it** in `artefacts` (C1, C4). Before citation it is a workspace file, invisible to the record; a test already asserts upload changes no transition.

Material kind	Realisation
Held artefact (data file, figure, script, minutes, draft, photo, transcript, calibration file, instrument config)	`state:`/hash reference in `artefacts`; bytes in project file store (C8: deletable, skeleton stays valid)
External paper	`doi:` / `arxiv:` / `isbn:` reference — same hash/id ⇒ one shared node lab-wide
Web resource / preprint server page / code repo URL	`url:` reference
Dataset (versioned)	each version = distinct hash = distinct material node; "new version" = transformation transition, target `artefact`, relation `modifies`, citing the new hash, parent = the transition that cited the old one (C4: specific prior state, never "the dataset" as a whole)
Code release	`release` act, target `artefact`, citing the archive hash and/or `url:` of the tag; day-to-day commits stay applicative (git is workspace)
Manuscript draft vN	hash of the draft; revision = transformation citing the new hash (see §6.10)
Ethics approval, grant letter, MTA, DUA	artefact cited by the `decision` it licensed
Physical specimen / sample	**cannot be hashed** — nearest lawful: its metadata sheet (ID, collection record) is the artefact; the specimen itself is applicative inventory (§5)
Instrument	**refused as record node** (a thing-as-a-whole violates C4's spirit; a person/thing-centric graph invites C6). Nearest lawful: instrument *settings/calibration file* as artefact; instrument registry + booking in the local plane

47.1.5 2. Edge kinds

47.1.6 2.1 Structural (facts; no identity, no components, no actions)

Edge	Source	Notes
Follows (parent, same trajectory)	`parents` list	the DAG; branching = divergence, permanent (C5: never combined, the word never appears)
Crosses (parent, other trajectory)	`parents` entry created by `grrp connect`	cross-question edges are ordinary parent edges
Cites-artefact	`artefacts` field	transition → material node
Registered-by (attestation)	`registration` field	shown per transition only; **never aggregated per registrar** (C6)
Absorbed	`absorption` field	newcomer's transition → the specific prior states absorbed

47.1.7 2.2 Semantic (reified — each IS a connection transition, so it is a full node)

One presentation edge-kind per relation: the 16 CiTO bindings (`extends`, `modifies`, `refines`, `replaces`, `disagrees`, `agrees`, `supports`, `refutes`, `confirms`, `retracts`, `repliesTo`, `usesMethodIn`, `relates`, `supportedBy`, `usesDataFrom`, `disputes`) plus charter-local `generalises`, `specialises`, `transfers` (flagged, never presented as bound). Because the edge is a transition, it gets **every node component for free** — including workspace storage ("why this connection matters" can hold pages of argument, figures, worked examples). This is the answer to "edges should also have components": already true by reification; nothing to add at the protocol layer.

47.1.8 2.3 Derived presentation edges — [A] only, recomputed from files (C11), never stored, never exported

Derived edge	Computed from	Guard
Same-occasion (two transitions cite the same minutes/run log)	shared artefact hash	no count displayed across occasions (C6)
Same-source (two transitions cite the same paper)	shared `doi:`	reading-group view
Chronological adjacency within one project	`performed`	within-project only, no cross-project comparison (C6)

47.1.9 2.4 Refused edge features

- **Edge weights, strengths, confidence scores** — C6. Nearest lawful: the connection transition's *content* states the strength in prose; its `disposition` (accepted/contested/unresolved) is the only typed qualifier.
- **Person→person edges** (co-author graph, supervisor graph) — person-centric graph, C6/monitoring. Nearest lawful: none; CRediT roles live inside acts.
- **"Blocks/depends-on" task edges** — [A] task board only, never exported.

47.1.10 3. Components (the four classes, assigned per kind)

Universal on every node and every reified edge (the requested common component): **Local storage / workspace-facet** — `nodes/<transition>/`, ordinary mutable folder, records nothing; material enters the record only via a bridge action (§4.3).

47.1.11 3.1 Record-facet components (projections of signed fields; strictly read-only)

Component	Fields shown	Carried by
Identity	hash id, full and copyable	all record nodes
Type	act, target, relation (with bound/local flag), trigger, disposition	all
Provenance	performer, `performed`, contributions (CRediT), absorption, registration (attested? by whom? signature)	all
Material list	`artefacts` with digests — reads as the per-node file list; **cite, not own**	all
Bearing	parents / children / crossings	all
Occasion badge	trigger + shared-artefact cluster	transitions from occasions
Rationale	the state file's content (the "why")	all; the payload of connection edges

47.1.12 3.2 Sidecar-facet components (disclosure; widen-only, C7)

Component	Content
Disclosure status	current audience; history of widenings
Ground of restriction	one of the four closed grounds (rivalry/hazard/vulnerability/appropriability) with its stated residue
Release schedule	`release_at` (vulnerability only); shorten-only; refused extensions are themselves recorded
Redaction notice	redaction ground; skeleton+signature remain valid (C8)

47.1.13 3.3 Workspace-facet components (mutable, never bundled, deleting costs nothing)

Notes/scratch; draft material; run outputs awaiting citation; PDF annotation layer on cited papers; figure staging; code checkout; analysis notebooks; reviewer-response drafting table; onboarding tour bookmarks; task checklist (per node, not per person).

47.1.14 3.4 Local-plane-facet components (.grrp/events etc.; never exported)

Meeting details (time, place, video link, agenda); calendar entry; instrument booking; deadline entry (conference, grant, ethics renewal); reminder. **Commitments and chronology only, never activity** (settled). No attendee list anywhere, even locally: attendance is never recorded.

47.1.15 4. Actions (three classes)

47.1.16 4.1 Recording actions (each produces one transition through grrp; named by act)

`ask` (question — opens a trajectory), `claim`, `challenge`, `transform`, `decide`, `connect` (creates a semantic edge = full transition), `verify`, `release`. Plus **register/attest** (registrar ≠ performer at group tier, C2 — the credibility mechanism) and the administrative operations already in vocab: `disclosure_changed` (widen only), `redaction`, `key_rotation`, `fork_declared`, `attribution_contested`, `binding_recorded`, `deposit_recorded`.

47.1.17 4.2 Applicative actions (change workspace/local state; produce nothing in the record)

Schedule meeting; add-to-calendar; join-meeting (opens the link); book instrument; upload file to workspace; annotate PDF; edit notes; arrange/filter/pin the graph; add deadline; start onboarding tour; delete any of the above. A test-backed invariant: none of these touch the transitions directory.

47.1.18 4.3 Bridge actions (deliberate, visible promotion of workspace material into the record)

Cite-material (new transition whose `artefacts` includes the file's hash — usually a `connection` when attaching after the fact, per C3); cite-external (`doi:`/`arxiv:`/`url:`); attach-minutes (the meeting bridge); publish-dataset-version (release citing the hash); deposit (release + `deposit_recorded`). The bridge is always an act — there is no silent "sync folder to record".

47.1.19 5. Scenario walkthroughs (the daily-life checklist, each mapped)

1. **Lab meeting** — [A] schedule + details in local plane. During: notes in a workspace. After: attach-minutes bridge; each outcome its own transition, `trigger: discussion`, minutes hash shared ⇒ one meeting node, many edges; `contributions` per act. Nothing recorded ⇒ calendar entry only (C1). Attendance never recorded.
2. **Seminar** — same shape; external speaker without a key is not a performer: the lab member who took something from it performs (e.g. `connection`, relation `relates`/`extends`, `trigger: literature`) citing the abstract/slides.
3. **Reading group** — the paper (`doi:`) is the shared node. Per participant: `challenge` (relation `disputes`), `claim` (relation `agrees`/`supports`), `connection` (relation `usesMethodIn`) with `trigger: literature`; disagreements between members stay as sibling transitions with `disposition: contested` or `unresolved` — no combining (C5).
4. **Experiment + runs** — design: `decision`, target `method`, citing the protocol/SOP hash. Each run's outputs land in workspace (recording nothing — C1 protects against run-logging bureaucracy). A run that shifted understanding: `claim`/`challenge`/`verification`, `trigger: experiment`, citing run log + data hashes, parent = the specific hypothesis state (C4). Anomaly: `challenge`, `disposition: unresolved` — and it may lawfully stay unresolved forever. Deviation from protocol: charter-extended `target` (lab charter adds deviation types — explicitly anticipated).
5. **Datasets** — see §1.3; cross-trajectory reuse: `connection`, relation `usesDataFrom` (cito:usesDataFrom), which also makes the source transition a parent. Publication: `release` + `deposit_recorded`, DOI bound via `binding_recorded`.
6. **Code** — repo is workspace. A result depends on code: the transition cites the exact archive hash (`usesMethodIn` for someone else's code). Release: `release`, target `artefact`. CI, branches, issues: all [A].
7. **Instruments** — registry, booking, maintenance log: [A] local plane (booking is also presence-adjacent — never exported). Calibration file: artefact cited by the runs that depended on it. Restricted access: **rivalry** ground — the restriction covers access, never the trajectory (its stated residue).
8. **Field observations** — `trigger: observation`; field notes/media by hash; consent forms are artefacts cited by the `decision` to collect; personal data in content: redaction ground `personal_data` removes bytes, skeleton+signatures survive (C8). Works offline in the field (C9) — record at camp, register on return (C2 allows registrar later than performer).
9. **Peer review received** — reviewer with a key (best): they perform `challenge`, relation `disputes`, `trigger: objection`, we register (C2). Reviewer anonymous/external: we perform transitions responding, `trigger: objection`, citing the review report hash; response letter = `transformation` + `repliesTo`. Point conceded: `disposition: accepted` on our replying transition; point stood-beside: `unresolved` — the mandatory honesty case.
10. **Revision cycles** — each draft a hash; each revision a `transformation`, target `artefact`, relation `modifies` (cito:updates), parent = the previous draft's transition (C4). Camera-ready: `release`. The revision chain is the trajectory itself — no separate "version history" mechanism.

11. **Failed directions** — `decision`, target `path`, `trigger: failure`, relation `retracts` or `replaces` on the specific abandoned state; content says why. The branch stays in the DAG forever (C3) — presentation may render "closed path" leaves dimmed, never deleted, never scored.
12. **Conference deadlines** — [A] local calendar (commitment, legitimate). Submission: `release` citing the submitted PDF hash; acceptance letter an artefact; camera-ready another `release`. No countdown-pressure analytics beyond the plain date.
13. **External collaborations** — outsider gets a key ⇒ ordinary performer; `trigger: entering_party` on their first transitions with `absorption` filled. They may take the whole record and continue elsewhere without permission (C10); divergence is `fork_declared`, not a fight over the canonical copy. Disputed credit: `attribution_contested` — an operation, not an edit (C3). IP-constrained collaboration: **appropriability** ground; residue (existence, questions, decisions, negative results) stays visible.
14. **Student joining mid-project** — [A]: onboarding tour over the DAG (guided path through prior states — the graph *is* the onboarding document). [P]: their first acts carry `trigger: entering_party` + `absorption` referencing the specific states absorbed (C4 — never "joined the project"); their key registered; they attest others' acts immediately (C2 gives newcomers a real role from day one). Their naive `question` transitions are first-class — a newcomer's question is an origin state, not noise.
15. **Preregistration** — `release` of the hypothesis state before the experiment; later `verification/challenge` transitions parent it. **Vulnerability** ground with `release_at` for embargoed prereg; shorten-only.
16. **Grants / ethics / admin** — letters are artefacts cited by `decision` acts; `credit:FundingAcquisition` types the part; renewal dates are [A] calendar commitments. Grant reporting **must not** become a metrics surface: export for a funder is a bundle plus prose, never a dashboard (C6).

47.1.20 6. Refused, with nearest lawful alternatives

Wanted in labs everywhere	Why refused	Nearest lawful
Person node / member page / profile graph	person-centric graph → C6, monitoring	CRediT contributions inside each act; filter view by performer is at most a transient [A] query, never a stored or exported view
Project node, project status	C4: nothing attaches to a project as a whole	the trajectory's question node is the anchor; chronology within one project is permitted, uncompared
Attendance, attendee list, RSVP tracking	settled: never recorded, even locally	meeting logistics without people; presence is inferred by no one
Activity heatmap, streaks, per-person timeline, leaderboard, h-anything	C6 verbatim	calendar of commitments; within-one-trajectory counts shown without comparison
Merge of divergent branches	C5; the word never appears	a new transition citing both states as parents *as a claim about their relation* (`connection`) — divergence remains visible
Edit/annotate a past transition "to fix it"	C3	new transition, relation `replaces`/`retracts`
Mark-answered / close-question button	dispositions closed; fabricated closure	a new `decision` or `verification` with `disposition: accepted`; or it stays `unresolved`, which is the point
Meeting/experiment as new record types	closed act vocabulary; portability	occasion pattern (trigger + shared artefact + contributions)
Auto-record every run / every commit	C1 byproduct-only; recording cost kills adoption	workspace holds everything; bridge actions promote deliberately
Progress %, importance stars, priority ranks	C6 scalars	disposition + prose in state content

Wanted in labs everywhere	Why refused	Nearest lawful
Unpublish / retract-from-view	C7 widen-only	`retracts` relation (the retraction is public); redaction removes bytes only, with a stated ground
AI agent authoring or registering transitions	performer/registrar are keyed parties	`trigger: ai_suggestion` marks provenance; a person performs

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47.1.21 7. Priorities from this lens

The occasion pattern (minutes-hash + trigger + contributions) covers meetings, seminars, reading groups, runs, and field sessions with **zero new protocol surface** — invest in making the bridge actions (attach-minutes, cite-material) one gesture each, because C1 means anything slower simply won't be recorded. Second: reviewer keys and `entering_party` onboarding, since peer review and mid-project joins are where the record either earns trust (attested challenges, honest `unresolved`) or gets bypassed. Everything a forge would ship as a dashboard is either the [A] commitments calendar or refused.

48 implementation plan

Original source: `applicative_infrastructure/gr_academia_application/plans/implementation-plan.md`.
Original source SHA-256: `b4435a4fa139ddb703ff7dc3086046f6de4af84d94b55c6a29f5a985e5aa611c`.

48.1 GRRP — implementation plan

Single plan for the reference implementation of the **Generative Relational Research Protocol v0.1**. Supersedes `implementation_plan.md` and `GRRP-implementation-plan.md`, both retired.

Authority. The specification governs where this document and the papers differ: *Specifying the GRRP*. This plan restates only what a builder needs, and cites the requirement behind each item so a disputed choice can be traced.

Where the work is. `grrp/` ·notes: Paper I ·II ·III ·IV ·glossary

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48.1.1 Status

Milestone		
M0 Skeleton — layout, canonical hashing, `init`	[check] done	1–2 days
M1 Personal tier — **ship here**	[check] done	1 week
M1 usability pass — editor prompts, defaulted references, `show`	[check] done	1 day
Gate Use it on real work for two weeks	[unchecked] **deferred by decision**	2 weeks
M2 Integrity — full act vocabulary, chain verification, redaction	[check] done	3–4 days
M3a Group tier — keys, signatures, attestation	[check] done	3 days
M3b Attribution and absorption	[check] done	2 days
M3c Disclosure classes, grounds, monotone release	[check] done	3 days
M4 Open tier — bundle, continue, profile, deposit, seal	[check] done	1 week
UI A local page — Level 3, outside conformance	[check] done	1 day
M5 Conformance suite	[unchecked]	3–4 days

175 tests pass; 1 is skipped, and it is platform-specific. A walkthrough of the whole thing is at `grrp/examples/walkthrough.sh`; writing it found two bugs in `bundle` that argument had not, and running it on another platform found a third, worse one: **records written on Windows did not verify anywhere**, because `Path.write_text` translates newlines and the identifier is the hash of the bytes. **All eight acceptance tests pass.**

48.1.2 0. The constraint register

Never violated. Where a decision touches one, it is recorded in notes/gaps-and-repo-actions.md §F rather than settled quietly.

	Constraint	Consequence for the code	Requirement
C1	**Byproduct only**	Every command serves a purpose the user has anyway. Its `--help` names that purpose. A command whose only purpose is that a record should exist is not written.	R1 ·P-IV Req. 4.2, 20.6
C2	**Attested registration**	At group tier and above the registrar must differ from the performer. Refuse when the keys are identical.	R3 ·P-IV Req. 8.1–8.2
C3	**Append-only**	Nothing is edited or deleted. A correction is a further transition referencing the one corrected. Current state is derived on demand.	R5 ·P-IV Req. 4.4
C4	**Granularity**	A transition references a specific identified prior state. Project-, repository- or person-level records are rejected.	R4 ·P-IV Req. 4.5
C5	**No merge**	No operation combines two divergent states. The word appears nowhere in the interface.	R6 ·P-IV Req. 10.5
C6	**No scalars**	No count, score, ranking or index over participants or trajectories — not computed, stored, displayed or exported. Counts *within* one trajectory, shown without comparison, are permitted.	R10 ·P-IV Req. 8.5, 20.4
C7	**Monotone disclosure**	Disclosure may widen, never narrow. No `unpublish` exists. A schedule may be shortened, never extended.	R11 ·P-IV Req. 12.1, 12.4
C8	**Separability**	Content lives in files separate from the skeleton, referenced by hash. Removing content leaves the skeleton and its signature chain valid.	R12 ·P-IV Req. 13.2
C9	**Independence**	Works with no model, no network, no service. AI assistance is optional and additive.	R14 ·P-IV Req. 20.5
C10	**Portability**	Any participant obtains the complete record and continues it elsewhere without permission.	R7 ·P-IV Req. 16.4

	Constraint	Consequence for the code	Requirement
C11	**Plain durable formats**	The authoritative record is human-readable text. No database is the system of record; caches are reconstructible.	R13 ·P-IV Req. 17.1
C12	**Bind, do not reinvent**	Relations → CiTO, contributor roles → CRediT, provenance → PROV.	R2 ·P-IV Req. 7.1

48.1.3 M0 — Skeleton [check]

- ☒ Repository layout: `.grrp/` and `trajectories/<id>/{states,transitions,disclosure,releases}/`
- ☒ `profile.yaml` — protocol version, tier, hash, canonicalisation, party, bound vocabularies
- ☒ `.grrp/.gitignore` — `events/` and `keys/*.key`, so the event plane is never committed *(P-IV Req. 3.1)*
- ☒ Canonical serialisation — JSON, sorted keys, no insignificant whitespace, UTF-8
- ☒ Content hashing — `state:sha256:<hex>` over the exact bytes written *(P-IV Req. 5.2)*
- ☒ Transition identifier over the **covered payload and parent identifiers**, excluding `registration` and `disclosure` *(P-IV Req. 8.3 — the named most-likely serious bug)*
- ☒ `grrp init` — profile, keypair, layout
- ☒ **Test:** two runs over the same payload produce the same identifier
- ☒ **Test:** altering a covered field, or a parent, changes the identifier
- ☒ **Test:** adding `registration` or `disclosure` does **not** change the identifier

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48.1.4 M1 — Personal tier [check] ·*ship here*

The tier that has to be worth using by one person, alone, on the first day. It delivers **utility and no evidential weight**, and the two must never be confused. *(R15 ·P-II Req. 11.4 ·P-IV Req. 20.2)*

48.1.5 Acts

- ☒ `grrp new "<question>"` — open a trajectory; the question anchors the first claim *(C4)*
- ☒ `grrp claim` — state a position
- ☒ `grrp challenge <state>` — object to an identified state; **does not alter it** *(P-IV §6.2)*
- ☒ `grrp transform <state> [--answering <tx>]` — produce the successor
- ☒ `grrp decide <state> [--abandon]` — record a decision **with its reason** *(the demanding act)*
- ☒ `grrp release <state>` — publish, enumerating the objections standing *(P-IV Req. 12.6)*

48.1.6 Record and views

- ☒ Append-only writer; refuses to rewrite a recorded transition *(C3)*
- ☒ Five-dimension factored type: `act × target × relation × trigger × disposition` *(P-IV Req. 6.1)*
- ☒ `disposition` fixed at exactly three values, `unresolved` among them *(P-IV Req. 6.3)*
- ☒ `grrp state` — live positions, derived; **no branch marked principal** *(P-IV Req. 10.3)*
- ☒ `grrp log` — parents before children; **graph order, not clock order** *(P-IV Req. 10.1)*
- ☒ `grrp open` — the register of unresolved states: **the entry path** *(P-IV Req. 6.5)*
- ☒ `grrp export <release>` — citable document with lineage, contributors, standing objections *(R16 ·P-IV Req. 12.7)*
- ☒ `grrp check` — identifier recomputation, acyclicity, vocabulary, granularity, scalar exclusion
- ☒ `grrp profile` — what another implementation needs to read the record
- ☒ Every transition marked **unattested**, on every display and every export *(P-IV Req. 20.3)*
- ☒ Commit to git automatically when inside a work tree — **only the paths grrp wrote**

48.1.7 Tests

- ☒ The philosophy case: claim → objection → transformation answering it → an objection that is never resolved → divergence → release enumerating it *(P-IV Case 22.3)*
- ☒ The mathematics case: claim → `decide --abandon` with the reason; the direction is retired and the reason kept *(P-IV Case 22.1)*
- ☒ A challenge does not supersede the state it challenges
- ☒ Divergence preserves both directions and designates neither
- ☒ Every command's `--help` contains `Purpose (for you):` *(C1)*

48.1.8 M1 usability pass [check]

Not features — the difference between a tool that gets used on a Tuesday and one that does not. The byproduct principle is a claim about *cost to the participant*, so friction on the acts is a conformance concern and not a matter of polish *(C1 ·P-II Claim 11.1)*.

- ☒ **Omitting `-m` opens `$GRRP_EDITOR` / `$EDITOR`**, with a prompt for the act being performed. Writing a paragraph inside shell quotes is friction, and it falls hardest on the **decision** act — the one whose purpose for the performer is weakest and on which reuse depends entirely
- ☒ The prompt sits below a cut line and is never recorded; an empty message records nothing
- ☒ A 30-line editor launcher rather than a dependency — `typer` 0.27 no longer bundles `click`, and every command still accepts `-m` and `--file`, so an environment with no editor loses nothing
- ☒ **`challenge`, `transform`, `decide`, `release` default to the live position** — no copying a hash out of one command's output into the next. Still references a specific identified prior state *(C4)*
- ☒ A divergence **refuses and lists both positions with their text**, rather than picking — nothing in the design gives a basis for picking *(P-IV Req. 10.3)*
- ☒ **`grrp show`** — one screen per trajectory: question, live positions, what is unanswered, what has been released. Derived; per-trajectory; nothing compared across trajectories or people; no number summarising how it is going *(C6)*
- ☒ Refusals reach the user as guidance on stderr, naming the constraint and what to do instead
- ☒ `new` points at the next act

48.1.9 Gate — use it, before writing another line [unchecked]

The point of M1 is to find out whether the tool is worth using at all. M2 onward invites architecture the early tiers do not need.

- ☐ Use `grrp` on real work for two weeks
- ☐ Record what was annoying — **those notes are the input to M2 and beyond, and they belong in a trajectory**
- ☐ Check the two signals the papers name as diagnostic:
  - ☐ Is the **`decision` act rare while transformations are common**? That would mean the act on which reuse depends is not being performed, and making it cheap was insufficient *(P-IV §24.4, finding 2)*
  - ☐ Did anything want to be a score, a ranking or a dashboard? Record what, and refuse it *(C6)*

48.1.10 M2 — Integrity [check]

- ☒ Complete the act vocabulary — `grrp connect <state> --to <ref>` and `grrp verify <state>` *(the eight acts, P-IV Def. 6.2)*

  - ☒ External references carry a persistent identifier and **its scheme**, plus **the date the reference was made** — a reference to something since changed is uninterpretable without it *(P-IV Req. 5.5)*
  - ☒ A connection to another **state** needs no new field: the transition that produced it becomes a parent, so the link is in the graph and travels with the record
  - ☒ A **failed** verification is recorded `unresolved`, so it stands on the open register until something answers it — which is also where a stranger could take it up
  - ☒ Neither connection nor verification supersedes the state it concerns
- ☒ `grrp check` verifies the **whole chain**, not each record in isolation
  - ☒ An altered early transition invalidates every descendant (parents are inside the payload)
  - ☒ Content missing **without a recorded redaction** is a failure, not an absence
- ☒ Administrative operations: same envelope, **mandatory `kind`**, `act`/`target`/`relation`/ `disposition` **absent**, an `operation` field in their place; never presented as transitions *(P-IV Req. 4.6)*
- ☒ `grrp redact <state> --ground <g>`
  - ☒ Removes content; the skeleton stays valid and verifiable *(C8)*
  - ☒ Recorded as an operation with performer, time and **ground covered by the identifier**, so a ground that could be altered afterwards would be no ground at all *(P-IV Req. 13.4)*
  - ☒ **The graph is unchanged** — parent links, state references and the induced ordering survive *(P-IV Req. 13.5)*
  - ☒ The redaction record is not removable; redacted content is **never represented as never having existed** — `show`, `log` and `export` all say so, with the ground
  - ☒ Confirmation before removal, and a plain statement that **earlier git commits still contain the text** and that a copy already obtained by another party is beyond reach of both

48.1.11 Decided in the course of M2 — flagged, not settled quietly

- **Content stays inside the versioned tree.** The specification prefers content held outside it (§21.5, weakness 3), because git history is immutable and a redaction cannot reach a prior commit. Moving it out would mean a `git clone` no longer carries the record, and portability would then depend on `grrp bundle`, which does not exist until M4. So content is versioned, `redact` removes it from the working tree, and the tool **says plainly what it has and has not achieved**. *Revisit at M4, when bundle can carry content.* **Touches C8, C10.**
- **Redaction grounds are a local vocabulary** (`erasure_request`, `consent_withdrawn`, `personal_data`, `hazard`, `legal_order`). No deployed vocabulary covers *why content was removed*, and this is deliberately separate from the four closed grounds of **restriction**, which concern disclosure rather than removal. A charter may replace it. **Touches C12.**
- **The per-record secret is still not decided** — see Open decisions. It has to be settled before any short redactable content is hashed, because it changes identifier construction.
  - ☐ Decide it.

48.1.12 M3 — Group tier [unchecked]

Where credibility begins. **Minimum viable adopting unit: two parties who register each other's transitions** *(P-II Claim 13.4)*.

48.1.13 Identity and signatures [check]

- ☒ `grrp key add <name> <pubkey>` — known parties in `.grrp/keys/`; `grrp key mine` prints what to hand to a colleague; adding a second party's key **moves the record to the group tier**
- ☒ Detached ed25519 signatures over `{id, registrar, time}` — **never over `disclosure` or any field a later lawful operation may change** *(P-IV Req. 8.3)*

- ☒ **Pseudonymous participation** — nothing anywhere requires a legal name, telephone number, affiliation or government identifier *(P-IV Req. 14.3)*
- ☐ Passphrase on the private key *(still deferred; a signature is what it protects)*
- ☐ Optional **bindings** to external identifiers: recorded as operations, visible wherever the party is shown, attributed, revocable *(P-IV Req. 14.4–14.5)*
- ☐ Assurance **by class and by act kind, never as an entrance gate** — gating a stranger's challenge to a publicly disclosed claim reproduces the bootstrap failure *(P-IV Req. 14.6)*
- ☐ Key rotation by an operation **signed with the old key**; loss via a charter procedure that is **marked as weaker than a signature** *(P-IV Req. 14.7)*
- ☐ Compromise = revocation with a date; prior registrations stay, marked

48.1.14 Attestation [check]

- ☒ At the group tier **an act is a proposal**, not a log entry — a party cannot register their own act, so what they perform waits for someone else. Proposals live outside `transitions/`, so registering never edits a file under it *(C2, C3)*
- ☒ `grrp pending` — what waits on you, and what of yours waits on someone else
- ☒ `grrp register <tx>` — **refuses when performer and registrar are identical**, naming the constraint and what to do instead *(C2 ·acceptance test 7)*
- ☒ Registration is **outside the identifier**, so registering a proposal does not change the thing its children point at
- ☒ `grrp check` verifies the signature, and catches a record marked attested whose registrar is its own performer
- ☒ `grrp withdraw <tx>` — a further **challenge** that retracts, naming the registration among its parents. Nothing is deleted; a reader sees both *(P-IV Req. 8.7)*. **A withdrawal is itself an act, so at the group tier it too must be registered by another party** — the rule does not bend for the party undoing something
- ☒ **No aggregate over attestations** — not counts, depths, ratios or derived scores *(C6)*
- ☐ A standing arrangement (a supervisor routinely registering a student's transitions) **recorded, not forbidden** *(P-IV Req. 8.2)*

Decided: `GRRP_KEY` selects which local key acts, for a machine two parties share and for the tests, which need a second party to exercise registration at all. One key is the ordinary case.

48.1.15 Attribution and absorption [check]

- ☒ `--contributor name=Role` on every act — CRediT identifiers stored, **never display labels**, because a record holding the word "Methodology" is uninterpretable once a second vocabulary uses it differently *(C12 ·P-IV Req. 7.3)*
- ☒ `--from <state>` on every act — the link records the state, **the party who produced it** (looked up from the record, so nobody types a key), and the transition that took the content *(P-IV Req. 9.3)*
- ☒ `grrp attribute <proposal>` — adds contributors or absorption **to a proposal**, before anyone has registered it. A recorded transition is never edited, and attempting it **refuses with C3 and points at `grrp contest`** *(C3)*
- ☒ Absorption links **presented alongside the transition wherever it is displayed** (`export`)
- ☒ **No veto.** No `approve`, `deny`, `block`, `veto`, `permit` or `consent` anywhere in the command surface, and a test that keeps it that way. A party who does not want their state absorbed has **one instrument: its disclosure class** *(P-IV Req. 9.4)*
- ☒ `grrp contest <tx>` — a challenge that **disputes** (`cito:disputes`), naming the transition among its parents. Nothing deleted or altered; **no party is empowered to resolve it** *(P-IV Req. 9.5)*
- ☒ **No measure of the influence of an absorbed state** *(C6)*
- ☒ `grrp transform --with <state>` — a **synthesis**: a state its performer composed from what several branches reached. It does **not** close them, and nothing is combined by rule *(P-IV Def. 10.4, Req. 10.5)*

Found and fixed in the course of it: the release record stored an `attested` flag captured when the release was still a proposal, so an exported document went on saying "unattested"

after the release had been registered. Now derived at export time from the log — the stored-derived-value mistake, in miniature *(P-IV Req. 4.4, 5.3)*.

48.1.16 Disclosure [check]

- ☒ `grrp disclose <tx> --class <c> --ground <g> [--release-at <date>]`
- ☒ `grrp charter adopt --classes a,b,c` — classes exist, are **ordered by inclusion** (narrowest first), are enforced, and are **opaque to the protocol**. **No model charter and no default set**: a specification supplying one would be a specification of governance *(P-IV §18.5)*. Without a charter there is nothing to disclose at, and the tool says so
- ☒ `grrp charter adopt` again bumps the version; amendments are **prospective only** *(Req. 18.4)*
- ☒ **Four grounds, closed set.** A value outside it is refused, naming the four *(P-III Req. 2.5)*
- ☒ **Reject a restriction that declares no ground**, and display the ground wherever it is shown *(Req. 11.3)*
- ☒ **Surface the residue.** Declaring a ground prints what it leaves disclosable **and the named failure it becomes if misapplied**. `grrp grounds` prints the whole typology *(P-III Req. 2.6 — the only part of the design that gains without giving something up)*
- ☒ **Composition = intersection of residues**, and the tool says declaring more grounds is not free, since each is an assertion a reader may find false *(P-III Req. 7.2)*
- ☒ **Monotone enforcement** *(C7)*
  - ☒ Narrowing is refused, naming C7 and why a withdrawal cannot be effected
  - ☒ No `unpublish`, `unrelease`, `hide`, `conceal` or `restrict` command exists
  - ☒ A schedule **fires without a further act by any party** — derived from the log and the clock, so there is nothing to fire and nothing that can be forgotten *(Req. 12.4)*
  - ☒ A schedule may be **shortened**; **extending or cancelling is refused and the attempt recorded** as an operation, because a charter may in some circumstances allow it and it should be visible that it was made
  - ☒ `--release-at` **only with** `vulnerability` — the only ground with a terminus. Rivalry and appropriability end unobservably from here, and **hazard does not end** *(P-III Claim 7.4)*
- ☒ **Per record**, never per repository or trajectory: records in one trajectory carry different classes *(Req. 11.5)*
- ☒ Charter identifier **and version** recorded on every disclosure *(Req. 18.3)*
- ☒ `grrp show` surfaces what is restricted, on what ground, and when it widens

48.1.17 Decided in the course of M3c — flagged, not settled quietly

- **An undisclosed record is not a restriction without a ground.** Req. 12.2 fixes a restrictive default and Req. 11.3 demands a ground for anything below the widest class; read together they would demand a ground for every record ever made. The reading taken: a record with no disclosure operation is **not yet published**, which is a different thing from **withheld**. The ground requirement bites when a restriction is imposed. **Touches C7.**
- **Redaction grounds and grounds of restriction are separate vocabularies**, as flagged at M2 — one concerns removal, the other disclosure. `grrp grounds` prints only the four.
- **Operations carry** `subject` **and** `payload` rather than a field per operation type. Both are covered by the identifier, so a declared ground that could be altered afterwards would be no ground at all. Redaction was migrated to the same envelope.
- **Disclosure operations chain**, each taking the previous as a parent. Ordering by recorded time does not work: two changes made in the same second have no path between them, and the tie would be broken by identifier, which is arbitrary. *(Found by a failing test, not by argument.)*

☐ **Test 5:** changing a class, or a schedule firing, invalidates no signature

☐ **Test 7:** `grrp register` refuses when performer and registrar keys are identical

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48.1.18 M4 — Open tier [check]

- ☒ `grrp bundle [<traj>] -o traj.zip` — transitions, skeletons, signatures, attributions, absorption links, parent structure, profile, charter and public keys — **obtainable without anyone's permission** *(C10)*
- ☒ `grrp continue traj.zip` — appended transitions reference the obtained ones as parents, so the result is **one graph and not two** *(Req. 16.4 ·acceptance test 8)*
- ☒ Restricted content travels **only where it can be honoured**. The default is to withhold, and the manifest **names what was withheld** — a reader is entitled to know a record travelled without part of its content
- ☒ `grrp profile --json` — the machine-readable declaration: protocol version, tier, hash, canonicalisation, **covered and excluded fields**, signature scheme and signing input, bound vocabularies with versions, custody and succession *(Req. 16.3)*
- ☒ A receiving implementation **records the declaration under which records arrived**
- ☒ Received records: **copied byte for byte**, never parsed and re-serialised. The prohibition on alteration extends to normalisation, which would invalidate signatures *(Req. 16.5)*
- ☒ Failure cases *(Req. 16.5)*
  - ☒ **Version mismatch** — retained unprocessed, and said so. A record created under one version asserts what that version's fields meant
  - ☒ **Unverifiable signature** — retained and marked, never discarded
  - ☒ **Partial records** — missing parents named; **nothing synthesised to fill the gaps**
  - ☒ **Divergent continuation** — a divergence. Both retained, neither principal, no reconciliation
- ☒ `grrp deposit <release> -o <dir>` — the citable document, its release record, the declaration and the continuable record. **Released material only**: depositing sealed or restricted content with a third party would place it outside the regime governing it *(Req. 17.5)*
- ☒ `grrp deposit <release> --identifier doi:⋯` — records the identifier an archive issued
- ☒ `grrp custody add` / `custody succession` — **durability is not claimed without a published succession arrangement**, and a record held by one party is named as not surviving that party *(Req. 17.4, 17.6)*
- ☒ Sealed registration *(§15)*
  - ☒ `grrp seal` — content-derived identifier, party and time recorded; **content disclosed to nobody**, held in a gitignored local store
  - ☒ `grrp openseal` — verifies the content yields the identifier registered earlier
  - ☒ **Never described as establishing priority**; the tool says plainly that an unanchored time is the registrant's own assertion, and that a sealed state **generates nothing** *(Req. 15.7)*
- ☐ Resolvable identifiers at state granularity — **still open**, and expensive. Content-derived identifiers are stable and are not resolvable by a party holding no copy *(§24.2)*
- ☐ Redaction notices forwarded to implementations records were propagated to *(Req. 13.6)*

48.1.19 Decided in the course of M4 — flagged, not settled quietly

- **Content still lives inside the versioned tree**, as flagged at M2. Now that `bundle` exists it could move out, and the trade is real: out-of-tree content makes redaction reach further, and makes `git clone` alone stop being the record. **Not taken unilaterally.**
- **A gap the record explains is not tampering.** `check` fails on content missing with nothing to account for it, and notes it where a redaction was recorded, the state is sealed, or the manifest says the sender withheld it. An earlier attempt downgraded all four to a note and lost a real guarantee; a failing M2 test caught it.
- **`deposit_recorded` was added to the operations vocabulary.** The specification's list is illustrative rather than closed, and Req. 17.5 requires the deposit identifier to be recorded in the trajectory. **Touches C12.**

48.1.20 M5 — Conformance suite [unchecked]

- ☐ Automated tests for **C1–C12**, each naming the constraint it enforces

- ☐ The three conformance tests as executable checks inside `grrp check` *(P-IV Req. 20.4–20.6)*
  - ☐ **Scalar test** — fails on any total order or numeric measure over participants or trajectories. Within-trajectory counts shown without comparison pass
  - ☐ **Independence test** — the record can be created, registered, read, verified, exported and continued **with a text editor and a version-control system**
  - ☐ **Byproduct test** — every required act has a purpose *for the party performing it*, stated in the documentation
- ☐ `grrp check --self-declare` emits the conformance declaration *(P-IV Req. 20.7)*
- ☐ Container run with **no network and no model**: create, register, verify, export, bundle, continue
- ☐ Field documentation published **outside the implementation**: vocabularies with versions, identifier construction, signature construction *(P-IV Req. 17.2)*
- ☐ Attack cases from P-IV §23 exercised: collusive fabrication, retroactive alteration, backdating, flooding, registrar gatekeeping, misapplied grounds, disclosure by inference, reflexive confirmation

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48.1.21 Level 3 — applications, outside conformance

The protocol is implementable with none of it, and requires none of it *(C9 ·R14)*. Anything here is optional, additive, and clearly marked as outside conformance.

> The applicative graph model — node kinds, edge kinds, components, actions — is specified in spec-graph-model.md (v1 kernel; extension machinery deferred), with the design-pass records in design-pass-graph-model/. Its build order: recording acts from the page → attestation → the four-component panel → the meeting flow → disclosure/redaction UI → import/fork surfaces.

- ☒ **`grrp ui`** — a local page for starting records, recording acts, and seeing the trajectory drawn. Stdlib only, loopback only, no account, nothing leaves the machine, a per-run token on every form. It shows the question, the live positions, the open register, what is proposed, what is restricted **with its residue beside it**, and the lineage — and it declares itself Level 3 on every page
  - ☒ Tested for what the design forbids, because a screen is where the temptation is strongest and where a reader would most readily believe a number: no quantity over participants or trajectories, no branch marked principal, **the word merge appears nowhere**, no control that narrows disclosure, no approve or veto
  - ☒ A test asserts **no module of the record imports it**, so the claim that the protocol is implementable without it is checked rather than asserted
  - ☒ **Starts records**: a directory, a git repository inside it if wanted, a keypair, and the opening question — so the first thing anyone meets is not a terminal
  - ☒ **Draws the trajectory** as a DAG in inline SVG, no libraries: one column per step from the question, edges labelled by the act that made them, **divergent branches drawn identically**
  - ☒ Records every act, registers a colleague's proposal, and releases
  - ☒ Record-writing logic extracted to `actions.py`, shared with the command line. A test asserts a record written from the page and one written from the terminal are **the same record** — otherwise the page is a second implementation rather than an application over the first
- ☐ Capture assistant proposing candidate transitions from the local event plane
  - ☐ A model may **occasion** a transition and may **not author or register one**; a model-originated proposal is **marked** *(P-IV Req. 4.3)*
  - ☐ Registration stays an **affirmative act** — a default that registers unattended proposals is forbidden, because the record's credibility rests on registration meaning something
- ☐ Visualisation of a trajectory graph — **no branch marked principal, no ordering exported**

- ☐ Retrieval over one's own record
- ☐ Import of git history / OSF projects / DOI-identified works as **artefact references and external references**, never as transitions *(C4)*

48.1.22 Excluded, and not by taste

	Why
progress reports, "project health", trajectory risk analysis	scalars over trajectories *(C6, R10)*
contribution scores, reputation, contributor ranking	scalars over participants *(C6)*
absorption counts, attestation depth	scalars, and **farmable by reciprocal registration** *(P-II Claim 8.4 ·P-IV Req. 8.5)*
similar-trajectory search, cross-field matching **as an adoption argument**	not decomposable by tier, returns nothing to any adopting party, and the matching problem is unsolved *(P-II Claim 13.5 ·P-I Claim 18.3)*
automatic classification of a user's work by a model without confirmation	*(C1, C9)*
any merge, auto-reconciliation, or canonical-branch selection	*(C5)*
a new identifier service	content hashes locally, repository DOIs on deposit
a web application, hosted service, or accounts	not in v0.1

48.1.23 Open decisions — needed from the maintainer [unchecked]

- ☒ **Licence — settled: MIT.** Discharges both dependent requirements: **the specification is forkable** *(P-IV Req. 19.4)*, so custodianship is a service rather than a position; and **a record is licensed to permit continuation elsewhere** *(P-I Req. 16.2, property 4)*, which is the property that distinguishes portability from export.
  - ☐ The four PDFs still carry an embedded **CC BY-NC 4.0** notice and remain under it until their author revises them. Regenerate the licence block if MIT is intended there too.
- ☐ **Per-record secret before hashing redactable content** *(M2 above)* — decided in advance or not at all, because it changes identifier construction.
- ☐ **Custodial separation.** Serendip Commons Society would maintain the specification and operate an implementation. Req. 19.4 requires the two functions separated, **or the conflict recorded with the arrangements limiting it.** Which, and where is it recorded?

48.1.24 Evaluation — what would show this was wrong

Not a retrospective. These are stated in advance so they can be looked for.

- ☐ **Personal-tier adoption without progression to the group tier**, over a substantial population and period → private utility without the attested records on which every evidential claim rests. The tool would have become **a note-taking convention** *(P-IV §24.4 ·P-II Claim 16.1 — the prediction the account is most exposed on)*
- ☐ `decision` **acts rare while transformations are common** → the act on which reuse depends is not being performed
- ☐ **Group-tier declarations alongside pairs who register only each other** → attestation operating as a formality
- ☐ **A widely used external score computed over conformant records** → the scalar exclusion displacing the dynamic rather than preventing it

And the difficulties the papers record as **unaddressed** — no mechanism with an identified cost-bearer for whom bearing it is rational. Nothing in this plan solves them: **assessment capacity** *(the one most likely to determine whether a conforming arrangement survives at scale)*, **maintainer labour**, **the regressive incidence of overhead**, and **recognition of attributed contribution** *(P-II §17.2)*.

48.1.25 Sequence

check M0, M1.
unchecked **Use it for two weeks on real work.** Write down what was annoying.
unchecked Those notes are the input to M2 and beyond — and they belong in a trajectory.
unchecked M2 → M3 → M4 → M5, in order. Do not start M3 before the group tier has a second party willing to register.

49 spec graph model

Original source: `applicative_infrastructure/gr_academia_application/plans/spec-graph-model.md`.
Original source SHA-256: `676b45a3d77c2de84d5fe725b430c4ba993d508efef481143664a5d119b13d85`.

49.1 The graph model: node kinds, edge kinds, components, actions

Specification, v1 — draft for discussion. Applicative-layer specification over GRRP v0.1. Builds on design-nodes-time-and-occasions.md; where they overlap, this document governs.

How it was produced: three independent design passes (research practice, component architecture, adversarial conformance), then three verification passes (constraint audit — 17 findings, completeness — 28 gaps, simplicity — 22 cuts). Every finding is either incorporated below or answered in §10. The synthesis leans deliberately toward the simplicity verdict: **v1 commits to a small kernel, and defers the extension machinery until a second real community exists.**

49.1.1 1. The model, affirmed

The requested reading — *each vertex is an event; relations are typed; both nodes and edges carry types, components, and actions* — is not a departure from the protocol. It **is** the protocol:

requested	in GRRP
an event	a **transition** — something happened to an understanding
an event's type	the five-dimension factored type: act × target × relation × trigger × disposition
a typed relation	a `parents` entry (structural) or a **connection transition** carrying a CiTO relation (semantic)
a relation with components	already true: a semantic relation *is* a transition, so it has content, artefacts, provenance — and a workspace

Two invariants govern everything below:

I1 — Kinds are lenses, not types. No kind adds a field to a transition, mints a record type, or changes what `grrp` writes. Delete every kind and the record is untouched. This is what makes the whole applicative layer safe to build, rebuild, and throw away.

I2 — `grrp` is the sole record-writer. Every record-writing action is a thin form over exactly one `grrp` invocation. The UI never constructs a transition skeleton, never computes an identifier, and surfaces `grrp`'s refusals verbatim. One implementation owns lawfulness. (Already the rule in `web/packages/server/src/records.ts`.)

49.1.2 2. Subjects — what can be selected

A **subject** is a thing that can be selected, carries components, and offers actions.

49.1.3 v1 subjects

subject	identity	exists when
transition (any of the 8 acts, connections included)	its id	recorded
material — held artefact	`state:sha256:⋯` over its bytes	**cited by at least one transition**
material — external work	`doi: arxiv: isbn: url:`	cited by at least one transition

A workspace file that nothing cites is not a subject and does not appear in the graph (C1, C4).

49.1.4 Deliberately not subjects

- **Structural edges** (`parents` entries, artefact citations). They are facts inside a signed payload, not claims — no identity, no components, no actions. *To contest a parent link, challenge the **child** transition: the link lives in its signed payload, and C4 hands you the specific state.* This paragraph exists so that edge identity is never added "just for commenting" — the request will come, and this is the answer.
- **States.** A state is reached through the transition that produced it. Pickers pick states; the panel opens the producing transition. One subject per event.
- **Persons, projects.** Refused outright — §8.

49.1.5 3. Node kinds

Three families, hardcoded in v1 (no plugin machinery — §9).

49.1.6 3.1 Transition kinds — the eight acts, as they read to a person

label shown	act underneath	disposition default
Question	`question`	unresolved — and it stays so; that is the design
Position	`claim`	accepted
Position, changed	`transformation`	accepted
Objection	`challenge`	unresolved / contested
Decision	`decision`	accepted
Connection	`connection`	accepted
Check	`verification`	accepted (or unresolved when it failed)
Release	`release`	accepted

Label discipline (C12): labels map 1:1 onto acts; the protocol term is always inspectable one gesture away (shown in the record panel); labels are never persisted into anything that travels. No ninth label may exist, because no ninth act exists.

49.1.7 3.2 Material kinds

- **Held artefact** — bytes in the project store or a workspace, identified by hash. The digest is always displayed: it is what a transition cites and what a reader elsewhere checks.
- **External work** — `doi:` / `arxiv:` / `isbn:` / `url:`. Renders **fully offline** (identifier + citing transitions); live metadata fetch is an optional enhancement cached under C11, never a dependency (C9). The same identifier cited from anywhere in the project is **one node** — this is how a paper read by the whole group appears once with many edges.

49.1.8 3.3 Occasion kinds — derived, never created

An **occasion** (meeting, experiment run, observation session, reading, failure…) is not a record type and not a creatable node. It is a *reading* of the graph:

> an artefact node whose citing transitions carry an occasion trigger (`discussion`, `experiment`, `observation`, `simulation`, `literature`, `failure`, or a charter-local trigger).

The trigger is the label: an artefact cited with `discussion` presents as a meeting-like occasion. Three rules, each of which closes a hole the review found:

1. **No create-occasion affordance exists.** An occasion with no transitions behind it is a calendar entry, not a node (C1). The button will be asked for; it does not get built.
2. **No roster, ever.** The occasion panel lists its *transitions*. It never unions their performers into a "participants" view — that would rebuild the attendance list from signed parts, and it is the single most likely quiet violation in this design.

3. **Occasion membership is the citation itself.** No time-window clustering, no inference: the shared artefact's citing edges *are* the gathering.

49.1.9 4. Edge kinds

49.1.10 4.1 Structural — facts

edge	read from	drawn
follows	`parents`, same trajectory	plain line
crosses	`parents`, another trajectory	distinct line — the structure the graph view exists to show
cites	`artefacts`	dashed line to the material node
absorbs	`absorption`	shown in the panel; drawn on demand
registered-by	`registration`	a badge on the node — **never aggregated per registrar** (C6)

No identity, no components, no actions (§2).

49.1.11 4.2 Connection — the reified semantic edge

One presentation covers **all** relations: the sixteen CiTO bindings and the three charter-locals (`generalises`, `specialises`, `transfers` — flagged as unbound, never presented as CiTO). Not nineteen kinds; one kind that renders its `relation` field.

- **Drawn as an edge** in the graph (its parent link to what it connects); **opened as a node** in the panel. One subject, two renderings.
- **Multi-parent connections are first-class.** A transition citing two divergent states as parents — saying in its content what it makes of the divergence — is the lawful neighbour of the refused combining operation (C5). It draws as a fan; it is still one subject.
- **This is where "edges have components" is true** — and only here. A connection has content, a workspace (the dossier of a disagreement lives *on the edge*), provenance, disclosure. Each component earned its place on this subject under the same twelve constraints as anywhere else; nothing is inherited "for free".

49.1.12 5. Components — exactly four

One per storage class. The class fixes where data lives, who writes it, and whether it travels — so "does it travel?" is answerable by grep.

component	class	lives at	written by	in a bundle?	in git?
Record panel	record-facet	signed YAML + state files	`grrp` only	**yes — it is the record**	yes
Disclosure panel	sidecar-facet	disclosure sidecar + operations	`grrp disclose` / `redact`	yes	yes
Workspace	workspace-facet	`nodes/t/<id>/` `·nodes/a/<hash>/`	any project party, via the app	**never**	yes
Calendar entry	local-plane	`.gra/calendar/`	the host app	**never**	**no — gitignored**

49.1.13 5.1 Record panel

The whole signed payload, read-only: act (with its presentation label *and* the protocol term), target, relation (with its CiTO binding, or flagged `local:`), trigger, disposition, performer, contributions (CRediT), absorption, **the state content rendered as markdown**, artefact citations with digests, attestation status, and the identifier in full.

- **Two timestamps.** Registration may lawfully be later than performance (offline field work; C2 applies at registration, not at recording). Chronology orders by `performed`; the panel shows both times whenever they differ materially. This is the honesty surface for offline recording.
- **Counts live here and only here.** The C6 carve-out (counts within one trajectory, uncompared) renders exclusively in the *selected* subject's panel — "this question has 4 objections, 2 unanswered" — never as decorations across the canvas. Badges on many nodes at once are comparison by juxtaposition.

49.1.14 5.2 Disclosure panel

Class, ground (with its object and residue), `release_at` (shorten-only — and a refused extension shows here **as a recorded fact, not an error**), plus the operations history touching this subject: disclosure changes, redaction notices (with ground), contested attributions. **Operations render as panel facts, never as graph nodes.**

49.1.15 5.3 Workspace

The one **universal** component: every transition subject and every material subject carries one — which, by reification, means every semantic edge carries one (the requirement that edges have storage, satisfied structurally). Folders allowed; the path guard already refuses escape.

The workspace is project-shared scratch, not private. It travels with a git clone (though never in a bundle), and every project party can read it. Anything private — personal notes, drafts not for colleagues, pins — belongs in the **local plane**, which never leaves the machine. The review found the drafts quietly contradicting each other here; this paragraph is the ruling.

Deleting workspace content costs nothing and records nothing — test-enforced: *every applicative action leaves* `transitions/` *byte-identical* (the existing upload test, generalised).

49.1.16 5.4 Calendar entry

When / where / link. **The schema contains no people fields** — not attendees, not organiser, not RSVP. Attached to occasion subjects where one exists; **future occasions are free-standing entries** in `.gra/calendar/`, attached to nothing (the meeting node cannot exist before its minutes are cited — the review caught that a subject-bound schedule would pressure someone into building a create-meeting-node path).

Legitimate calendar content: scheduled occasions, `release_at` commitments, embargo expiries, deadlines *of the calendar's owner*. Never: anyone's activity, anyone's presence, a deadline attached to a question or an objection ("resolve by Friday" — the vocabulary keeps `unresolved` precisely so closure is never owed on a date).

49.1.17 6. Actions — exactly two classes

The review considered and rejected two more (a separate "bridge" class, and a declarative precondition vocabulary). Both rejections are load-bearing:

- **Citing material is a parameter, not an action.** A free-standing "cite this file" button would produce a transition that exists so that a record exists (C1). Instead, every recording form carries an **artefact picker** — material is cited from *within* a real act with real content. That picker is the entire bridge between the layers, and crossing it is always deliberate.

- **No precondition layer beside `grrp`.** A declarative lawfulness vocabulary drifts from the implementation, and both candidates the drafts proposed encoded violations: an "open question" test would quietly mint the fourth disposition the protocol refuses, and a registrar-differs gate at recording time would block lawful offline work (C2 constrains *registration*, which may come later). The UI checks exactly one thing — a parent state is selected where the act needs one (C4) — and everything else is `grrp`'s refusal, shown verbatim.

49.1.18 6.1 Record-writing actions (through `grrp`; exactly one invocation each)

Acts — each a form: content (required, markdown) ·parent/subject picker (C4; defaults to the live position when unambiguous; `grrp` refuses ambiguity and the refusal is shown) ·artefact picker (optional; workspace files by digest, external ids by scheme) ·vocabulary pickers constrained to the bound sets, charter-locals flagged ·contributions (optional; CRediT role per named party — unilateral, and contestable by that party through `attribution_contested`, which is the protocol's own consent mechanism).

action	act	notes
Ask	`question`	opens a trajectory; the origin state
Take a position	`claim`	
Change a position	`transformation`	parent = the position changed
Object	`challenge`	disposition `unresolved` is the honest default
Decide	`decision`	including abandoning a path (`trigger: failure`)
Check	`verification`	outcome in content; a failed check stays `unresolved`
Connect	`connection`	relation required, from the bound set; cross-trajectory target makes that transition a parent
Release	`release`	disclosure act about specific states and artefacts — never a project-status marker

Operations — same class, same discipline (one `grrp` invocation, refusal verbatim):

action	operation	notes
Register a colleague's act	registration	completes an existing unattested transition. Refused when the keys are identical (C2). **Attestation is witnessing, not approval** — it asserts that an identified party registered an act at a time, and nothing about the content. Endorsement-as-record is an `agrees`/`supports` connection under the endorser's own key.
Widen disclosure	`disclosure_changed`	ground with object + residue; `release_at` shorten-only
Redact content	`redaction`	ground from the redaction vocabulary; bytes go, skeleton and signatures stay (C8)
Continue a bundle	import	unknown *act* → `grrp` rejects (closed vocabulary); unknown `local:` values → retained and flagged; same id with different bytes → refused loudly; dangling parents → rendered as "not held here" stubs

action	operation	notes
Declare a fork	`fork_declared`	C10 made first-class, not an edge case
Contest an attribution	`attribution_contested`	the dispute path for contributions
Record a binding / deposit	`binding_recorded` / `deposit_recorded`	DOI and archive identifiers, shown in the record panel

Global actions (no subject yet exists): create a project, open a question, import a bundle, generate/register a key. These live on the project shell, not on kinds — most are already built.

49.1.19 6.2 Applicative actions (record nothing — test-enforced)

Workspace file operations ·calendar add/edit ·**the join launcher** — a hyperlink stored in the calendar entry that opens `{link}` and *writes nothing anywhere*; the moment joining leaves a trace it is presence logging ·private local-plane pins and bookmarks (invisible to every other party, uncounted) ·search (filters; any transient match ordering is never displayed as a number, never persisted, never applied to performers) ·bundle export (reads the record, writes a file; C10 is owed, so friction here is a bug).

49.1.20 6.3 Where refusals surface

1. **Never offered** — the constitutive refusals of §8 have no UI surface at all.
2. **Disabled with the reason shown** — the one UI precondition (no parent selected).
3. **Refused by `grrp`** — stderr verbatim; nothing written.
4. **Refused and recorded** — where the protocol itself records refusals (a refused schedule extension), shown as a fact of the record, not as an error.

49.1.21 7. The meeting, end to end

The motivating example, run through the whole model:

Before. A free-standing calendar entry in `.gra/calendar/` — when, where, link. Agenda drafted wherever its author likes (a workspace, the local plane). *Add to calendar* and *Join* are applicative; join opens the link and writes nothing. There is no attendee field to fill in, because the schema has none. Nothing has been recorded (C1).

After, if it changed something. The minutes land in a workspace. Each outcome is recorded as its own act — a decision, an objection, a changed position — with `trigger: discussion`, citing the minutes' digest through the artefact picker, contributions typed per act (CRediT: who conceived, who analysed, who supervised — a role in an act, never a presence at an event).

The meeting node is the minutes artefact: same hash, one node, its citing edges are the gathering. Components: record panel (the citing transitions, the digest), workspace (source notes, follow-ups), calendar entry (the past schedule, locally). The panel lists transitions — never a merged list of people.

After, if nothing came of it. It remains a calendar entry. That is not a failure to record; that is C1 working.

49.1.22 8. Constitutive refusals — one page, closed

Each will be asked for. Each answer is one sentence a user can accept.

refused	constraint	the sentence
Person / profile nodes; per-performer views, filters, timelines	C4, C6	The moment a person is a node, everything they did aggregates to them and the graph becomes a dossier; a performer is a key on a transition, not a place things pile up.
Project-level nodes, project status	C4	Nothing in the record attaches to a project as a whole; the record's version of stopping is silence.
Attendance, RSVP rosters, presence dots, "last active"	event-plane ruling	A log of who was present is a monitoring record by construction — presence is never written down in any layer that travels, and not in the ones that don't.
Shared bookings pairing a name with a time and place	C6	Book slots, not people: shared state shows taken/free; your own bookings stay in your own local plane.
Activity feeds across projects, heatmaps, streaks, nudges	C1, C6	Silence is a permitted state of work; an operation that exists so that a record exists is the definition of the failure.
Progress bars, importance, priority, weights, scores, centrality, size-by-degree, canvas count badges	C6	Any computed prominence is a ranking with extra steps; a node with many edges is a node with many edges.
Kanban columns	closed dispositions, C12	A column is a disposition vocabulary in disguise: "done" is the fourth value the protocol deliberately refused.
Reactions, emoji, votes	C1, C2, C6	A reaction is an endorsement with no content and no attestation that exists to be counted; the record's [approval] is an `agrees` connection where you say why, under your key.
View counts, read receipts	C6, monitoring	Counting reads requires logging readers — a record of attention on both sides of the number.
Relevance as a standing index	C6	Search filters; a stored ranking over trajectories is a measure adopted to direct attention.
Combining divergent states — and the word never appears	C5	Both remain true records of what was understood; a transition may take both as parents and say what it makes of the divergence, but nothing collapses them.
Edit-in-place, delete, unpublish	C3, C7	The signature covers the bytes; a corrected understanding is a new transition, so the record shows both that you were wrong and that you noticed. Others may have continued from what you shared — the ground under their work cannot be pulled back.
Mark-answered / close-question	closed dispositions	The lawful neighbour: record a decision or check that *answers* it, standing beside the objection forever; or it stays unresolved, which is the point.

refused	constraint	the sentence
Approval as a gate	C2, C10	Nobody's permission is required to continue the record — including yours; endorsement is a record, never a lock.
Model as performer or registrar	C2	`trigger: ai_suggestion` marks that a model occasioned a transition; a person performs it, and attestation between a person and their own tool is theatre.
Auto-recording runs/commits; template-solicited records	C1	The workspace holds everything; the record holds what somebody deliberately said changed their understanding.
Occasion rosters	C6, monitoring	The occasion panel lists transitions, never a merged list of the people behind them.

49.1.23 9. Extension — deferred, and why deferring is safe

The architecture pass designed a full manifest system: community kinds distributed with charters, `degrades-to` fallbacks, a loader denylist, a projection mini-language. It is good design and it is **not in v1** — it is a plugin architecture for an ecosystem of zero communities, and every piece of it polices an extension surface that does not need to open yet.

What a charter can already extend **today**, through `grrp` alone: `target` values, `trigger` values, local relations, and the redaction-grounds set (a local vocabulary by design). A community occasion — "instrument calibration" — is a charter-declared trigger plus this spec's occasion pattern, with no new machinery.

Deferral is safe **because of I1**: kinds are lenses that never touch the record. Any future manifest system can re-read everything v1 writes. When a second real community exists, the manifest sketch (three worked examples included) lives in the design pass records.

49.1.24 10. Rulings on the sharp questions the review surfaced

- **Redaction aftermath.** The node stays; the record panel shows *(redacted, on the ground of X)* where content was; kind matching never depends on bytes, only on signed fields, so redaction changes no node's kind. The app must purge its own derived caches (search text, previews) on redaction. Workspace copies of redacted material are the holder's obligation, surfaced as a notice — the git-history tension that paper IV itself names is real and stays open here too.
- **Import conflicts.** Same identifier, different bytes: refused loudly — that is tampering surfacing, not a a situation to smooth over.
- **Restricted disclosure rendering.** Each ground's stated residue determines which panel fields render for an out-of-audience viewer. The detailed per-ground table is deferred to the disclosure-UI milestone — marked open, not silently skipped.
- **Workspace path collisions.** Workspaces key by family-prefixed id (`nodes/t/⋯`, `nodes/a/⋯`), so a transition and an artefact sharing a digest tail cannot collide.
- **The charter as a subject.** A plain page rendering `charter.yaml` — which values it defines, which version — added to the build order; cheap, and the `local:` flags link to it.
- **Contributions consent.** Attribution is unilateral and contestable (`attribution_contested`). The spec states this rather than inventing a countersign flow the protocol does not have.

49.1.25 11. Build order

Unchanged in spirit from the design note; sharpened by this spec:

1. **Recording acts from the page** — the §6.1 act forms. The system is a viewer until this exists.
2. **Attestation** — register-a-colleague's-act (§6.1 operations). C2 is the credibility mechanism and is currently unreachable; two accounts already exist to test it.
3. **The panel → this spec's four components** (record, disclosure, workspace, calendar).
4. **The meeting flow** (§7): free-standing calendar entries + the artefact picker polish.
5. **Disclosure & redaction UI** (with the per-ground rendering table, resolving §10's open item).
6. **Import / fork surfaces.**

The standing gate remains: **use it on real work for two weeks** before building further layers on top. Nothing in this specification has been lived with yet.

49.1.26 12. Open decisions

1. **Workspace = project-shared scratch** (travels with a clone, readable by all parties; private material goes to the local plane). This is a privacy ruling — confirm it.
2. **The manifest/plugin system stays out of v1.** Confirm the deferral.
3. **Contributions are unilateral and contestable** — the protocol's own mechanism, no countersign flow. Confirm.
4. Tab naming: this spec uses "graph" for the whole-project view currently labelled *Trajectories*. Rename or keep?

50 LICENSING NOTES

Original source: `applicative_infrastructure/gr_academia_application/provenance/LICENSING_NOTES.md`.
Original source SHA-256: `f3a48306d7939ed63ce550e103b6fb84dc9adde565ff85b4da5e40fb36ce946c`.

50.1 Licensing transition record

Document class: Informative provenance record. **Date:** 2026-09-22. **Current repository licence:** MIT for project-authored material, within the scope of LICENSE.md.

50.1.1 Import baseline

The import from source commit `b98730b46eca5fdf441937aef0180f5b3d4f94dd` initially preserved the source's AGPL-3.0-or-later software and CC BY 4.0 documentation declarations. The four PDFs contained CC BY-NC 4.0 notices. A stale MIT reference in the original GRRP README was aligned with the then-current AGPL statement during relocation. That historical inconsistency remains recoverable in the source bundle.

The original licensing statement referred to a missing `LICENSE` file. The relocation added the official GNU AGPL v3 text (34,523 bytes; SHA-256 `0d96a4ff68ad6d4b6f1f30f713b18d5184912ba8dd389f86aa7710db079abcb0`). That exact text is now retained at docs/history/AGPL-3.0.txt. The earlier scope statement and import licensing notes are preserved byte-for-byte. References inside those snapshots describe their original context.

50.1.2 Current decision

After the migration, the project owner explicitly instructed that all four repositories use MIT and include contributor lists. The active repository licence, scope statement, README licence summaries, Python metadata and npm package declarations now implement that instruction. The new CONTRIBUTORS.md records the author and organizational credits found in the source notices and metadata. It does not invent additional contributors or a copyright assignment.

MIT applies as an additional grant for project-authored documentation and papers as well as code. It does not retract earlier permissions or silently rewrite historical terms. External works and user research records remain outside the project's grant. See the current scope statement for redistribution of PDFs with preserved embedded notices.

The dated machine-readable transition record lists the preserved notice hashes and unchanged PDF and bundle hashes. It is separate from the original import and relocation manifests, which continue to describe their own historical states. The original Git bundle and original external source checkout are unchanged.

The MIT text was checked against the Open Source Initiative version. The earlier AGPL text came from the official GNU source.

51 README

Original source: `applicative_infrastructure/gr_academia_application/provenance/README.md`.

Original source SHA-256: `78135aa644a03da87c7b760069c84133235b77ff38a7ac78564356ef3ac4daec`.

51.1 Academia import provenance

Status: Informative preservation record, 2026-09-22.

The import contains 121 committed source files from `b98730b46eca5fdf441937aef0180f5b3d4f94dd` in `git@github.com:huangwanhong-maker/Generative-Relational-Academia-Application.git`. The original working tree was clean when inspected and was not modified by this import.

The import baseline was captured **before relocation edits**. The corrected import manifest distinguishes raw Git blob bytes, Git archive export bytes, source working-tree bytes, the initial imported bytes, and the final relocated bytes. Every form has its own SHA-256 hash and byte length. The import used `git archive` output; it did not copy raw Git blob bytes directly.

A subsequent independent audit identified an incorrect label in the initial manifest: `committed_sha256` described archive export bytes, and the accompanying text called them committed bytes. Git's archive export converted LF to CRLF in 56 of the 121 files in this Windows configuration. The correction recomputed all raw blob hashes with `git cat-file blob`, verified that a fresh archive matched all 121 initial imported hashes, and recorded the distinction explicitly. The initial manifest is preserved verbatim as import_manifest.initial.json, an explicitly superseded record whose original labels remain incorrect. Its hash and the correction details appear in the corrected manifest.

The baseline `imported_sha256` values have not changed. After relocation, **111 files remain byte-identical to that initial archive-export import**, and 10 have documented edits. This count does not claim byte identity with the raw Git blobs. The relocation change inventory uses the initial imported bytes as its before-edit basis and records final hashes separately.

Original path	Imported path
`web/`	`web_application/`
`grrp/`	`domain_packages/grrp/`
`README.md`	`docs/history/original_README.md`
Other tracked paths	Same relative path

`original-history.bundle` contains all source Git references and their reachable history, created with `git bundle create --all` and successfully checked with `git bundle verify`. It is a portable history archive, separate from the parent programme's working-tree history. It does not pretend that the imported files were always at their new paths.

```
git bundle verify provenance/original-history.bundle
## Restore into a NEW directory when the original layout or history is needed:
git clone provenance/original-history.bundle <new-restore-directory>
```

The source archive excludes untracked and ignored state. No `.git` directory, virtual environment, `node_modules`, build output, account database, record runtime, private key file, or `.env` file was copied as source. An all-history tracked-path audit found no runtime database or private-key paths. This path audit is not a claim that a comprehensive secret scan was performed.

Runtime migration is a separate operation managed by the programme: `.runtime/academia` holds retained application state, while `.runtime/environments/academia` holds the recreated Python environment. Neither belongs in this source bundle.

The validation report distinguishes relocation changes from inherited implementation limitations. The root README and runtime helper describe current launch paths; imported plans and papers remain historical material and may use the earlier layout or describe unfinished work.

52 relocation validation

Original source: `applicative_infrastructure/gr_academia_application/provenance/relocation_validation.md`.

Original source SHA-256: `7da0c3e4ca8db57ac4d63e62133a7a9b15eadd56a8eb0b504c78d13aa81bb508`.

52.1 Relocation validation

Status: Informative implementation report, 2026-09-22.

The academia application was imported from source commit `b98730b46eca5fdf441937aef0180f5b3d4f94dd` without modifying that repository. Its GRRP v0.1 semantics, canonicalization, identifiers, protocol test vectors, and TypeScript package names remain unchanged. Python `grrp` and TypeScript `@gra/protocol` remain academia-specific packages.

52.1.1 Relocation changes

- Moved `web` to `web_application` and `grrp` to `domain_packages/grrp`.
- Added a server runtime resolver that derives source and runtime paths independently of the process working directory. The server and account CLI use the same retained database location.
- Set the independent server port to 8001 and the client development proxy to the same port.
- Selected the isolated Python executable with `GRA_PYTHON`, passed as one argument even when the executable path contains spaces. The default environment is `.runtime/environments/academia`.
- Kept retained records and the account database under `.runtime/academia`, outside source and environments. Corrected inherited wording that implied the account database was entirely disposable or that private keys could never exist anywhere on the host.
- Updated demo tool locations; demo seeding requires an explicit separate runtime and server URL. Corrected an inherited malformed string literal in `tools/demo.ts`. Demo seeding was not run against migrated data.
- Preserved the original root README, licensing statement, research documents, and complete Git history. Added current installation documentation, the missing official AGPL licence text, and explicit licensing preservation notes.

52.1.2 Executed checks

Check	Result
Source archive import	121 files; initial imported hashes preserved; corrected manifest distinguishes raw blobs, archive export, source worktree, and final relocated bytes
Provenance correction	56 archive exports differ from raw blobs only by LF-to-CRLF conversion; all 121 initial imported hashes independently reproduced
Relocation comparison	111 files unchanged against the initial archive-export import; 10 files contain documented edits
Original Git history	7,255,564-byte bundle; `git bundle verify` succeeds and reports complete history
Original repository after import	Same HEAD and clean working tree
Python package	Installed editable from the relocated domain package into the isolated environment
Python suite	**208 passed, 1 skipped**; the skipped test is a POSIX editor fallback on Windows
TypeScript protocol vectors	**43 passed**
Relocated Python vector generator	Reproduces the original TypeScript fixture byte for byte
Fastify application and path tests	**48 passed**, including 3 new runtime-boundary tests
Production build	Protocol, server, and React client builds pass

Check	Result
Optional demo tool	TypeScript syntax transform passes; no seeding performed
Deep Windows runtime path	Isolated project and question creation both return 201; graph returns 200; `grrp check` succeeds

The Python tests used a fresh explicit `--basetemp` because the machine's pre-existing shared pytest temporary directory was inaccessible. Windows sandbox ancestor-directory access also blocked esbuild configuration discovery; running the scoped build/test commands outside that sandbox restriction succeeded. Neither issue required changing machine-wide long-path or execution-policy settings.

The server suite creates temporary accounts and projects, invokes the relocated Python implementation, tests Git repositories and record operations, and checks graph behavior. These checks do not certify conformance to the generalized protocol or establish production readiness.

The long-path check used a separate `.runtime/academia-relocation-smoke` tree under the programme, with an in-memory account database. It exercised the new runtime depth without adding records to retained user data. That temporary tree was removed after verification.

52.1.3 Inherited dependencies and limitations

`npm ci` reproduced the existing lockfile without a dependency upgrade. The npm advisory report on 2026-09-22 reported six affected packages: three high (`@fastify/static`, `drizzle-orm`, `fast-uri`) and three moderate (`fastify`, `vitest`, `@vitest/mocker`). Several suggested fixes require version changes outside the existing declared ranges. A separate dependency-maintenance review is needed before public deployment; advisory presence alone is not a finding that every reported path is exploitable in this application.

Installed Python and Node versions are recorded separately in `installed_dependencies.json`; this is a validation environment record, not a new dependency lock or compatibility guarantee.

The migration preserves application behavior, including existing custody choices and historical documentation. It does not introduce the generalized application's transaction receipts, relation module semantics, concurrency behavior, or standards-alignment claims. Future convergence requires an explicit domain compatibility design.

Actual retained-data backup, transfer, and live-service verification are handled separately by the programme migration. The source import did not include account databases, runtime records, private keys, or generated dependency trees.

53 README

Original source: `applicative_infrastructure/gr_academia_application/web_application/README.md`.
Original source SHA-256: `0527be3cce58696c4e28074f2daead5eaa83a29761c228ebcb3335df29c6d7c8`.

53.1 GRA — the web platform

A host for records, which is **not** their authority.

Three packages, and the boundary between them is the design:

`packages/protocol`	GRRP v0.1 in TypeScript	canonicalisation, identifiers, signing — the same code in the browser and on the server
`packages/server`	Fastify + SQLite	accounts, sessions, an index. Owns no protocol decisions
`packages/client`	React + Vite	the pages. Disposable by design

The front page is public. Reading what people have shared, and searching across it, needs no account — an account is access to this host, not permission to look, and a front door that demanded a login before it showed you anything would have already decided it was the authority. Signing in adds one thing: your own projects, and the ability to open one.

Project is the top-level object, the way a repository is on a forge. It is created with a name and, if you want, a description — kept as a plain `README.md` in the project directory, so it travels with the record and outlives this server.

A project starts **empty**, and a question is opened separately inside it. The two are different things: a project is a container, a question anchors a *trajectory*, and a trajectory is what transitions attach to (C4). Demanding a question at creation conflates them, and implies a project is one enquiry.

Nothing can be recorded in a project with no question open — every act changes an identified state, and the question is the first state there is. The interface says so rather than preventing the situation.

The reference implementation, `grrp`, stays Python and stays the thing the protocol is defined against. This server invokes it as a subprocess to create records, for the same reason a git forge shells out to `git`.

53.1.1 Running it after relocation

See the application guide for installation, the independent port 8001, and absolute runtime settings. Source packages stay under this directory; retained accounts and records live under `applicative_infrastructure/.runtime/academia`. The source location determines defaults regardless of the process working directory.

The Python implementation is installed from `../domain_packages/grrp` into `../../.runtime/environments/academia`. `GRA_PYTHON` selects its interpreter; `GRA_RECORDS`, `GRA_DB`, and `GRA_CLIENT` can select explicit absolute paths. Back up the account database together with the complete records tree.

53.1.2 What the database is not

No database is the system of record (C11). The record is plain files: transitions in YAML, state content in files named by the hash of their bytes. The SQLite file holds two things — *accounts*, which are local to this host and part of no record, and *an index*, which is derived and rebuilt by `POST /api/reindex`.

This is tested rather than asserted. Delete `index.sqlite`, restart, and every record comes back identical from the files. Accounts do not, because they are the one thing not derived from anything — back them up, or make them again.

53.1.3 What this platform refuses to do

Each of these will be asked for, and each request is the design working:

- **No count, score, ranking or index over participants or trajectories** (C6). There is no `stars` column and there will not be one. A count *within* one trajectory, shown beside its own question and never next to another's, is permitted — that is the line.
- **Search filters; it does not rank.** No relevance ordering, no "best match". The API says so in its own payload so a second client cannot present results as ranked without contradicting it.
- **Disclosure widens and never narrows** (C7). There is a route that lists a record and none that unlists it.
- **No combining of two divergent states, and not the word for it** (C5).
- **No directory of people.** Not of accounts here, and certainly not of records elsewhere. A service that knew where everyone's records were would be party to every entry.

53.1.4 Keys

An **account** is a name and a password. It reaches an identity; it signs nothing. An **identity** is a keypair, and the keypair is what signs.

The account database stores public keys only. The record runtime can also contain private GRRP signing keys used by subprocess operations. Browser-generated keys and record-local signing keys have different custody paths; a database schema alone does not establish that the host cannot sign for a party. Back up and restrict access to the complete runtime accordingly.

The bootstrap path is the weak point and is not glossed: `account add` without `--party` generates a keypair in this process and prints the private half once. Prefer `--party` with a key the person generated themselves. Browser-side key generation is the next piece of work.

53.1.5 Two implementations

`packages/protocol` and `grrp` must agree on every identifier for every input. `../domain_packages/grrp/tools/make_vectors.py` generates the vectors; the TypeScript suite must reproduce all of them. A disagreement is a specification bug.

The first run of that suite found one: Python and TypeScript stripped different sets of trailing whitespace, so the same document got two different state identifiers. See `TRAILING_WHITESPACE` in `canonical.py` and `TRAILING` in `canonical.ts`.

54 CONTRIBUTING

Original source: `applicative_infrastructure/gr_generalized_application/CONTRIBUTING.md`.
Original source SHA-256: `b5537fa667fdefc6d15430987f2e27b0ab9495a6d7af16b91e9d917bba7d0670`.

54.1 Contributing

Use this repository for generalized application behavior, presentation and integration. Shared record protocol and Git-store changes belong in the infrastructure repository. Describe the user-visible problem, explain affected record semantics and provide proportionate validation. Keep account data, signing keys and project records outside the source repository.

The project-authored material is offered under the MIT licence, with scope and exceptions. By intentionally submitting original work for incorporation, you offer it under MIT while retaining your copyright. Identify third-party material and its licence separately, and state your authority when contributing on another rights holder's behalf.

Add your preferred contributor name or organization and a brief contribution description to CONTRIBUTORS.md when your work is incorporated. Preserve the separate Cytoscape attribution and all other third-party notices. AI tools may be acknowledged as tools, not as copyright holders.

55 CONTRIBUTORS

Original source: `applicative_infrastructure/gr_generalized_application/CONTRIBUTORS.md`.
Original source SHA-256: `daae5976f15b02bd86a51ef389c6c4502082fbcaa392889d9a373de9b41fc630`.

55.1 Contributors

Copyright (c) 2026 the contributors listed in this file, for their respective contributions.

Contributor	Recorded contribution
Wanhong Huang	Generalized GR application conception, requirements, design and development direction.

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Add a contributor's chosen name or organization and a brief contribution description when their work is incorporated. Preserve existing attribution. Corrections can be proposed through the same review process as other repository changes.

AI tools have assisted drafting, implementation, and review. They are development tools and are not listed as copyright holders. Third-party components retain their own author and licence notices.

56 LICENSE

Original source: `applicative_infrastructure/gr_generalized_application/LICENSE.md`.
Original source SHA-256: `6e2a0623446b1c1cd5758ebd8d1777b3d66570e98e2bcd99c068a4b8d3c3b892`.

56.1 Licensing scope

Effective date: 2026-09-22. **Licence:** MIT, under the project owner's explicit instruction for the repository family.

The MIT licence covers project-authored application code, documentation, tests and other project-controlled material in this repository. Its copyright notice refers to all contributors listed in CONTRIBUTORS.md, for their respective contributions. The licence text follows the Open Source Initiative MIT text.

The vendored Cytoscape.js distribution retains the Cytoscape Consortium's own MIT notice and provenance record. Do not replace this third-party attribution with the project's contributor list. Other dependencies retain their own licences and notices.

User-created records, evidence, attachments, account information and private project Git histories are not licensed under MIT simply because the application stores or presents them. Their applicable rights and access conditions remain separate from the software licence.

Contributions and attribution are described in CONTRIBUTING.md. Contributors retain rights in their respective contributions; no collective ownership of every file is implied.

57 README

Original source: `applicative_infrastructure/gr_generalized_application/README.md`.
Original source SHA-256: `25afdb8356afb5d8079abbe20202c4f12b2362cb1922fc892f03834b9715b7d8`.

57.1 Generalized GR application

Class: Application and development guide
Status: Experimental application; gsp-record-protocol/0.2 and gsp.general/0.2
Source repository: Generalized-Generativity-Relational-Social-Science-Application

The generalized application is a local web workspace for recording situations, their relations, the grounds of accounts about them, and their subsequent revision. A visual graph lets users create and connect records, inspect their modules and return to a coherent historical view.

It is one application within the Generativity Standards Program. The programme's operational recording roles and working specifications inform its model; neither saving a record nor passing its validation establishes factual truth or formal Standard conformance.

57.1.1 Current capabilities

- Register and sign in; create multiple private projects, each with its own record Git repository.
- Create records with overlapping Entity, State, Event, Process, Relation and Property roles, attributed context, knowledge basis, uncertainty and alternatives.
- Create first-class Relations with named participants and qualified direction/reference scope; connect to an existing record or create a record and its relation in one save.
- Explore, select, filter and arrange the graph or browse a record list. Layout choices affect the display without creating record revisions.
- Explore event-defined spacetime: record precedence claims, select consistent temporal cuts, and inspect scoped ontology topology and subject trajectories independently of Git recording order.
- Attach notes and retained files through record modules, replace material, or detach its current association with an attributed reason.
- Revise records with a reason and change category; inspect historical labels, relations, modules and file bytes at one selected revision.
- Export JSON metadata, a material-bearing snapshot ZIP, or a Git bundle of reachable project history.
- Preview and explicitly migrate a legacy workspace while preserving earlier revisions.

The web application guide gives the detailed interaction model, resource limits and account behavior. A Relation can itself have properties, notes, files and history. The graph's position and arrows add no causal, epistemic or legal meaning beyond the records they present.

57.1.2 Demo gallery

Explore **River Commons**, a fictional inquiry into shared care of a garden. Its 31 records cover all six operational roles, five Events, notes, six retained files and seven Git revisions. The scenario includes retrospective recording, branching event precedence, changing State accounts, contested interpretations, an unrealized alternative and a correction whose earlier account remains accessible.

[Image description: River Commons record graph and the selected stewardship Relation]

[Image description: Event-defined spacetime with precedence independent of Git recording order]

57.1.3 Visualized spacetime

Choose an event boundary to see the ontology topology applicable there. The two views below use the same retained revision: the first includes the encounter and agreement; the second also includes the workday and review.

After the agreement: 10 projected records. Trial access and a provisional stewardship arrangement apply.

[Image description: Agreement frontier, scoped ontology graph and trial-access State]

After the review: 13 projected records. Trial accounts end; revised access, renewed stewardship and the workload concern apply.

[Image description: Review frontier, changed ontology graph and revised-access State]

The trajectory view connects descriptions under their recorded subjects. For the garden, follow **Access not yet arranged → A garden open for a trial → Access under a revised rota**, with their inclusive start and exclusive end boundaries:

[Image description: Subject trajectories with event bounds and applicability]

The independent water observation remains unordered. These are selected partial-order cuts, not equally spaced instants or assertions that incomparable events occurred simultaneously. Moving between cuts changes the projection without creating a Git revision.

The full gallery contains ten actual interface screenshots, including two temporal cuts at the same revision, subject trajectories, temporal editing, file attachment, historical contradiction and mobile use. The graph overview shows the visible **care** filter (11 of 31 records) and locally arranged node positions.

The demo guide provides the narrative walkthrough and commands to create a separate synthetic account and project, then reproduce the images. Demo credentials stay in the ignored infrastructure runtime. The example illustrates implemented behavior; its invented accounts and files do not establish facts about a real community.

57.1.4 Source repository and dependencies

```
gr_generalized_application/             This application Git repository
├── README.md  LICENSE  CONTRIBUTORS.md
└── web_application/
    ├── run.py                          Local Waitress entry point
    ├── generative_app/                 Flask application, templates and interface
    ├── tests/                          API and opt-in browser journeys
    ├── requirements.lock              Application dependency versions
    ├── DESIGN.md
    └── TESTING.md
```

This repository is a submodule of applicative_infrastructure. It consumes the sibling record-protocol package and Git-store package. Common tools and packages belong to the infrastructure repository; this application does not depend on academia.

The supported setup expects the infrastructure checkout with its submodules initialized. With GitHub SSH access configured:

```
git clone --recurse-submodules git@github.com:huangwanhong-maker/Generativity-Relational-Epistemic-Applicative-Infrastructure.git
↪  applicative_infrastructure
cd applicative_infrastructure
```

To obtain only this application's source, use `git clone git@github.com:huangwanhong-maker/Generalized-Generativity-Relational-Social-Science-Application.git gr_generalized_application`. That clone does not include the common packages or setup tools. Programme specifications and design decisions resolve in the complete programme checkout. The Git workflow guide covers Windows SSH setup and repository remotes.

Application source commits and user project commits are separate histories. A parent infrastructure commit pins the application revision; runtime project repositories retain the users' record revisions.

57.1.5 Install and run

Requirements: Python 3.11 or later and Git on PATH. No Node build, hosted fonts or external service is needed for the interface. Its vendored Cytoscape.js component includes its own notice and source manifest.

From the **parent infrastructure directory**:

```
python common/tools/setup_application.py generalized --dev
python common/tools/run_application.py generalized
```

Open **http://127.0.0.1:8000**. On Linux/WSL, use the system's Python 3 command. The setup tool creates the generalized environment, installs the common packages and application dependencies, and optionally installs test tools. No default account is created; registration is available in the interface.

The launcher binds to loopback, accepts a different port and stops with Ctrl+C:

```
python common/tools/run_application.py generalized --port 8002
```

The application has independent account/session storage and the gsp_session cookie. Existing credentials from the local migration remain in that runtime; a fresh source clone has no migrated account data.

57.1.6 Records, configuration and recovery

```
applicative_infrastructure/.runtime/generalized/
├── accounts.sqlite3                Users, sessions, ownership and rate limits
└── repositories/
    └── <project-uuid>.git/          Bare Git repository for one user project
```

The GSP_DATA_DIR environment variable selects another absolute runtime path. GSP_COOKIE_SECURE and GSP_TRUSTED_HOSTS configure HTTPS-only cookies and accepted request hosts; details are in the configuration guide.

A transaction publishes record changes, retained assets and its receipt atomically. If another edit advances the project, the application rejects a stale save and preserves the user's draft for reconciliation. Retrying an unchanged transaction can recover its original receipt.

Revision and withdrawal retain earlier text in Git history. Detaching a file removes the current association, while earlier descriptors and bytes can remain retrievable. A project bundle includes reachable history but excludes accounts and application ownership; it is an inspection/export artifact, not a complete running-service backup. Importing arbitrary edited Git history is not implemented.

For a complete backup, stop the writer and copy the entire runtime, including the account database, journals and project repositories. Restore a matched runtime and application version together. Source submodule updates do not transfer or convert these records. The infrastructure recovery guide describes the retained relocation backups.

57.1.7 Verification

After development setup, from this application directory on PowerShell:

```
& ../.runtime/environments/generalized/Scripts/python.exe -m pytest -c web_application/pytest.ini web_application/tests
↪  ../common/packages/gsp_record_protocol/tests ../common/packages/gsp_git_store/tests --basetemp
↪  ../.runtime/test-output/generalized -q
```

Use bin/python on POSIX. The temporary-output directory is disposable and must not contain valuable records. Set GSP_BROWSER to msedge for the browser journeys if Edge is installed. See TESTING.md for browser alternatives and shared verification for scope.

The migration's combined generalized/common run passed **128 tests**, including three browser journeys. Its verification report records the tested revision and preservation boundary.

57.1.8 Current limits and development

The application currently provides owner-private projects. Sharing, invitations, email verification, password recovery, selective erasure, remote synchronization, independent custody witnessing and a formal contestation workflow remain outside the implemented experience. Public hosting requires deployment-specific administration and operating controls. The web guide documents size limits, exports and failure recovery.

Academia remains a separate native GRRP application; a shared domain adapter is future work. Preserve the distinction between retained material and assessed evidence, the account owner's status choice and independent review, and application attribution and authenticated external identity.

Commit application edits here, then update its pinned commit in infrastructure and the infrastructure pin in the programme. Changes to common packages belong in infrastructure.

Link conceptual changes to programme requirements and ADRs rather than redefining GR theory in application code alone.

Publish this application’s commits before publishing an infrastructure commit that references them, then publish the programme’s updated infrastructure reference. Inside a submodule, select a development branch before committing because initialization normally checks out the pinned commit with a detached HEAD.

57.1.9 License and contributors

Project-authored material is available under the MIT License, with copyright held by contributors recorded in CONTRIBUTORS.md. See LICENSE.md for scope and retained third-party notices. The license does not assign rights over records or uploaded files created by application users.

58 README

Original source: `applicative_infrastructure/gr_generalized_application/docs/gallery/README.md`.
Original source SHA-256: `f905ec649c101e31f830caffbe16ef2c010f1193cd54af056530830dd77bc1a4`.

58.1 River Commons gallery

Class: Informative application demonstration
Status: Synthetic example of the experimental generalized application

The River Commons project follows a fictional inquiry into shared care of a garden. Its 31 records include all six operational roles, five Events, scoped State descriptions, qualified Relations, notes, six retained files, an unrealized alternative and a corrected chronology. Every account and source file is invented.

These images are generated from the running application and its retained project, using ordinary controls. They are screenshots, not UI mockups. See the demo guide for the story, local account setup and reproduction commands. The generated capture manifest records source and project revisions, viewport dimensions and image hashes without credentials.

58.1.1 See the visualized spacetime

Read the following views together: **event precedence defines possible boundaries; a selected boundary reveals an ontology topology; subject trajectories connect scoped descriptions across those boundaries.** Here, “space” means the topology of applicable ontology records. Selecting a boundary changes the view of one retained account, without creating a Git revision.

58.1.2 Event order defines the available boundaries

[Image description: Event precedence graph with an event-defined boundary and the retrospective encounter account]

2. A partial order of represented events. The later review was recorded first; the encounter and other earlier events were added retrospectively. Recorded precedence branches from the encounter through the agreement and workday, then reaches the review. The agreement and workday have no established mutual order. The independent water observation has no established order relative to the other events. Incomparable events are not asserted simultaneous, and horizontal positions are layout rather than a clock scale.

58.1.3 The ontology topology changes with the selected boundary

The two screenshots below use the **same current Git revision**. Their boundary labels identify different selections of passed events. Recorded predecessors are included automatically.

Chosen boundary	Events included	Records in the topology	Accounts to compare
After the provisional access agreement	Encounter and agreement: 2 of 5	10	Trial access and provisional stewardship apply
After the shared review	Encounter, agreement, workday and review: 4 of 5	13	Revised access, rotating care and renewed stewardship apply

[Image description: Ontology topology at the access-agreement boundary, with the trial-access State selected]

3. After the access agreement. The selected State, **A garden open for a trial**, and the Relation **A provisional stewardship arrangement** apply at this boundary. The workday is outside the chosen cut: no retained claim orders it before the agreement. Records with unknown or unscoped presence remain separately inspectable.

[Image description: Ontology topology at the shared-review boundary, with the revised-access State selected]

4. After the review. Both branches now lie before the selected boundary. The trial State and provisional arrangement have ended within this account. **Access under a revised rota**, **Care shared through a rota** and **A renewed agreement to care** are applicable. The independent observation is still outside this cut and remains unordered. These changes follow declared temporal extents; the visualization does not infer that an event caused them.

58.1.4 Subject trajectories connect the scoped descriptions

[Image description: Record trajectories with event boundaries and presence classifications]

5. Follow changing and competing descriptions. Under **River Commons garden**, the State accounts describe **Access not yet arranged**, then **A garden open for a trial**, then **Access under a revised rota**. Their inclusive start and exclusive end boundaries connect them to the agreement and review. The provisional and renewed stewardship Relations have their own extents under the same subject.

Under **Stewardship team**, **An informal team taking shape** ends at the review and **Care shared through a rota** becomes applicable. The workload concern remains visible beside those descriptions. Subject grouping does not independently establish identity, continuity or agreement. Unknown water applicability remains indeterminate; it is not placed into a definite period merely to complete the picture.

To explore these views, open **Spacetime**, choose **Before all**, then mark **A provisional access agreement** as passed. Read the topology and trajectories, then mark **A shared review** as passed and compare. Keep **Current project** selected throughout; no project revision is saved by these controls.

58.1.5 Records and their relationships

[Image description: Record graph with the provisional stewardship Relation selected and its participant roles visible]

1. A record graph with inspectable Relations. The selected arrangement has its own account and named participant roles. The visible search query **care** shows 11 of the project's 31 records for readability; it does not remove the other records. The capture script arranges these nodes into a local display grid, equivalent to manual dragging, without changing records or connections. Graph layout does not establish causation or chronology.

58.1.6 Describe temporal scope

[Image description: Temporal-extent editor showing inclusive and exclusive event boundaries, subject grouping and grounds]

6. Record the grounds for temporal scope. The actual editor distinguishes event, unknown and unbounded boundaries, and retains the stated basis and optional subject grouping. This pictured editor is opened for the trial-access State and canceled during capture.

58.1.7 Retained materials and usable controls

[Image description: Files module showing fictional review materials attached to their account]

7. Material accompanies the account. Fictional review evidence is retained through the Files module, with download links and custody details. Preserving bytes establishes what was retained, rather than independently verifying their content.

[Image description: Styled native upload chooser with a synthetic encounter-notes file selected]

8. Attach material through the real upload dialog. The native file chooser uses the application's button styling. The selected synthetic file is a screenshot-only draft; capture discards it instead of creating a duplicate attachment.

58.1.8 Preserve contradictions and their revision

[Image description: Read-only historical snapshot with contradictory event order and record history]

9. A historical contradiction remains inspectable. This pinned revision contains the mistaken claim that the review preceded the encounter. The cycle prevents a consistent temporal cut. The current account withdraws that claim while retaining this historical record; it also corrects the reported attendance from 18 entries to 16 distinct attendees. Those are revisions of the account, not changes to past events.

58.1.9 A narrow viewport

[Image retained in source archive.]

10. The same project on mobile. Ordinary workspace controls and the event-order view remain available at a 430-pixel viewport. This bounded screenshot shows a portion of the scrollable workspace.

58.1.10 Capture and preview maintenance

The capture script reads the synthetic project's saved revision, operates the UI, captures these ten images and checks that the project head remains unchanged. Its generated manifest describes the particular capture; this gallery is not a substitute for application test results.

Five deliberate preview copies are generated inside each of the programme and infrastructure repositories for their READMEs:

Canonical screenshot	Parent preview filename
`01-record-graph.png`	`generalized-record-graph.png`
`02-event-order.png`	`generalized-spacetime.png`
`03-earlier-topology.png`	`generalized-spacetime-earlier.png`
`04-later-topology.png`	`generalized-spacetime-later.png`
`05-subject-trajectories.png`	`generalized-spacetime-trajectories.png`

The copy mapping and source hashes are recorded in the manifest. Keeping previews inside each repository avoids broken image paths across Git submodule boundaries. The complete gallery and reproducible demo sources remain here in the generalized application repository.

59 README

Original source: `applicative_infrastructure/gr_generalized_application/web_application/.pytest_cache/README.md`.

Original source SHA-256: `73fd6fccdd802c419a6b2d983d6c3173b7da97558ac4b589edec2dfe443db9ad`.

59.1 pytest cache directory

This directory contains data from the pytest's cache plugin, which provides the `--lf` and `--ff` options, as well as the `cache` fixture.

Do not commit this to version control.

See the docs for more information.

60 DESIGN

Original source: `applicative_infrastructure/gr_generalized_application/web_application/DESIGN.md`.
Original source SHA-256: `bdc48f69a9b8004dda210fa5f4cfa63f6304e1b98cb2bd230d81089f81fd648f`.

60.1 Project workspace — implementation design

Document class: Informative application design
Maturity: EXPERIMENTAL; initial implementation
Date: 2026-09-22
Draft reference baseline: GR-100/110/200/210 Working Draft 0.3
Decision: ADR-0007

Historical scope: The text below records the initial `gsp-workspace/0.1` design and its original gaps. The current graph/module/transaction architecture is in graph_workspace_design.md and ADR-0008. That extension replaces the implementation restrictions on single-role records, structured relations, attachments, revision categories, migration and project graph views; the broader epistemic, governance, custody and legal limitations remain. See the current operation guide.

60.1.1 Purpose and supported use

The application lets a person register, sign in, create private projects, and record qualified accounts within a project. A person can revise a record with a reason, inspect its retained versions, export the project's current snapshot as JSON, or download its complete reachable history as a Git bundle. Its immediate purpose is to make trajectory recording usable enough to examine the programme's proposed distinctions and practical burden.

The application does not claim conformance to any GR draft. It implements selected recording functions with declared information limits. Choosing a role or filling a field does not establish occurrence, target identity, evidential warrant, ethical acceptability, or legal effect. A project's owner-assigned record status is separate from the represented effect's modality and from any independent review.

60.1.2 Components and storage authority

Component	Responsibility	Authority boundary
Browser interface	Registration, login, project navigation, recording, revision, history, and export	User input is validated again by the server; a visible interface control is not an authorization rule
Flask application	Authentication, access checks, validation, server audit attribution, and bounded Git operations	The trusted server mediates every project operation
SQLite	Accounts, credential verification material, sessions, and project ownership/index lookup	Authentication and access data stay outside project content history
Per-project bare Git repository	Project manifest and JSON records, retained through commits	The committed project snapshot is authoritative for project content; the database is not a second record-content store

Projects are private to their owning account through this application. The first version provides no project invitation, shared editing, public link, or Git push/fetch service. An authorized owner can download a Git bundle and clone it locally. Host filesystem access remains an administrative trust boundary. The application is bounded to 1,000 records per project and limits request and field sizes; these are prototype resource limits, not GR requirements.

The storage design avoids a shared writable checkout. A mutation reads the current project tree, creates new content/tree/commit objects, and conditionally advances one project reference using the previously read commit. Git documents the conditional old-object check in `upd`

ate-ref. A competing successful update causes a conflict; the client can reload and reconsider its edit. This prevents one accepted write from silently replacing an intervening accepted write through the application. It does not authenticate represented observations or make all infrastructure operations atomic.

An object written before an unsuccessful reference update can remain unreachable in Git storage. It is not an accepted project revision. A crash between repository initialization and database registration can also require operator reconciliation. Recovery must inspect the authoritative committed project manifest and access records; an orphan repository is not automatically published or assigned to another account. Database and Git backups need a consistent recovery procedure before operational dependence.

60.1.3 Recording semantics

Field names below describe the application's narrow data model, not a standardized interchange vocabulary. Project and record JSON declare `schema_version: gsp-workspace/0.1`. The server controls record identifiers, audit account identifiers, and recording timestamps.

Information	Application representation	Interpretation and limit
Stable record reference	`id`	Identifies this application record; does not establish target identity
Account content	`title`, `content`	Recorder's description; a compound account can still require finer claim separation
Primary recording role	`record_type`: Entity, State, Event, Process, Relation, Property	One primary role per record; overlapping target descriptions can use linked records; role-specific criteria are not fully enforced
Epistemic mode	`epistemic_mode`: observed, reported, inferred, interpreted, retrospective	A primary account mode, not a truth rating; combined modes require qualification in prose
Asserted modality	`modality`: realized, intended, possible, unrealized, unknown	Describes the asserted effect or occurrence, separately from how it is known
Recorder's status	`status`: unreviewed, contested, revised, withdrawn	Owner-assigned description; not an independent assessment or institutional case state
Attributed source	`attributed_to`	Reported observer, speaker, source, collective, or explicit uncertainty; distinct from the signed-in recorder
Method and grounds	`method`, `evidence`	Supplied method description and grounds/references; no automatic evidence verification, external retrieval, or preserved evidence attachment
Qualification	`uncertainty`, `alternatives`	Space for limits and competing accounts; empty content does not establish certainty or absence of alternatives
Generative context	`conditions`, `consequences`	Enabling/constraining context and asserted effects; no mechanism, beneficial effect, or completed repair is inferred automatically
Represented time	`occurred_at`	Recorder-supplied occurrence/target-time description, distinct from server recording time; uncertainty can be stated in the description

Information	Application representation	Interpretation and limit
Cross-references	`related_records`	Links within the project; a link does not establish identity, causation, support, or a typed Relation
Audit information	Server-assigned creation/update time and recording-account identifiers	Captures application activity under the server's clock and access model; does not verify real-world identity or independent time
Revision rationale	Reason supplied with the revision and retained in its history	Explains the edit; the first version does not structurally classify target, evidence, and descriptive-regime changes

A Relation can be recorded as a separately referenceable record with its own account and history. The cross-reference list is a navigation facility. It does not replace a Relation record when that relation's own properties or history matter, nor does it yet provide structured relation participants and identity criteria.

The selected mode, modality, and status can coexist. For example, a recorder can describe a realized event through retrospective reconstruction while marking its account contested and explaining the dispute. If both inference and reconstruction matter, the primary mode alone is insufficient; the content and method explain their separate contributions. This known limitation is a candidate input to a richer information-model specification.

60.1.4 History, conflict, and export behavior

The authoritative current project is a Git commit containing its manifest and records. An accepted record revision preserves the record identifier and creates a new commit with its reason and accountable recording actor. Earlier snapshots remain accessible while their commits are retained. Ordering in this history is recording order; the account can describe an earlier occurrence or an uncertain time.

Updates carry `expected_head`, the project revision the client edited, and `revision_reason`. A stale update is rejected instead of being automatically merged. This is project-wide conflict detection: even an intervening change to another record can require a reload. The conservative boundary keeps the first implementation's behavior explicit. The application does not expose branch creation, concurrent interpretation branches, semantic merging, or a claim that the latest account has the best evidence.

History and historical record reads pass through the same project ownership checks as current reads. A revision identifier is a locator, not a permission token. A version inspected in the application needs to belong to that project's retained history. The history endpoint returns the latest 100 revisions affecting the selected record. It is not a project-wide timeline or a complete browser listing of longer histories; the Git bundle permits examination of the complete reachable history with Git tools.

The JSON export is a current snapshot identified by its source project revision. It contains project records and their available qualifications. It does not contain credentials, authentication sessions, prior snapshots, externally referenced evidence, or confirmation that downstream recipients obtained later corrections. It is a local experimental format, not GR-130 conformity or a complete repository backup.

The separate Git bundle contains the main reference and its complete reachable commit history. It therefore contains earlier and withdrawn account content, revision reasons, and recorded actor names/identifiers, even when the current snapshot no longer displays the earlier formulation. It does not contain the account/session database, authentication credentials, access configuration, or unreachable objects from unsuccessful writes. The owner can clone the bundle for independent inspection, but the bundle alone does not restore a complete running service.

60.1.5 Traceability to draft needs

Each row identifies a design relationship, not a fulfilled requirement. Exact obligations and conditional triggers remain in the cited 0.3 sources: GR-100, GR-110, GR-200, and GR-210.

Draft references	Implemented contribution	Material gap or assessment boundary
R110-001; E200-001	Project name/description, identifier, owner, version, and private access boundary	No complete collection declaration, purpose/claim-selection assessment, descriptive-regime register, or allocation of independent institutional responsibilities
V100-005/010/011; R110-006/009	Stable records, primary operational role, first-class Relation records, cross-references	Target identity and role admissibility criteria remain descriptive; linked records are not a tested multi-role semantics or a metamodel mapping
V100-016; R110-012; E200-005	Separate primary epistemic mode, modality, and owner-assigned status	Limited mode vocabulary; combined modes, perspective, and assessment disposition are not comprehensively structured
E200-004/029/030	Separate authenticated recorder and attributed source; method field	No verified source identity, complete attribution/transformation chain, instrument version, calibration record, or observation window
V100-006; R110-008; E200-008	Represented time separate from application creation/update time	Observation, acquisition, assessment, intervals, and uncertain ordering lack separate structured fields
E200-006/010/011/014/015	Method, supplied evidence text, uncertainty, and alternatives	No separate versioned material items, claim-relative evidence-role assignments, assessor record, custody chain, or completed examination of alternatives
R110-010/015/017/058/112	Conditions, consequences, and alternative-account descriptions	No automatic generative attribution; no structured link-specific evidence, counterfactuals, recirculation stages, or generativity-return assessment
V100-007; R110-020/021; E200-017/038	Retained revisions, accountable actor/time, required revision reason, accessible earlier versions	No structured classification of revision grounds, parallel interpretation branches, independent retention guarantee, or dependent-claim follow-up
R110-025/085/087/092; E200-023/043	Owner-only access across current content and history; credentials kept out of project history	No per-record disclosure, protected-source arrangement, retention schedule, selective erasure, legal hold, or backup disposition workflow
R110-029/030/093; E200-026	Qualified record presentation and current export identified by source revision	No complete transformation/omission declaration, standardized interchange validation, external correction delivery, or observed user-comprehension assessment
R110-023/082; E200-021; C210-005/009/013/048	The owner can describe a dispute and revise their account	No third-party intake, responsible independent reviewer, service periods, notice, appeal, evidence determination, or operative GR-210 case procedure
R110-032/033/034/099; E200-002/045/049	Tests can examine application behavior and distinguish selected checks from a whole-package claim	No per-requirement conformance dossier; passing application tests does not establish the full GR-200 dependency or any unqualified draft-conformity claim

60.1.6 Security, custody, and participation boundaries

The server authenticates each account and checks ownership on project, record, history, and both export operations. Authentication credentials and session state are not project records. Password verification uses Werkzeug's scrypt hashing. Browser session cookies carry opaque random tokens; SQLite retains their SHA-256 digests with a twelve-hour absolute expiration. Session identifiers and anti-forgery tokens rotate at authentication changes. Anonymous sessions also receive anti-forgery protection for login and registration. Cookies use HttpOnly and SameSite=Lax; Secure is configurable for HTTPS deployment. Authentication throttling uses server-observed direct IP addresses and an email digest, without trusting arbitrary forwarded headers.

Write requests require the application's anti-forgery protection as well as authorization. Content is presented as text rather than executed as user-supplied HTML. Git receives bounded arguments and server-controlled repository paths. The initial configuration binds to loopback, limits trusted hostnames to localhost and the IPv4/IPv6 loopback addresses, and sets a content security policy. These controls address ordinary application attack surfaces; deployment controls still matter. Flask's security guidance addresses complementary browser, cookie, request, and resource protections. Configuration and operating instructions accompany the implementation. The initial release does not offer email verification, account recovery, or a claim of production readiness.

An authenticated account is not a verified person or qualified reviewer. Attribution to a different person does not imply their consent or endorsement. A host administrator can read stored content and rewrite or delete repository history. This version offers no encryption-at-rest, signed record attestations, trusted timestamps, or independently witnessed history. A commit hash identifies retained content within Git's model; it does not establish the truth of that content.

Withdrawal is an account status, not erasure. Earlier record content can persist in Git objects, repository copies, and backups. Exports place another copy under the recipient's control. The application cannot establish the removal of those copies. A project owner therefore needs a purpose and permission basis appropriate to what they choose to record; the application does not determine that legal or institutional basis.

The first version is suitable for bounded local experimentation with material appropriate to these limits. Organizational use involving other people's consequential records requires agreed custody, access, retention, recovery, participation, and review arrangements. Such arrangements are not created by deployment or by a technical conformance label.

60.1.7 Follow-on design questions

The following are OPEN or DEFERRED rather than hidden capabilities:

- **OPEN — Shared access:** membership, roles, invitations, revoked access to history, exports, and disclosure of protected sources.
- **OPEN — Representation:** separate claims/material/evidence-role objects; combined epistemic modes; target and observation times; typed missingness; role criteria; parallel accounts and revision grounds.
- **OPEN — Retention and recovery:** authorized selective erasure, repository copies, backup restoration, orphan initialization, and consistency across database and Git.
- **DEFERRED — Review practice:** actual challenge intake, reviewer independence, service clocks, replies, reasoned disposition, notification, and repair follow-up.
- **DEFERRED — Interchange:** migration, import validation, attachment custody, independent implementations, and promotion of stable elements into a separately reviewed Specification.

The next empirical step is to record a bounded case, revise it after new evidence, inspect what another intended reader can reconstruct, and measure the burden and missing distinctions. Results can inform the draft programme through its development procedure. They do not automatically convert this implementation into an adopted model.

61 README

Original source: `applicative_infrastructure/gr_generalized_application/web_application/README.md`.
Original source SHA-256: `f3202d4676a9c54344f519d3b51a71ac9cda06f4bcd0b68b536d5af1df8249ce`.

61.1 Generativity workspace

Document class: Software implementation guide
Status: EXPERIMENTAL; application schema `gsp-workspace/0.2`, protocol `gsp-record-protocol/0.2`; 2026-09-22.

A working web application for private projects, connected records, retained files and revisable accounts. Explore an interactive graph, select a record to inspect its modules, and create attributed relations through participant controls. Each project has its own Git repository. This is an experimental implementation informed by the programme's Working Drafts, not an adopted Standard or a conformance claim.

61.1.1 Run locally

Requirements: Python 3.11 or later and Git on `PATH`. Python 3.12 and Git for Windows were used for development. The interface needs no Node build, external fonts or hosted services. Cytoscape.js is vendored locally with its MIT license and source/hash manifest under `generative_app/static/vendor/`.

From the programme root, use the shared setup and launch tools:

```
python applicative_infrastructure/common/tools/setup_application.py generalized --dev
python applicative_infrastructure/common/tools/run_application.py generalized
```

Open **http://127.0.0.1:8000**. The setup tool recreates the application's own environment and installs both shared packages. It handles Windows extended paths for nested dependencies; the same commands also work with `python3` on Linux or WSL. No demonstration account or default password is installed. Existing migrated accounts and sessions remain available.

The launcher uses Waitress, binds to loopback by default and resolves source/data locations independently of the shell's working directory. Use `--port 8002` if the default port is occupied. Stop it with Ctrl+C. Development previews record their process ID and logs under `build/application-servers/` at the programme root.

61.1.2 What you can do

- Register, sign in and sign out; sessions expire after 12 hours.
- Create multiple private projects, each accessible only to its creator through the application.
- Add records with overlapping recording roles, content, primary knowledge basis, occurrence/modality and owner-assigned status.
- Record attributed sources, methods, evidence references, uncertainty, alternatives, enabling/constraining conditions and consequences.
- Explore the graph or record list; select nodes, filter, pan, zoom, arrange and fit the view. Layout is a local display preference and creates no record revision.
- Open Spacetime to inspect asserted event order, select an event-defined temporal cut and view the corresponding scoped ontology subgraph and trajectories.
- Create a Relation record with named participant roles, record/target reference scope, direction and completeness qualifications. Add further participants or relate a Relation to another record. Create a new record and its connection in one save.
- Add retained notes and files through a record's modules. Replace a file or detach its current reference with an attributed reason.
- Revise a record with a reason and change category; inspect its previous versions and the project's latest 100 revision entries. Historical views pin labels, relationships, modules and file bytes to the same revision.
- Export selected-revision metadata as JSON, download a snapshot ZIP with material referenced by supported file modules, or a Git bundle containing complete reachable project history.

- Preview and explicitly migrate an earlier workspace. Reading a project never migrates it; earlier revisions remain unchanged.

Retained files are material, not automatically assessed evidence. The application does not fetch evidence URLs. A selected status such as `contested` describes the owner's account; it does not establish an independent review finding. The form records one primary knowledge basis; use method/context fields to preserve qualifications and mixed bases. The graph's placement and arrows establish no additional causal, evidential, ethical or legal meaning.

If another edit advances the project while your form is open, saving returns a conflict and preserves the draft. Review the latest version and reconcile before saving again. This applies across records in the same project. A retry of an unchanged transaction uses its original identifier; the server returns the original receipt if it already succeeded. Editing the request creates a new transaction identity.

61.1.3 Demonstration and screenshots

The **River Commons** demo contains 31 synthetic records across all six roles, five Events, six source files and seven preserved project revisions. Follow an inquiry from retrospective event recording through two topology cuts, subject trajectories, competing accounts and a correction of the retained history.

[Image description: The synthetic River Commons graph and Relation inspector]

[Image description: River Commons event order in the Spacetime view]

61.1.4 See the ontology change across event boundaries

After the access agreement: the encounter and agreement are included, with 10 scoped records in the topology. The inspector shows **A garden open for a trial**.

[Image description: Spacetime topology at the agreement boundary with trial access]

After the review: its declared predecessors are included, with 13 scoped records. The inspector shows **Access under a revised rota**. Both views use the same Git revision.

[Image description: Spacetime topology at the review boundary with revised access]

Subject trajectories retain successive descriptions and their event bounds, including accounts that ended or remain indeterminate:

[Image description: Subject trajectories for the garden and stewardship team]

To reproduce this in the demo, open **Spacetime**, choose **Before all**, then mark **A provisional access agreement** as passed. Inspect the topology and trajectories; next mark **A shared review** as passed and compare. This changes the chosen partial-order cut without saving a revision. The independent water observation remains unordered, and incomparable events are not asserted simultaneous.

See the ten-image gallery and demo setup and walkthrough. The scripts create a separate test account through the ordinary API and capture the actual UI. Credentials remain in ignored `.runtime/demo/river-commons.json`. The pictured graph uses the visible **care** filter and a local display arrangement; neither changes retained records.

61.1.5 Spacetime and trajectories

Here, space means the topology of the represented ontology at an event-defined boundary. Geographic coordinates can be part of a contextual State or Property account; graph layout positions do not record geographic position.

1. Create Event records, including events learned about retrospectively. Their save order does not determine their represented order.
2. In **Spacetime**, add an event-order account identifying which Event precedes another and the grounds for that claim. It is retained as a first-class Relation with its own qualifications and history.
3. Select a record's **Time & trajectory** panel to state the temporal applicability of its account. Boundaries can reference Events, remain explicitly unknown, or be explicitly unbounded within the stated scope. An optional subject groups related State, Property or other accounts into a trajectory; explain the continuity judgment in the basis.

4. Choose included Events in Spacetime. Selecting a later Event includes its asserted predecessors. The topology displays records established active at that cut, alongside separate coverage and uncertainty information. Changing the cut creates no Git revision.
5. Use the existing project revision selector to choose which retained account supplies those claims. Historical projections and their record inspectors use that same revision.

The selected Events form a downward-closed set in a partial order. A shared display column does not establish simultaneity, and no relation between two Events means their relative order remains unspecified. Event ranks do not measure elapsed time. The first extension uses Events as operational boundary markers; extended occurrences, onset/completion distinctions and overlapping intervals need further work.

Extent starts are inclusive and ends exclusive. An unknown boundary does not establish presence. Records lacking a scope remain **unscoped**, and an extent with incomparable, identical or reversed Event boundaries remains **indeterminate**. When a scoped Relation has participants not established active at the cut, the view discloses the omitted incidences. Contradictory order cycles remain inspectable and prevent a consistent cut until the account is revised. Unsupported event-order versions also prevent a cut; unsupported extent versions leave the affected account indeterminate. Withdrawal is an attributed revision, not deletion of the earlier claim.

This is a projection of explicit temporal accounts. It does not simulate event effects or treat the latest description as evidence of every earlier target state. Preserve distinct historical State accounts and their bounds when the target changes. Competing and non-realized accounts retain their qualifications; a temporal projection is not factual adjudication.

The read-only API is `GET /api/projects/<id>/spacetime?revision=<40-hex-head>` for the all-event cut, or `POST` to the same URL with `{"after":["event-uuid"]}` to select a cut. POST requires the ordinary session and CSRF token but creates no transaction. `after: []` selects the empty cut. Requests are limited to 1,000 distinct Event identifiers and 64 KiB. Both methods return the selected `head`, `current_head`, event order, cut, scopes, topology and diagnostics.

61.1.6 Where records live

By default, private application data is stored outside the source files in ignored `applicative_infrastructure/.runtime/generalized/`:

```
.runtime/generalized/
  accounts.sqlite3             # users, password hashes, sessions, ownership, rate limits
  repositories/
    <project-uuid>.git/          # bare Git repository, one per project
```

Each repository contains `project.json`, `records/<record-uuid>.json`, `.gsp/protocol.json`, `.gsp/transactions/<transaction-uuid>.json`, and `assets/<sha256>` on its `main` branch. A transaction publishes its records, material and receipt atomically. Git commits attribute saves to the account's display name and a pseudonymous account identifier, not its login email. Account passwords and session tokens are never placed in project repositories. Record text can itself contain personal information supplied by the author.

Changing a record or marking it withdrawn preserves its earlier text in history. Detaching a file removes the current record association; retained bytes and earlier descriptors remain available through history. A history bundle includes that earlier content and retained material. Git hashes and application attribution do not establish factual truth, independently authenticated identity or an immutable archive against the server operator.

To inspect a downloaded bundle, replace the example filename with your download:

```
git clone .\generativity-PROJECT-ID.bundle .\project-history
git -C .\project-history log
```

That checkout is an inspection copy. Importing edits back into the application is not implemented. JSON excludes all attachment bytes. Snapshot ZIPs exclude older revisions, receipts and unreferenced retained assets; their manifests disclose unsupported module dependencies. A Git bundle preserves project history but does not include accounts or application ownership. None of these exports alone is a complete running-service backup.

For a complete local backup, stop the server and copy the entire data directory, including the SQLite database and any journal files, plus repositories. Restore the whole directory with

the same application version into a controlled location. Crash recovery across initial Git-repository creation and the SQLite ownership transaction remains a manual administration task; an interrupted creation can leave an inaccessible orphan repository. Individual record writes publish atomically through Git reference comparison.

61.1.7 Configuration

Environment variable	Default	Purpose
`GSP_DATA_DIR`	`applicative_infrastructure/.runtime/generalized`	Absolute path recommended for a different private data location
`GSP_COOKIE_SECURE`	unset	Set to `1` when serving exclusively over HTTPS
`GSP_TRUSTED_HOSTS`	`localhost,127.0.0.1,[::1]`	Comma-separated request hostnames

Only use a data directory controlled by the application administrator. Protect filesystem access; private project access here is application authorization, not encryption at rest. The server deliberately does not trust forwarded client-IP headers. There is no production proxy configuration included.

The current version has no invitations, sharing, email verification, password recovery, account deletion, selective erasure, independently witnessed custody, remote Git synchronization or formal contestation workflow. The academia application is a subsequent adapter/upgrade project; it has not been modified here.

The HTTP/Git binding allows 1,000 records per project, 100 operations per transaction, 32 incidences per Relation, eight binary parts, 10 MiB per file, 20 MiB combined uploaded bytes and 128 MiB retained asset bytes in the main tree. Transaction JSON is limited to 1 MiB; resource JSON to 2 MiB and aggregate snapshot JSON to 32 MiB. Core account/compatibility requests retain a 128 KiB bound. Logical retained-asset limits exclude Git metadata and unreachable prepared objects and are not a physical disk quota. Public hosting needs deployment-specific TLS, registration controls, recovery, operational quotas, monitoring and an exercised retention/backup policy.

61.1.8 Verification and design

Install test tools with the setup command's `--dev` option. The shared verification guide gives the combined package/API/browser command; TESTING.md retains the original graph-release evidence and current reproduction instructions.

Tests use isolated temporary databases and real Git repositories. The browser test is opt-in; its instructions and observed results are recorded in TESTING.md.

The current design and ADR-0008 connect manuscript interpretation, user interaction and architecture. The academia review records useful patterns and incompatibilities without copying its implementation. DESIGN.md retains the earlier design and initial traceability baseline.

The reusable protocol package, GR-SPEC-120, GR-SPEC-121 and GR-SPEC-130 define the experimental model and binding. The event-spacetime design records manuscript grounding and the operational limits. Official implementation references include Git update-ref, Flask security guidance and Cytoscape.js.

62 TESTING

Original source: `applicative_infrastructure/gr_generalized_application/web_application/TESTING.md`.
Original source SHA-256: `4d3a64a97f2d4eaea26c3de5f07d9f99f73a3e476f6fe53f398b8809a319a7ae`.

62.1 Application verification

Document class: Informative implementation verification record
Status: EXPERIMENTAL; implementation checks, 2026-09-22; preview verification, 2026-09-27.

62.1.1 Observed results

The following checks passed against the local implementation. They establish the tested behavior in this environment, not a comprehensive security audit, accessibility conformance, standards conformance, or observed institutional practice.

62.1.2 River Commons demonstration and gallery (2026-09-27)

The synthetic demo was created through the authenticated local API in a separate account. Its verified inventory contains 31 records, all six roles, five Events, five order accounts (one withdrawn), six retained files and seven project revisions. All six downloaded materials matched their authored source bytes. The initial revision contains the later review before the earlier encounter is recorded; a historical cycle remains readable, while the current account supports consistent cuts. The agreement and review cuts project 10 and 13 records respectively without changing the accepted Git head.

The capture script produced ten actual Edge screenshots at desktop and mobile sizes. Visual review covered the graph, both topology cuts, trajectories, temporal editor, files, native upload control and historical contradiction. Capture discarded the unsaved editor/upload drafts and verified that the project head stayed unchanged. No page errors, captured CSP errors or horizontal mobile overflow were reported. The refreshed topology captures retain the selected event frontier and compare trial access with revised access; capture assertions check the 10-record and 13-record projections. Image hashes and the ten parent preview copies matched; 139 local links across the six related READMEs resolved. The gallery manifest records the capture inputs and image hashes without credentials.

An additional isolated server check began with the server unavailable, then recovered the saved unconfirmed registration. It produced exactly one account and one project. Repeating the seeder preserved that account, project, accepted head and complete seven-revision history. The check did not use the live demo runtime. These are focused demo and reproduction checks; the implementation suite results below were not rerun as part of adding the gallery.

62.1.3 Event-defined spacetime extension

The completed checks total **185 passing tests across separate runs**: 178 non-browser tests and seven Edge browser tests. The reusable protocol package is version 0.3.0; protocol, record-schema and profile identifiers remain at 0.2. The implementation review records the scope and limits.

The non-browser run includes 100 protocol cases, existing real-Git storage and API regressions, and six new temporal API cases. It checks retrospective ordering, ancestor-closed cuts, incomparable events, retained cycles and withdrawal, inclusive/exclusive boundaries, unknown and unscoped presence, subject grouping, partial Relation topology, unsupported interpreter behavior, historical projections and authorized read-only cuts. A 1,000-record case checks iterative traversal within the profile's limit.

Three temporal browser journeys cover event-order and extent forms, cut controls, desktop/mobile topology, historical read-only views, conflicting claims, exact cut retry, preserving concurrent unseen relation qualifications, and retaining a selected zero-byte file when discard is declined. The existing registration, graph and retained-file journeys also pass. One existing graph test exceeded its five-second assertion during concurrent browser/Git activity; the

fixture now allows 20 seconds, and that journey passed in an isolated rerun. Tests keep their behavioral assertions.

A seventh browser test covers a connected pair beside an isolated topology node. Final visual review found force-layout overlap; edgeless views now use a grid, with collision fallback for connected views. The new test and affected temporal journey passed together on 2026-09-27, checking node separation, retained edges and desktop/mobile layout.

All three JavaScript files pass syntax checks, and the editable package installation passes `pip check`. Screenshots include `build/webapp-review/spacetime-desktop.png`, `spacetime-mobile.png`, and the native file-picker views. These are isolated authored scenarios; assistive-technology and participant-comprehension studies remain open.

On 2026-09-27 the refreshed preview at port 8000 advertised `gsp.spacetime/1` and served the temporal script. Both existing project heads matched their earlier private capture; preview startup did not migrate or seed user projects.

62.1.4 Graph protocol release, schema 0.2 (historical baseline)

The combined non-browser run passed **125 tests**, with three opt-in browser journeys skipped in that command. The checks exercise the shared package together with the real storage/API implementation:

Check	Result	Scope
Independent protocol package	53 passed	Role overlap; same-batch references; unary, cyclic, repeated, parallel and higher-order incidence; opaque modules; profile guards; explicit migration; canonical digests; exact identifiers; byte descriptors and budgets; packaged schema and CLI
Real-Git storage	46 passed	Original storage regressions plus atomic graph/files/receipt publication, failure, racing writers, durable receipts, historical replacement/detachment, long paths, batch reads, quotas, supported binding manifests and bundle restoration
Flask API	26 passed	Original account/authorization regressions plus atomic graphs, pinned labels/material, durable replay/restart, altered transaction IDs, deterministic retry races, verified uploads and limits, exact multipart/JSON parsing, migration-only legacy mutation and precise ZIP scope
Browser journeys	3 passed	Registration and two-tab conflict regression; actual canvas selection and blank-canvas draft creation; multi-participant, higher-order and self relations; explicit completeness and change category; notes/files; pinned historical replacement bytes; lost-response replay after a later edit; list/keyboard alternatives and mobile layout
JavaScript and dependencies	Passed	Both application scripts passed `node --check`; `pip check` found no broken requirements

Check	Result	Scope
Publication/navigation integrity	Passed within stated scope	Local Markdown links resolve; 45 new bounded Working Draft clause IDs are unique; historical validation dossier checks remain valid

The browser trio passed independently with `GSP_BROWSER=msedge`. After final focus, canvas and historical-replay corrections, the two affected journeys passed again individually. Browser review artifacts use authored test accounts and isolated data, not the user's project. The live preview was refreshed after an offline copy of its existing data directory; its existing legacy project remained readable and unmigrated. This backup operation is not a general restoration certification.

Important defects identified during this cycle included legacy compatibility routes bypassing explicit migration, an identical-request race between receipt lookup and snapshot loading, undeclared opaque-module export limitations, permissive trailing-newline identifier patterns, and unsupported binding manifests being overwritten. Regression checks now cover those cases. Browser integration also required a local external stylesheet rule for the vendored graph renderer under the existing CSP and a renderer resize after connection controls change the canvas position. A recovered receipt for an earlier successful save now remains explicitly historical when newer edits exist; the browser does not label that older accepted snapshot current.

62.1.5 Initial schema 0.1 baseline (historical)

The earlier observed results below are retained as the initial implementation baseline; current graph scope is described above.

Check	Result	Scope
Real-Git storage integration	22 passed	Historical content, authorship/reasons, stale and concurrent writers, unreachable revisions, project isolation, path/ref input, isolated Git environment, failed writes, bundle restoration, and long Windows paths
Flask API integration	11 passed	Registration/login/logout, session rotation/revocation/expiry, password hashing, CSRF/origin/host checks, ownership on all project routes, revision reasons/conflicts, restart persistence, exports, validation, related-record boundaries, rate limits and Unicode handling
Browser journey	1 passed	Registration, project creation, record creation/revision, historical viewing, two-tab conflict/reconciliation, draft preservation, safe HTML-text display, search, both downloads, mobile layout, logout and login
JavaScript syntax	Passed	`node --check applicative_infrastructure/gr_generalized_application/web_application/generative_app/static/app.js`
Installed Python dependencies	Passed	`python -m pip check` reported no broken requirements

Check	Result	Scope
Visual review	Four screenshots inspected	Registration, record/history, desktop project, and 390-pixel mobile project; no observed overlap or horizontal overflow in these views

The tests ran on Windows with Python 3.12.10, Git 2.50.0.windows.1, Flask 3.1.3, Waitress 3.0.2, pytest 9.1.1 and Playwright 1.63.0 using the installed Microsoft Edge in headless mode. The runtime dependency versions are retained in requirements.lock.

Browser screenshots are generated under `build/webapp-review/` at the repository root. Their project and account content is authored test data, isolated from the application's private runtime directory. The visible HTML-looking string is an intentional injection probe verified to remain text, not an image element or executed script.

62.1.6 Infrastructure relocation verification (2026-09-22)

The relocated application and both common packages passed the combined suite: **128 passed**, including all three Edge browser journeys, with isolated test data and the new Python environment. The Git-store implementation remains byte-identical to the source before extraction. Storage tests now live with the reusable Git package; application tests import it through its public package. See the migration evidence for runtime preservation and academia checks.

62.1.7 Reproduce

From the repository root in PowerShell:

```
python applicative_infrastructure/common/tools/setup_application.py generalized --dev
.\applicative_infrastructure\.runtime\environments\generalized\Scripts\python.exe -m pytest -c
↪  applicative_infrastructure/gr_generalized_application/web_application/pytest.ini
↪  applicative_infrastructure/gr_generalized_application/web_application/tests --basetemp build/webapp-tests
.\applicative_infrastructure\.runtime\environments\generalized\Scripts\python.exe -m pytest
↪  applicative_infrastructure/common/packages/gsp_record_protocol/tests --basetemp build/protocol-tests
```

The browser test is skipped unless `GSP_BROWSER` is set. To include the browser journey using an installed Microsoft Edge:

```
$env:GSP_BROWSER='msedge'
.\applicative_infrastructure\.runtime\environments\generalized\Scripts\python.exe -m pytest -c
↪  applicative_infrastructure/gr_generalized_application/web_application/pytest.ini
↪  applicative_infrastructure/gr_generalized_application/web_application/tests --basetemp build/webapp-tests-with-browser
```

Use `chrome` for installed Google Chrome, or install Playwright Chromium with `python -m playwright install chromium` and set `GSP_BROWSER=chromium`. Browser checks start and stop an isolated Waitress server on a dynamically allocated loopback port; they do not require the ordinary application to be running. The chosen `--basetemp` directory is disposable test output; do not point it at application data or other valuable files.

The release integration command for all non-browser tests is:

```
.\applicative_infrastructure\.runtime\environments\generalized\Scripts\python.exe -m pytest -c
↪  applicative_infrastructure/gr_generalized_application/web_application/pytest.ini
↪  applicative_infrastructure/gr_generalized_application/web_application/tests
↪  applicative_infrastructure/common/packages/gsp_record_protocol/tests
↪  applicative_infrastructure/common/packages/gsp_git_store/tests --basetemp build/graph-release-tests -q
```

The graph browser journey generates `build/webapp-review/graph-multi-participant.png` and `graph-mobile.png`. The earlier manual smoke review generated `graph-desktop.png` and `graph-relation.png`. Pointer, form and list interactions are exercised; assistive-technology evaluation and measured user comprehension remain open.

62.1.8 Defects found and corrected

- A non-ASCII CSRF header reached a comparison requiring ASCII text. The API now rejects it with 403 rather than a server error.
- JSON containing an unpaired Unicode surrogate could reach password hashing or persistent storage. The API now rejects malformed Unicode with 400, while the regression test preserves valid Japanese, accented text and emoji.
- Browser integration exposed Git for Windows rejecting a long absolute `--git-dir` with `'$GIT_DIR' too big`, even with long-path configuration enabled. Repository operations now run from the selected bare repository using `--git-dir=.`. A storage regression exercises the long path without shortening the test location.
- Interface review corrected skip-navigation hash handling and invalidated pending route responses on logout, so those responses cannot re-render a signed-out workspace.

The Git storage tests deliberately leave unreachable objects when publication fails; the old main reference and current snapshot remain unchanged. Such objects are not accepted revisions and do not appear in the exported reachable history. This behavior is distinct from crash recovery across project creation and account ownership, which remains an operational limitation described in the design.

63 README

Original source: `applicative_infrastructure/gr_generalized_application/web_application/demo/README.md`.
Original source SHA-256: `3483e59c1efb28a1b20937f833e617817d09b62d3161f139d0ef215cb68eecf6`.

63.1 River Commons demonstration

Class: Informative application example and reproduction guide
Status: Synthetic demonstration for the experimental generalized application
Scenario: `river-commons/1`

River Commons is a fictional inquiry into shared care of a garden: how an encounter opens a possibility, how a provisional arrangement changes, and how accounts of those changes are questioned and revised. Every person, institution, place, observation and source file is invented. The example makes no claim about a real community or legal arrangement.

Start with the visualized spacetime walkthrough: see the event partial order, compare ontology topologies at two boundaries, then follow the garden and stewardship trajectories. The gallery also shows the record graph, temporal editor, retained files and historical contradictions. Its screenshots come from the running application, using ordinary controls.

63.1.1 What the project contains

The project contains 31 records, all six operational recording roles, notes, six retained source files and a deliberately nonchronological recording history.

Primary role	Records	Examples
Entity	4	The garden, residents' circle and stewardship team
State	5	Trial access, revised access and changing stewardship arrangements
Event	5	Encounter, access agreement, workday, review and an observation with no usable temporal anchor
Process	1	Learning to care for a shared place
Relation	12	Seven qualified relationship accounts and five event-order accounts
Property	4	Contextual location, unknown water suitability, proposed capacity and disputed workload

Four event-order claims are active in the final account. A fifth is withdrawn after it creates a contradictory chronology. The withdrawn record and its earlier assessment remain available in history.

Six materials in materials/ are attached through the normal file API: encounter notes, an access memorandum, water observations, a review summary, an attendance ledger and a chronology reconciliation. They contain synthetic evidence for the story, not independent verification of it.

63.1.2 Follow the story

The seeder preserves five narrative stages, followed by one attachment transaction:

1. **Begin with the later review.** The first record describes the end-of-trial review. Earlier occurrences have not yet been recorded.
2. **Add retrospective context.** Record the encounter, agreement and workday, their participants, and explicit event precedence. The independent water observation remains unordered.

3. **Describe scoped accounts.** Add successive and competing State accounts, contextual Properties, first-class Relations, an unrealized alternative and temporal extents.
4. **Preserve a contradiction.** An imported index is mistakenly interpreted as placing the review before the encounter. The historical temporal projection reports a cycle and does not invent a consistent cut.
5. **Revise the account.** Withdraw the mistaken order claim and correct reported review attendance from 18 entries to 16 distinct attendees. Both earlier assertions remain inspectable.
6. **Retain the materials.** Save the six fictional files alongside their associated records in one project revision.

Recording order and represented event order therefore differ visibly. The correction changes the recorded account; it does not change what happened in the fictional review.

63.1.3 Explore the visualized spacetime

Here, **space is the topology of applicable ontology records**, and an event boundary selects which temporal extents apply. A contextual location Property, **A place beside the footpath**, provides a geographical description within the story. It does not define the coordinates of this visualization.

Keep **Current project** selected so every view below uses the same retained revision. In **Spacetime**:

1. **Read the event partial order.** Follow the arrows from **The riverside encounter**, through two branches (**A provisional access agreement** and **The first shared workday**), to **A shared review**. No claim orders the two middle events relative to one another. **An independent water observation** is incomparable with all four. Neither graph columns nor the absence of arrows assert simultaneity.
2. **Select the trial boundary.** Choose **Before all**, then mark **A provisional access agreement** as passed. Its predecessor, the encounter, is included automatically: 2 of 5 events have passed. The ontology topology contains 10 records, including **A garden open for a trial** and **A provisional stewardship arrangement**. The workday remains outside this selected cut because it is not an established predecessor of the agreement.
3. **Select the review boundary.** Mark **A shared review** as passed. Both branches and the encounter are included: 4 of 5 events have passed. The topology contains 13 records. Trial access and the provisional arrangement have ended; **Access under a revised rota**, **Care shared through a rota** and **A renewed agreement to care** are applicable. The independent observation remains outside the cut and unordered.
4. **Follow the subject trajectories.** In **Record trajectories**, inspect the garden's State descriptions: **Access not yet arranged**, **A garden open for a trial**, then **Access under a revised rota**. Their inclusive starts and exclusive ends connect them to the agreement and review boundaries. Compare the stewardship team's informal and rotating-care descriptions, together with the contested workload concern.

The gallery's two boundary screenshots make this comparison visible, with the actual boundary labels and selected State accounts. Choosing cuts and viewing trajectories do not save project revisions. These projections apply recorded extents; they do not infer event effects or causation.

Unknown water applicability remains indeterminate, and the proposed six beds remain unscoped. A subject grouping connects descriptions without independently establishing identity, continuity or agreement among them. A consistent cut is a selected event boundary, not evidence that every applicable description shared a physical clock instant.

63.1.4 Inspect the accounts and their preservation

In **Graph**, select **A provisional stewardship arrangement** and open **Relation** to inspect its three participant roles. Open **Notes** or **Files** for associated context and material. The higher-order relation **Access is more than an open gate** refers to accounts being qualified, making its epistemic role explicit.

Select **A garden open for a trial**, open **Time & trajectory**, and choose **Revise temporal extent** to inspect its inclusive agreement boundary, exclusive review boundary, subject and stated basis. Cancel to keep the demonstration unchanged.

Finally, use the **Project revision** selector to open the stage whose reason begins **Retain a contested chronology claim**. Its event-order cycle prevents a consistent topology projection. Returning to the current project shows the withdrawn claim alongside the remaining active order. Record **History** and **Read full account** expose the preservation and attribution details.

63.1.5 Create the demonstration

Use the complete application/infrastructure checkout and the development environment described in the application guide. From `applicative_infrastructure/`, install the environment if needed:

```
python common/tools/setup_application.py generalized --dev
```

If the generalized application is not already running, start it in another terminal:

```
python common/tools/run_application.py generalized
```

Then create or resume the demo through its local HTTP API:

```
& .runtime/environments/generalized/Scripts/python.exe gr_generalized_application/web_application/demo/seed.py
```

The default origin is `http://127.0.0.1:8000`. Use `--base-url http://127.0.0.1:8002` when the application runs on another local port. The client accepts local HTTP origins only. On Linux/WSL, use `.runtime/environments/generalized/bin/python` instead of the Windows interpreter path.

The script creates a separate **Demo curator** account with an `example.test` email address and a generated password, then creates its private project through the ordinary API. It prints the project link and the path to local sign-in details. It does not select another user's project.

Credentials, project identifiers, transaction-recovery data and accepted revision identifiers are kept in the ignored file:

```
applicative_infrastructure/.runtime/demo/river-commons.json
```

Read that file locally when signing in to explore the project. It contains a plaintext generated demo password; do not add it to source control or include it in screenshots. The actual account database and project Git repository remain in the application's configured runtime.

Rerunning the seeder resumes recorded stages and retries a pending transaction with its original identifier. It does not reset the project. If registration was interrupted before confirmation, it first tries the saved credentials and retries registration only when no account or project has been confirmed. If other edits have advanced the demo, the script stops rather than overwriting them. A different server or scenario is also rejected while this manifest belongs to the existing demonstration. Preserve the manifest together with the relevant runtime if you need to resume that instance later.

63.1.6 Reproduce the gallery

After seeding, run from `applicative_infrastructure/`:

```
& .runtime/environments/generalized/Scripts/python.exe gr_generalized_application/web_application/demo/capture.py --browser msedge
```

The development dependencies include Playwright. The default browser is installed Microsoft Edge; `--browser chrome` uses installed Chrome, and `--browser chromium` uses a separately installed Playwright Chromium browser.

The capture script signs in using the private manifest, reads the actual project and operates ordinary UI controls. It opens the temporal editor and selects a synthetic upload file, then discards both drafts. It checks that the project head is unchanged, rejects captured browser errors and checks the narrow viewport for horizontal overflow.

The script writes ten PNG images and a public `manifest.json` into the gallery directory. The manifest records the synthetic scenario, capture time, application source commit, project head, viewport dimensions and image hashes; it excludes credentials. Five preview images

are synchronized into each of the programme and infrastructure repositories' `docs/gallery/` directories: the record graph, event order, earlier topology, later topology and subject trajectories. The gallery maintenance table gives the exact canonical-to-preview filename mapping. These deliberate copies let parent READMEs render locally and on GitHub across submodule boundaries. Regenerate previews through this script instead of editing the copies independently.

The graph overview uses the visible search query **care**, showing 11 of the 31 records. That filter makes the pictured relationships readable; the other records remain in the project. The capture script arranges those visible nodes into a local display grid, equivalent to dragging them into position; it does not change records or invent connections. Desktop captures use a 1680 × 1120 viewport and the mobile capture uses 430 × 1050. Scrolling, selected cuts and graph layout affect presentation without creating project revisions.

63.1.7 Source and limits

- scenario.py describes deterministic record identifiers, staged operations and attachment inputs.
- seed.py submits those stages through authenticated, CSRF-protected application endpoints and verifies the scenario's principal temporal distinctions.
- capture.py produces the actual UI images and synchronizes parent previews.

This example illustrates implemented recording and projection behavior. It does not simulate unrecorded event effects, infer causation from precedence, establish a common physical clock, or demonstrate factual truth or formal Standard conformance. Its unresolved access concerns, unknown observation scope and unrealized alternative are part of the example rather than missing setup steps.

64 ADR 0001 project architecture

Original source: `decisions/ADR-0001-project-architecture.md`.
Original source SHA-256: `6ba33b7be65700312a75ad66df2bb998bda194899534ae16b6465a407e5e29f1`.

64.1 ADR-0001 — Separate Governance, Standards, Manuals, and Technical Reports

Status: Accepted

64.1.1 Context

The project combines procedural governance, normative standardization, practical guidance, and theoretical research.

64.1.2 Decision

Maintain four primary publication layers:

1. governance documents;
2. normative standards;
3. non-normative manuals/guides;
4. technical reports.

64.1.3 Rationale

This reduces category confusion and allows philosophical or mathematical work to mature without prematurely becoming normative.

64.1.4 Consequences

Every substantive contribution should be placed in the appropriate publication class.

65 ADR 0002 standards first specifications on demand

Original source: `decisions/ADR-0002-standards-first-specifications-on-demand.md`.
Original source SHA-256: `56874fe4b95f53cbadb8a21b71044cff33150cdb74e86bddb176d11b76282751`.

65.1 ADR-0002 — Standards-First, Specifications-on-Demand Development

Status: Accepted

65.1.1 Context

The programme distinguishes Standards from Specifications.

A Standard expresses programme-level normative requirements and conformance expectations. A Specification defines technical or infrastructural details needed to implement, exchange, validate, or automate those requirements.

Developing specifications before the normative need is understood risks creating unnecessary infrastructure. Finalizing standards without testing technical realizability risks producing requirements that cannot be implemented coherently.

65.1.2 Decision

The programme will generally begin from the **Standard track**.

The Standard should first establish:

- purpose;
- scope;
- terminology;
- normative principles;
- minimum requirements;
- conformance boundaries;
- institutional and ethical constraints.

During standards development, contributors shall identify requirements that cannot be implemented or tested without additional technical infrastructure.

Those requirements may create one or more **Specification work items**.

Preferred development pattern:

Standard Working Draft → Infrastructure Need → Specification → Pilot / Implementation → Standard Revision → Adopted Standard

Specifications are therefore developed when required by the Standard, rather than as the default starting point.

65.1.3 Clarification

“Standards-first” does not mean that the Standard must be finalized before specifications are written.

The Standard and its dependent specifications may co-evolve during working-draft and pilot stages.

The Standard should define **what shall be achieved**.

A Specification should normally define **how a technical representation or infrastructure realizes part of that requirement**.

65.1.4 Example

A draft Generativity Recording Standard may require:

> A conforming record shall preserve the identity, temporal placement, provenance, and epistemic status of a recorded Event.

If implementation shows that interoperable exchange requires a common identifier format and a machine-readable epistemic-status model, the programme may then initiate:

- an Identifier Specification;
- an Epistemic Record Specification;
- an Interchange Specification.

The Standard should not contain unnecessary serialization details merely because they are needed by one implementation.

65.1.5 Consequences

- Standards remain conceptually and institutionally primary.
- Specifications remain demand-driven and technically scoped.
- Technical experimentation can feed back into the Standard before adoption.
- The programme avoids building infrastructure that has no normative use case.
- Published Standards may normatively reference stable Specifications where required.

65.1.6 Affected documents

- `AGENTS.md`
- `docs/framework/publication_taxonomy.md`
- `docs/planning/preliminary_plan.md`
- `PROGRAMME_BRIEF.md`

66 ADR 0003 epistemic praxis development plan

Original source: `decisions/ADR-0003-epistemic-praxis-development-plan.md`.
Original source SHA-256: `beabbdbea78da1f3913070c5760f82015d6726bd0251bbc29a9d9f70946b0bed`.

66.1 ADR-0003 — Epistemic and Practical Development Architecture

Document class: Architecture Decision Record
Status: Proposed
Date: 2026-09-22

66.1.1 Context

The programme initiator confirmed that symbolic crisis and the conditions of warranted recognition and practical action are the organizing motivation. Existing programme documents support these concerns but foreground archival loss and AI provenance. The previous plan postpones some epistemic, presentation, protection and institutional work until after recording and information-model development.

The initiator requested comprehensive planning for standards, protocols and specifications. This authorizes preparing a reviewable plan; it does not itself adopt technical Standards, establish legal authority, or settle every proposed allocation below.

The initiator further specified comparison with established approaches such as ISO and IEEE and substantive coverage of governance, jurisprudence, public policy, ethics and related domains. Those domains require their own inquiry and review, not merely technical metadata or an adoption-stage checklist.

Accepted ADR-0002 already establishes Standards-first, Specifications-on-demand development. The specification-first statement in the historical preliminary plan is inconsistent with that accepted decision.

66.1.2 Proposed direction

1. Use epistemic and practical infrastructure as the programme-level purpose. Treat archival preservation and AI provenance as important components of it.
2. Develop a bounded initial cycle spanning recording, evidence, contestation, revision, presentation, protection and practical response. Preserve the distinction between changes in the situation, knowledge, and descriptive regime.
3. Develop protocols within Specifications as behavior involving participants, states, exchanges, transitions and failures; protocols can also be specified in an adopted Standard. Do not create a fourth publication authority class or equate institutional procedures with network protocols.
4. Preserve existing publication codes. Clarify Standards-track requirements versus Specification implementation responsibilities for GR-120/130/200. Open additional work items only when a distinct need is demonstrated.
5. Use source traceability, staged governance, pilots and explicit conformance subjects to determine readiness. Retain the earlier plan as historical evidence and use the comprehensive plan for current proposed sequencing.
6. Compare ISO/IEC and IEEE development mechanisms and document proportionate local choices. Maintain a cross-domain programme connecting motivations, substantive questions, publication roles, reviewers and evaluation; distinguish public-policy and legal proposals from technical conformance.

This is the selected direction for the present planning draft. The architecture proposal remains subject to recorded review; the confirmed mission framing and accepted ADR-0002 are distinguished from newly proposed scope and gates.

66.1.3 Alternatives considered

Alternative	Reason not selected for this planning draft
Begin with an exhaustive six-class schema	Settles implementation before epistemic and institutional needs; risks treating record forms as ontology
Complete the recording model before adding epistemic and procedural work	Does not test the confirmed mission in the first usable cycle
Create a separate publication family for every protocol	Confuses a technical subject with publication authority and adds maintenance overhead
Attempt the complete standards portfolio in the first release	Exceeds demonstrated capacity and delays evaluation of a useful bounded cycle
Replace the earlier plan with a clean narrative	Removes evidence of the programme's changing emphasis and contradictory sequencing
Copy an established standards body's procedures wholesale	Imports organizational and resource assumptions without establishing their fit or authority
Treat legal, ethical and policy questions only as metadata	Omits substantive conflicts, justification, institutional options and practical consequences

66.1.4 Rationale

GRE Chapter 1 links symbolic production, referential reliability, classification and practical trust. Chapters 3–5 distinguish generative effects, reality, manifestation, evidence, interpretation and intervention. Metamodel Part II distinguishes formation, description and institutional uptake as well as possible transformations, occurrences and records. These sources motivate the proposal without directly conferring normative authority.

The foundation traceability map records passages, operational proposals and unresolved differences. The comprehensive plan supplies the portfolio, dependencies, evidence and work queue.

66.1.5 Consequences

- Initial pilots evaluate an epistemic and practical cycle, not only record serialization.
- Presentation, access, contestation and conformance become early design concerns.
- Technical choices remain conditional on demonstrated requirements.
- Proposals for legal profiles, metrics and stronger formal semantics remain explicitly unresolved or deferred.
- The plan does not certify historical truth, the goodness of generativity, or institutional legitimacy.

66.1.6 Affected documents

- `PROGRAMME_BRIEF.md` and `README.md`
- `docs/framework/publication_taxonomy.md`
- `docs/planning/comprehensive_development_plan.md` and supporting planning documents
- `docs/planning/preliminary_plan.md` and `docs/planning/open_questions.md`
- `foundation_manuscripts/MANIFEST.md`
- `specifications/README.md`
- `CHANGELOG.md` and `PROJECT_INDEX.txt`

66.1.7 Supersedes

No accepted ADR. ADR-0001 and ADR-0002 remain in force. The comprehensive plan replaces the earlier preliminary plan only as the current planning proposal; the historical text is retained.

66.1.8 Superseded by

None.

67 ADR 0004 initial working draft package

Original source: `decisions/ADR-0004-initial-working-draft-package.md`.
Original source SHA-256: `ca7520d7610091b6ecd00fe39eeb0a22645b92ada900ef6e8653a878fded058e`.

67.1 ADR-0004 — Initial working drafts and bounded operational requirements

Document class: Architecture Decision Record
Status: Proposed; implemented provisionally for drafting and review
Date: 2026-09-22
Related decisions: Accepted ADR-0002; Proposed ADR-0003

67.1.1 Issue and authorization

The programme initiator requested that development begin according to the comprehensive plan and authorized TeX sources and WSL compilation. The repository's governance-first rule requires coherent procedures before formal technical project initiation. Preparing substantive drafts and synthetic cases is authorized; authoring does not appoint a committee, adopt governance, approve GR/NWIP-001, settle manuscript disagreements, or publish an adopted Standard.

The earlier Markdown files are valuable scope outlines but are insufficient to assess obligations, responsibility, evidence, and failure behavior. An implementation-first schema would also prematurely settle the representation of claims, evidence, and the six record roles.

67.1.2 Alternatives

1. Draft governance alone and defer all technical clauses. This respects sequence but gives little concrete material with which to test drafting rules or discover conceptual problems.
2. Produce the entire technical family and schema now. This spreads review capacity thinly, conceals unassigned institutional responsibilities, and risks premature ontological and protocol decisions.
3. Produce a governance package plus a bounded preparatory vocabulary/recording/evidence/contestation cycle, assess synthetic cases, and derive later infrastructure needs from those requirements.

67.1.3 Provisional direction

Use alternative 3 for this authoring cycle. Prepare five governance Working Drafts and GR-100, GR-110, GR-200 and GR-210, with stable clause identifiers and assessment guidance. Preserve publication numbers and historical outlines. Use descriptive titles for governance documents; build filenames are not additional adopted publication codes.

The canonical substantive text for these editions is TeX. Shared presentation lives in `publications/preamble.tex`; a manifest drives repeatable WSL/LuaLaTeX compilation. Markdown supplies navigation, examples, review records, templates and decisions. PDFs are generated review artifacts, excluded from source control by default but available locally. Source and PDF hashes identify the built package. Compilation and text inspection are distinguished from substantive conformance, accessibility assurance and formal release.

67.1.4 Operational choices and their bounds

Choice	Rationale and alternatives	Source or issue	Affected clauses
Keep target, manifestation, representation, claim, evidence role and assessment distinguishable without selecting schema classes.	A single fact/truth field hides attribution and competing warrants; a mandatory class hierarchy is premature.	FM-004 §§4.2/4.6; FM-005 §5.4; Q-06	GR-100 definitions; E200-003–016
Use six operational roles with scoped identity and admissibility.	Roles can overlap; they are neither metaphysical atoms nor an asserted one-to-one interpretation of weak formal states/mechanisms. Property/Attribute remains unresolved.	FM-007 §§7–12; Q-05/09	GR-100 role definitions and V100 requirements; R110-006–009
Separate occurrence/modality from epistemic mode.	A realized event can be retrospectively inferred. Planned/possible and reported/inferred answer different questions.	FM-005 evidence distinctions; conceptual cross-review	GR-100 Event/Process; E200-005; R110-012
Require scoped, attributed generative accounts with grounds, alternatives, maintenance and loss.	A universal generativity score would exceed the current sources and evidence. Output count alone is insufficient.	FM-005 §5.14; FM-003 §§3.10/3.12; Q-10/16	R110-010–018; E200-024
Preserve changes in situation, evidence/assessment, and descriptive regime as distinguishable revision reasons.	Silent overwrite erases earlier knowledge and consequences. More than one reason can apply.	FM-005 §5.20; FM-007 §§16/19; Q-07	E200-017–020; R110-019–022; C210-017/020/025
Treat challenge handling as an accountable institutional procedure with a separate case record.	Supplying challenge fields does not establish meaningful receipt, review, action or remedy. This is a new operational proposal, not a claim that manuscripts prescribe this exact procedure.	FM-003 §3.12; FM-005 §§5.18–5.20; Q-14/17	E200-021; R110-023; C210-001–032
Permit bounded unknowns, restrictions and lawful disposal while recording their limits.	An immutable public history can expose protected information; removal without any permitted disposition can conceal consequential changes. Neither extreme is mandatory.	Programme privacy/jurisprudential discipline; Q-11	E200-023/026; R110-024–030; C210-027–029
Make GR-200 package obligations an explicit dependency of material-claim packages in GR-110/210.	Claim-level field checks alone miss package scope, assessment and transformed-view obligations.	Cross-document review; Q-12	R110-005; C210-030
Treat package-only/case-only reviews as partial documentary assessments in this edition.	A document cannot prove that a procedural action occurred. No reduced conformance profile is yet established; unobserved behavior is not assessed, not automatically inapplicable.	Q-12/14	R110-032–034; C210-030–032

Page-level source locators and limitations appear in the TeX source rationale and founda-

tion traceability map. FM-002/FM-003 chronology remains unresolved; this decision does not reconcile those manuscripts or resolve the formal issues in Q-09.

67.1.5 Governance choices

The Charter proposes an explicit founding instrument grounded in the signatories' actual authority, with accepted appointments, review evidence and declared limits. The committee is not treated as already constituted. D1 proposes 60-day public review, 30-day substantive re-review, a two-thirds returned-ballot quorum, at least three substantive votes and two-thirds approval of substantive votes. These are local proposals with alternatives and rationale, not imported ISO/IEEE rules. Separate Specification and policy release routes preserve their classes. Numerical defaults, representativeness, rights terms and independent-review capacity remain open before adoption.

67.1.6 Consequences and assessment

- Governance M1 remains incomplete until real authority, appointments, rights, review and adoption evidence exist. Technical documents remain preparatory Working Drafts.
- The first fixture is fictional; it is usable without collecting personal data. It tests distinctions and failure expectations, not live institutional effectiveness.
- No network protocol, canonical schema, universal confidence scale, universal generativity metric or legal entitlement is selected.
- GR-120/130/140/150/160/300/310/400 remain coordinated future work. Their contextual constraints appear in this draft cycle, but these four documents do not replace those projects.
- Implementation trials can now identify concrete Specification needs. A technical binding follows a demonstrated requirement and its own work-item decision.
- TeX/PDF accessibility is not established by a successful build. The initial source format and inspection limitations are recorded in the review report.

67.1.7 Affected artifacts and acceptance

Affected artifacts are the nine documents in the publication manifest, publication tooling, navigation, templates, the synthetic case, review evidence, issue register and changelog. Existing historical outlines and earlier ADR reasoning remain retained.

Acceptance of this ADR requires a recorded architecture decision by the programme's responsible authority. The user has authorized authoring; this record remains Proposed so that the operational choices remain available for explicit review rather than being represented as already approved normative interpretations.

68 ADR 0005 expanded drafts and source models

Original source: `decisions/ADR-0005-expanded-drafts-and-source-models.md`.
Original source SHA-256: `78639e78e531d7d2ffc6d31dfcbe49029399ad3dbb01bd2bdaef61bdbb4fcc52`.

68.1 ADR-0005 — Expanded drafts and external publication models

Status: PROPOSED; implemented as reversible preparatory authoring
Date: 2026-09-22
Class: Architecture and editorial decision record
Related: ADR-0004; Q-21–30

68.1.1 Issue

The first nine Working Drafts contained 318 requirement identifiers across 84 compiled pages. They established a bounded programme, but compressed definitions, operational procedures, application conditions and assessment evidence. The user requested more substantive documents and a more formal style, with ISO, IEEE and UN-system publications as possible models. Increasing page count without developing those functions would not address that request.

68.1.2 Alternatives

1. Retain 0.1 and change typography alone. This leaves important procedure and assessment detail underdeveloped.
2. Copy one organization's complete template and institutional model. This risks implying an authority the programme does not possess and importing requirements suited to another mandate.
3. Expand the existing nine drafts, preserve historical sources and stable requirement identifiers, and use a documented combination of verified editorial and institutional models.
4. Begin every planned GR publication immediately. This spreads source and review capacity across unresolved dependencies and contradicts the governance-first priority.

68.1.3 Selected direction

Use alternative 3 for Working Draft package 0.2. Preserve the 0.1 sources, preamble, manifest and build/check scripts under `publications/archive/0.1/`, with hashes. Existing IDs remain stable. Dependency references change explicitly to the coordinated 0.2 editions. New obligations receive new IDs. This decision neither adopts governance nor promotes a draft to a Standard.

Use the ISO annotated model and accessible IEEE rules for formal structure and drafting discipline; use the ITU author guide as a UN-system technical-writing comparator; use the UN NQAF manual for comparison of institutional, process and output quality. The source study records distinct purposes, actual access and limits. UN/CEFACT catalogue verification establishes a relevant technical publication class, but inaccessible clauses are not reconstructed from memory.

68.1.4 Operational changes and alternatives

Proposed direction	Reason and rejected alternative	Affected documents
Add formal front matter, stable clause hierarchy, normative schedules and informative annexes	Gives readers identifiable scope, dependencies and assessment obligations; cosmetic expansion alone is insufficient	All nine drafts; shared preamble; D2
Specify authority, resources, participation, delegation, review, maintenance, transitions and records	An institution cannot be established by writing a role name; fictional appointments or presumed capacity would obscure the development gate	Charter; D1; TC Charter

Proposed direction	Reason and rejected alternative	Affected documents
Specify conduct-case stages and distinguish evidence for findings from justification of remedies	A complaint label alone gives no workable response or protection process; automatic sanctions or unreasoned discretion are unsuitable	Ethics/IP policy
Propose 'more likely than not on the assessed evidence' for an internal substantiated conduct finding	Provides a reviewable local decision criterion; alternatives include a higher threshold, a context-specific schedule, or non-adjudicative findings only. The choice remains PROVISIONAL and needs governance/ethics review	EIP-069/070; Q-29
Expand terminology, six-role conditions, epistemic methods and generative accounts without imposing a schema	Keeps source interpretation, conceptual roles and encoding distinguishable; a new universal fact object or numerical generativity measure would exceed the evidence	GR-100/110/200
Specify case states, assessment and response, review capacity and dependent correction	Makes procedural action assessable; possession of a case record alone is insufficient	GR-210
Treat semantic and assessment schedules as proposed normative material	Makes missing information and incomplete assessment visible; arbitrary implementation field names remain avoidable	D2; GR-110/200/210 and governance annexes
Preserve partial-assessment limits and exact dependency editions	Prevents a package or case-only check from standing in for unobserved institutional behavior	All conformance clauses

The conduct evidence threshold is an internal programme proposal. It does not describe the standard of proof in any court or jurisdiction, establish external liability, or authorize a remedy without an identified institutional basis. Formal governance review can change it with a traced revision.

68.1.5 Scope and conceptual continuity

The programme continues to address symbolic crisis through inspectable recognition, evidence, contestation, revision and practical action. Metamodel, record roles, epistemic assessment, normative evaluation, jurisprudence, governance and implementation remain distinct. Foundation manuscripts supply conceptual authority, not institutional adoption. The Property/Attribute issue, manuscript chronology and limits of fixed-carrier formal results remain unresolved.

New semantic schedules are operational proposals. Their record components are not additional ultimate constituents of reality. They allow justified missingness, protected references, uncertainty, plurality, maintenance and loss. Historical actors are not assigned knowledge or categories that appeared later.

68.1.6 Consequences and review evidence

There are more obligations and therefore potentially greater recording and institutional burden. Q-26/28 require assessment of that burden and decisions about justified profiles. More pages, automated artifact checks and AI-assisted cross-review do not demonstrate stakeholder acceptance or successful implementation.

The expanded review record records actual build results, comparisons and unresolved checks. Historical fixtures P0 and P1 retain their 0.1 basis until separately reassessed; they are not evidence of fulfillment of newly added 0.2 obligations.

Affected files comprise the nine TeX sources, shared presentation, publication manifest/navigation, build/check tools, requirement change register, archive, source study/register,

Programme Brief development status, issue register, changelog and project index. Earlier ADRs and historical review findings remain available.

69 ADR 0006 validation and assessment boundaries

Original source: `decisions/ADR-0006-validation-and-assessment-boundaries.md`.
Original source SHA-256: `19800a59cc16fdeb25b5463d6fa261c178249a07c128ed515ae665b1c105bdf1`.

69.1 ADR-0006 — Validation of 0.2 and assessment boundaries

Status: PROPOSED; implemented in preparatory Working Draft 0.3
Date: 2026-09-22
Class: Architecture and operationalization decision record
Predecessors: ADR-0004 and ADR-0005 remain historical decisions

69.1.1 Issue and alternatives

The expanded 0.2 package needs substantive source and scenario review. Successful PDF production does not establish that requirements preserve distinctions, identify failures or work in an institution. The user authorized continuing with a substantive review matrix and updated P0/P1 assessments leading to a traced revision.

Alternatives considered were: expand the publication family immediately; claim full conformance from authored examples; or fix a baseline, review its provisions and source relationships, assess bounded synthetic components, and revise only supported defects and clarifications. This cycle selects the third alternative. It preserves the Standards-first development sequence and avoids treating a local fixture as an adopted information model.

69.1.2 Selected direction

Preserve the nine 0.2 sources, presentation, manifest, tools, Programme Brief and review records with hashes. Review all baseline requirement identifiers through explicit topical groups, with full source text and locators in a coverage matrix. Keep editorial review, component assessment, numerical execution and institutional readiness distinct.

The term `reviewed` in the matrix means that the identified text received the stated editorial/source examination. It is not a conformance result. A selected P1 component can receive a documentary result while a procedural component remains not assessed. Group coverage does not establish that every obligation or application was exercised. The baseline remains 0.2 even after current documents become 0.3.

69.1.3 Proposed changes

Finding	Direction and rationale	Alternatives and limits	Affected material
GOV-F01: an invalid/unresolved submission can disappear into non-response	Distinguish valid counted ballots, eligible participants with attributable unsuccessful attempts and no counted ballot, and eligible participants without an attributable submission. Retain a separate inventory for unattributable/ineligible submissions	Counting invalid attempts as abstentions changes quorum; calling them silence erases attempted participation. No change to the two-thirds or three-substantive-vote rules	D1-032/074; ballot dossier; P0

Finding	Direction and rationale	Alternatives and limits	Affected material
GR-210 dependency ambiguity	Import GR-100 terms, record-role meanings and result meanings within an explicit scope; preserve all applicable GR-200 package obligations	A separate blanket vocabulary-conformity claim adds obligations not clearly intended by the existing reference. Reduced claim-only GR-200 checking would conceal package obligations	GR-210 Clause 2
CF-01: a general safeguard can be incorrectly marked inapplicable	Assess V100-011's general metamodel/record distinction independently of its conditional mapping component	Presence or absence of a mapping does not determine whether the general safeguard applies	GR-100 Annex A
CF-02: dispute disposition appears among effect modalities	Separate occurrence/modality, epistemic basis and assessment/dispute disposition explicitly	An actual occurrence can be retrospectively inferred and its contribution contested; these are compatible states, not competing options for one field	R110-012
CF-03: recirculation link uncertainty can disappear within a generic return account	When recirculation is asserted, identify initial generation, conversion/transfer, return pathway and effect on later conditions, with stage/link-specific grounds and uncertainty	Do not define all generativity return as recirculation, require a universal quantity or infer entitlement. Missing links remain unresolved rather than invented	New R110-112; related assessment row and source rationale

The recirculation provision is an operational narrowing for a particular claim. Its conceptual basis is FM-005, section 5.17.3, PDF page 145, which distinguishes the uncertainty inherited across these stages. It does not settle the broader definition of generativity return, its valuation or any distributive rule. The conceptual review preserves source limits and unresolved terminology.

69.1.4 Baselines and evidence

P0/v2 and P1/v2 are new artifacts, not rewrites of the original fixtures. Numerical checks in P0 can be executed and reported as such. Fictional review, notification, custody and repair events remain fictional even when the narrative is internally consistent. A retained document can establish what the example says, but not that a real process occurred.

The current coordinated publication edition advances to 0.3. All historical IDs remain; changed text and dependency editions are separately recorded against 0.2. The new R110-112 is outside the 753-ID baseline matrix and has its own source and discriminating assessment route. No founding instrument, appointment, contribution licence, external partnership or standard adoption is created by this revision.

69.1.5 Open matters and consequences

Actual authority, independent capacity, rights, representation, accessibility and burden remain evidence gaps. Calendar-day boundary conventions and possible overlap of reply and ballot windows need an explicit governance choice before use. A conservative sequential synthetic schedule does not silently adopt that choice.

The revision adds one conditional recording obligation and clarifies several assessment boundaries. Its practical cost remains unmeasured. A future GR-150 profile proposal uses observed evidence and states precisely which subject and parent obligations it addresses; it does not convert this cycle's partial assessment into full conformity.

Affected documents are D1, GR-100, GR-110 and GR-210 substantively, the coordinated nine-document edition and dependencies, validation artifacts, archive, comparison/check

tooling, issue register, Programme Brief development status, publication navigation and changelog.

70 ADR 0007 git backed project workspace

Original source: `decisions/ADR-0007-git-backed-project-workspace.md`.
Original source SHA-256: `fa15ab564010e034c8d1a3302d8485ecb2d93273da73b695becbe4dbcb8f559f`.

70.1 ADR-0007 — Git-backed project workspace

Status: PROVISIONAL; selected for experimental implementation
Date: 2026-09-22
Class: Application architecture and scoped operationalization decision record
Related decisions: ADR-0002, ADR-0006

70.1.1 Issue and authorization

The user requested a web application implementing the programme's ideas, with registration, login, project creation, recording within projects, and Git as each project's record backend. The current Working Drafts identify practical needs for distinguishable records, qualified assertions, attributed revision, historical inspection, and bounded access. An application can expose implementation difficulties and recording burden that authored examples alone cannot establish.

The application is an experimental implementation of selected functions. It is not an adopted Standard, a complete GR information model, a formally approved institutional pilot, or a finding of conformity to GR-100, GR-110, GR-200, or GR-210. The user has authorized implementation now. This follows ADR-0002's provision for implementation during draft development; it does not constitute programme adoption or work-item approval. The accompanying design is informative implementation documentation, without a new GR publication number.

70.1.2 Alternatives

Alternative	Benefit	Limitation relevant to this request
Store projects and record history solely in a relational database	One transactional system and straightforward queries	Does not provide the requested per-project Git record backend
Store accounts, sessions, projects, and records together in Git	One storage mechanism	Replicates credential and session material into retained history; weak fit for authentication queries and expiration
Use SQLite for application accounts and access lookup, with a separate Git repository for each project's manifest and records	Separates authentication from retained project content; project history is inspectable using Git	Requires explicit authority and failure boundaries between the database and repositories
Depend on a hosted Git service for every operation	Reuses remote collaboration and repository administration	Adds a service account, network dependency, and permission system before the local recording workflow is established

The third alternative is selected. Flask serves the application and JSON endpoints, SQLite holds account/session information and project ownership lookup, and a separate bare Git repository holds each project's authoritative manifest and record snapshots. A browser interface uses ordinary HTML, CSS, and JavaScript. This bounded stack can run locally without an external hosting account.

70.1.3 Decisions and rationale

Projects initially have one owning account and private application access. The application does not infer that account ownership establishes legal ownership of recorded material. Registration establishes an application identity; it does not verify a person's real-world identity, evidence, competence, or authority.

Each accepted project or record mutation creates a new Git snapshot. A record has a stable application identifier; a commit identifies a retained project version. Revision requires a reason and records the authenticated actor and server time. The client supplies the project revision it edited, and the server advances the main reference only if its previous value still matches. Git's `update-ref` old-value check supplies this conditional update; `commit-tree` constructs a commit from a tree and parent. A conflicting writer receives a conflict rather than silently overwriting the intervening update. These mechanisms do not make SQLite and Git one transaction.

Project content is represented as versioned JSON, not as arbitrary user-selected filesystem paths or executable files. Password material and sessions remain outside project Git history. Git authorship identifies the recording account through server-assigned attribution; a record's separate `attributed_to` field identifies the source or observer as represented by the recorder. Attribution remains a claim unless separately examined.

The six role labels are Entity, State, Event, Process, Relation, and Property. One primary role is selected for a particular application record. This is an interface limitation, not a claim that targets fit exclusive kinds. Multiple linked records can describe the same target from different roles, without the linkage itself proving target identity. Role-specific admissibility and identity criteria remain incomplete. The application retains the programme's current label Property without deciding the unresolved relationship to the manuscript's Attribute.

The interface keeps epistemic mode, asserted modality, and owner-assigned status separate. This preserves a useful part of V100-016 and R110-012. Its finite mode list remains narrower than the drafts: a retrospective inference, for example, needs a primary choice with further qualifications in prose. Neither a completed form nor a status choice constitutes an evidence assessment. Evidence references and alternatives can be supplied without being described as verified or exhaustive.

70.1.4 Source basis and operational limits

The design was checked against PROGRAMME_BRIEF.md, the active 0.3 drafts, and these local foundation passages:

- FM-001, section 1.14.4, PDF page 81, distinguishes authenticity, provenance, and epistemic trust. This motivates separating the record's history from the warrant of its content.
- FM-005, section 5.4.1, PDF page 29, treats evidence relative to a claim and an inquiry. The application's evidence text therefore records supplied grounds or references, without automatically assessing their evidential role.
- FM-005, section 5.20, PDF pages 168 and 170, motivates reasoned, traceable revision with earlier formulations retained. The first application captures revision reasons and earlier snapshots but does not implement the full distinction among evidence updates, target changes, and category changes.
- FM-007, PDF page 2, presents overlapping analytical categories and leaves exhaustiveness and metaphysical priority open. Application role selection does not settle those questions.

These are scoped design translations. No foundation manuscript is promoted to a conformance authority. No new metamodel class, equivalence claim, universal generativity score, or legal determination is introduced. Exact feature-to-draft references and gaps appear in the design document.

70.1.5 Consequences, protection, and maintenance

Git provides retained versions while the repository and its history are preserved. It is not an immutable ledger: a server administrator can alter references, rewrite history, or remove objects. A commit identifier alone does not prove the factual truth, independent time, real-world authorship, or legitimacy of the represented claim. This version does not add independent signatures, external timestamp witnesses, replication guarantees, or content encryption at rest. The record-history view lists the latest 100 revisions; a separate owner-authorized Git bundle export contains the complete history reachable from the current main reference.

The `withdrawn` status changes the current account of a record. It does not delete content from earlier commits. Private application access does not remove access held by server operators or anyone with a repository copy. A current-snapshot JSON export excludes history and credentials. A Git bundle includes prior content, including withdrawn or subsequently edited content, but excludes account credentials, sessions, and application access configuration. Neither export is a complete service backup. Custodians need arrangements covering repositories, the account/access database, secrets, backups, and copies before relying on the service for consequential retention. Selective erasure, legal holds, retention schedules, and controlled disclosure are unresolved application work, not functions implied by using Git.

The initial owner-only model permits personal recording and revision. It does not establish third-party challenge intake, reviewer independence, participant notification, appeal, remedy, or completed practical repair. Broad sharing would require an explicit access model and protection review, including historical content and export permissions.

Future changes to schema meanings, role restrictions, access scope, and retention behavior need recorded migration and design decisions. Feedback from actual use can propose draft revisions; application behavior does not silently redefine the drafts. Automated checks establish only their tested behavior and environment. They do not establish user comprehension, evidential sufficiency, or institutional performance.

70.1.6 Affected artifacts

The new `webapp/` application, its design and operating instructions, application tests, repository navigation, changelog, and open-question register are affected. The normative text and maturity of the nine Working Drafts remain unchanged by this implementation decision.

71 ADR 0008 record graphs transactions and modules

Original source: `decisions/ADR-0008-record-graphs-transactions-and-modules.md`.
Original source SHA-256: `a053a5b6333ec15962ec92396f06f3755ee1703c1e139437de6d24bde72bcd79`.

71.1 ADR-0008 — Record graphs, atomic transactions and modules

Status: PROVISIONAL; selected for experimental implementation
Class: Architecture and scoped operationalization decision
Date: 2026-09-22
Extends: ADR-0007

71.1.1 Issue and sources

The initial workspace provides separately versioned records and untyped cross-references but cannot faithfully express multi-participant relations, relations on relations, coordinated graph changes, modular file custody or snapshot-consistent graph inspection. The user requested careful design and implementation of those functions before a later academia upgrade, and authorized corresponding specification/draft revisions. Current GR manuscripts take precedence over conflicting older academia design choices.

The graph source review cites actual FM-007 passages on overlapping roles, role-indexed incidence and relation continuity, together with GR-100/110/200 requirements. The academia comparison identifies useful modular panels and reified connections, plus implementation gaps and profile differences. Source conflicts remain explicit; old records and signed payloads are not revised retrospectively.

71.1.2 Alternatives and selected direction

Decision	Alternatives considered	Selected direction and rationale
Graph connections	Anonymous binary edges; every cross-reference promoted to a relation; first-class relation records	First-class Relation records with role-indexed incidence preserve identity, several participants, relations on relations and modules. Old cross-references stay neutral.
Role typing	One exclusive record class; unrestricted untyped tags; overlapping declared roles	Preserve primary display role and add an explicit role set, following the current manuscripts without equating record IDs with targets.
Revision protocol	Sequential REST writes; database content transactions mirrored later; one complete Git tree per transaction	Build/validate a whole candidate graph and publish one Git reference conditionally, so references and files are never partially accepted.
Retry evidence	In-memory token cache; SQLite receipt; receipt inside the accepted Git tree	A committed receipt remains recoverable after restart, export and a lost response without introducing a second content authority.
File custody	Mutable named paths; external content store; bounded retained Git blobs	Git blobs keep descriptors, bytes and history portable and atomic at this scale. A future external store needs an explicit completeness/recovery protocol.
Module extension	Hardcoded exclusive screens; executable user plugins; versioned declarative record modules	Fixed built-in interpreters with namespaced data preserve safe extensibility. Unknown optional modules remain intact and read-only; required unknown constraints prevent mutation.

Decision	Alternatives considered	Selected direction and rationale
Historical display	Old selected record mixed with current neighboring data; whole-project pinned view	One source commit resolves graph, labels, modules and downloads. View filtering/layout remains explicitly separate.
Academia alignment	Replace general roles with GRRP acts; rewrite academia immediately; shared substrate with later explicit adapter	Develop the generalized application first; preserve academia's native history and document mappings before changing its independent interface.

The full selected contract, limits, failure cases and sequence are in the implementation design. Experimental Specifications provide the concrete representation and Git binding. Existing 0.3 conceptual clauses remain unchanged where sufficient; preliminary model/interchange/presentation/preservation work items receive the newly identified implementation-neutral requirements.

71.1.3 Consequences and limits

The semantic graph can be cyclic even though the initial storage branch is a linear commit history. A relation predicate, preserved file, structural validation or Git hash does not establish causation, evidential sufficiency, truth, target identity or institutional authority. Module changes and file detachment retain older content under the declared custody policy; they do not claim erasure.

The project-level conditional update deliberately rejects unrelated concurrent changes too. Prepared but unpublished objects can remain unreachable. Initial file/operation/history budgets are implementation limits, not GR requirements. Cross-project protected references, large external assets, shared membership, independent signatures, semantic merging and governed erasure remain further work.

Migration is an explicit new commit, never a read-time mutation or historical rewrite. Existing unstructured relations and untyped references retain their scope. Shared package availability is not evidence that academia already conforms or that independent interchange has passed.

71.1.4 Affected artifacts

The independent protocol package and schemas; GR-SPEC-120/130; bounded working drafts for GR-120/130/140/160; generalized web application, Git adapter and tests; source reviews, application documentation, changelog, issue register and index. The academia repository remains a read-only reference in this phase.

72 ADR 0009 applicative infrastructure consolidation

Original source: `decisions/ADR-0009-applicative-infrastructure-consolidation.md`.
Original source SHA-256: `7a1fda1b90901d1a338717c65fa236ebfe7a16057f35750b55394fd4d58bc866`.

72.1 ADR-0009 — Applicative infrastructure consolidation

Status: Accepted for implementation by the user, 2026-09-22
Class: Repository and application architecture decision
Extends: ADR-0007 and ADR-0008; does not adopt a technical Standard
Subsequent decision: ADR-0010 adds independent nested source repositories and current MIT licensing. This decision remains the historical source/runtime relocation record.

72.1.1 Issue and authorization

The generalized application occupied `webapp/` while its shared record package occupied `packages/`. Academia remained in a separate source repository. The user requested a common implementation area and independently runnable domain applications, reviewed the proposed arrangement, and explicitly authorized migration. Current GR manuscripts continue to guide conceptual changes; relocation does not reinterpret historical academia records or adopt its older restrictions as general GR rules.

72.1.2 Alternatives

1. Retain separate repositories and distribute shared code as separately published dependencies. This preserves independence but leaves the requested local integration and joint inspection incomplete.
2. Combine application code, accounts, domain protocols and storage into one service. This would couple distinct workflows, identities and technologies before their semantic mapping is validated.
3. Consolidate source beneath `applicative_infrastructure/`, extract bounded common packages, retain independent domain applications and runtime, and preserve imported source provenance. This is the selected direction.

72.1.3 Selected arrangement

`applicative_infrastructure/common/packages/` contains the independent `gsp_record_protocol` package and extracted `gsp_git_store` package. Application-independent validation and storage remain distinct responsibilities. A future domain can depend on these packages or implement their versioned contracts without depending on another application's interface.

`gr_generalized_application/web_application/` contains the relocated Flask/Waitress application. `gr_academia_application/web_application/` contains the existing npm client/server/protocol workspace; `gr_academia_application/domain_packages/grrp/` contains its Python domain package. Academia's native protocol remains domain-specific pending an explicitly assessed adapter. Files are relocated and launch paths repaired before any new semantic alignment is attempted.

The programme's `standards/`, `specifications/`, `governance/`, `foundation_manuscripts/`, `decisions/` and publication history remain canonical at their existing locations. Shared implementation documentation links to these sources. Existing conceptual papers imported with academia remain historical domain source material, not newly designated programme foundations.

72.1.4 Source provenance and repository boundary

The programme is currently a directory within the larger `relational_being_infrastructure` Git repository. The academia source has its own independent repository. This migration does not rewrite or merge the outer repository's history. Academia's complete source history is preserved in a verified Git bundle, with source origin, commit, path mappings and file digests recorded in its provenance manifest. Its original checkout remains intact. Dependency directories, runtime, credentials and generated builds are excluded from the source import.

Original notices remain with imported components. The import does not extend academia's component-specific terms to independently authored common packages or change the terms of historical papers. Missing/stale source notices are documented rather than silently rewritten as new grants.

72.1.5 Runtime and failure boundaries

Ignored development runtime is located under `.runtime/generalized/` and `.runtime/academia/`, with separately recreated environments under `.runtime/environments/`. Applications use explicit resolved data locations. They retain separate account databases, session-cookie names, record stores and processes, with default ports 8000 and 8001. No shared account or cross-application access authority is introduced.

Runtime migration includes account data, records, project Git histories, files, and native identity material. Source provenance manifests exclude private runtime contents. Existing record/project identifiers and accepted Git heads remain unchanged. The generalized legacy schema is not automatically migrated. Database integrity, account/project counts and file digests are compared before the new location becomes active.

The old generalized writer is stopped before copying its data. Original data and source backups remain available for rollback. The original academia checkout and runtime remain untouched. Launch verification and regression tests use isolated test data; they do not register test accounts in the migrated user databases.

72.1.6 Verification and consequences

The migration is assessed through shared-package tests, generalized API/browser tests, academia Python/TypeScript tests and builds, independent launch checks, consistent runtime comparisons, verified source-history export, and corrected active documentation links. These establish relocation behavior, not cross-application semantic interoperability, security certification, institutional practice or Standard adoption.

Remaining work includes explicit GRRP/shared-protocol adapters and fixtures, source-notice reconciliation, independently assessed authorization and preservation procedures, and any later deliberate source-history integration. Separate application operation does not itself establish those capabilities.

72.1.7 Affected artifacts

Application source paths, common package metadata/imports/tests, independent launch configuration, application and infrastructure guides, source/runtime migration evidence, specification implementation links, project index, changelog and the open-questions register.

73 ADR 0010 nested git repositories and mit licensing

Original source: `decisions/ADR-0010-nested-git-repositories-and-mit-licensing.md`.
Original source SHA-256: `2117a2c1007e4a4bfe339b75baa601d89eb776166ec8bc9af1cc62266c25ad7c`.

73.1 ADR-0010 — Nested Git repositories and MIT licensing

Status: Accepted by explicit user instruction, 2026-09-22
Class: Repository architecture and current project licensing decision
Extends: ADR-0009; does not adopt a technical Standard

73.1.1 Issue and authorization

The user requested independent repositories for both applications, an infrastructure repository containing them as submodules, and an independent programme repository containing infrastructure as a submodule. The same instruction requests comprehensive READMEs, MIT licensing and attribution to all contributors through contributor files. The user subsequently confirmed that hosted repositories will be created after local commits are complete.

73.1.2 Alternatives

1. Keep one repository with ordinary application directories. This does not supply the requested independent version histories and commit pointers.
2. Create nested repositories without submodule entries. This leaves parent clones without a reproducible way to identify and obtain their child revisions.
3. Create four repositories and explicit nested submodules. This is the selected arrangement. Parent commits identify exact child commits; application record repositories remain private runtime repositories outside these source histories.

73.1.3 Repository boundaries

The programme root is a new independent Git repository. Its former enclosing repository neither tracks the programme files nor receives a commit or index change from this operation. The programme contains one submodule at `applicative_infrastructure/`.

Infrastructure tracks `common/`, its operation tools and repository documentation. It contains submodules at `gr_generalized_application/` and `gr_academia_application/`. Each application tracks its own web application and domain-specific source. All four default branches are named `main`.

Academia imports its preserved original Git history and creates a relocation/licensing commit whose ancestry includes source commit `b98730b46eca5fdf441937aef0180f5b3d4f94dd`. Existing working files are not replaced by checking out the old layout. The original external checkout and the retained history bundle remain unchanged. The other three repositories begin with local initial commits; no earlier source history is fabricated.

Commits proceed from applications to infrastructure to programme. The parent gitlink is updated only after the corresponding child commit exists. Submodule Git directories are absorbed into their parent's metadata using Git's supported operation.

73.1.4 Local URLs and later publication

The initial `.gitmodules` URLs use `./applicative_infrastructure`, `./gr_generalized_application` and `./gr_academia_application`, relative to their respective parent repository locations. They resolve to this local source hierarchy and support a recursive clone from this workspace. No hosted URL or remote publication is invented.

Before publishing, replace these local-layout URLs with actual hosted URLs and synchronize the local submodule configuration. Push applications first, then the infrastructure commit referring to them, then the programme commit. A parent push does not publish every child commit automatically. Detailed procedures appear in the repository guide.

Local file transport is enabled only on individual trusted local clone/initialization commands. Global Git transport policy and global user configuration are not changed.

73.1.5 Preservation and licensing

Each repository owns its own ignore rules; a parent's exclusions are insufficient inside an independent child repository. Private runtime, account databases, signing keys, local backups, dependencies and generated builds remain untracked. Source Git history and application-managed project record histories are separate layers.

Byte-preserving attributes avoid implicit line-ending conversion of retained source and archival files. Shell scripts retain an explicit LF rule. Historical provenance manifests describe their original capture and are not rewritten to claim that later README/licensing edits were part of the earlier relocation.

Each repository receives an MIT `LICENSE`, scope notes and `CONTRIBUTORS.md`. Copyright attribution refers to all contributors listed in that repository's contributor file; the grant does not transfer their ownership to a collective entity. The user's MIT instruction applies to project-controlled material. Third-party dependencies, vendored notices and independently contributed runtime material retain their own applicable terms. Existing historical licensing records and embedded notices are preserved with an explicit current licensing explanation.

Current repository licensing is distinct from formal adoption of the standards-development governance drafts. Those historical drafts remain inspectable and are not retrospectively rewritten as adopted decisions.

73.1.6 Verification

Check the four actual repository roots, clean committed trees, exact `160000` gitlink entries, matching checked-out child revisions, nested `.gitmodules`, academia ancestry, ignored private paths, source history integrity and a fresh recursive clone. Confirm the enclosing repository's index and references are unchanged. These are repository-preservation checks, not an application protocol or institutional conformance claim.

73.1.7 Affected artifacts

Git metadata and gitlinks, boundary-local ignore/attribute files, four repository READMEs, licensing/contributor files and package metadata, repository workflow and verification tooling, changelog, project index and Q-44. The application record protocol and retained user data are unchanged.

74 ADR 0011 event partial orders and spacetime projections

Original source: `decisions/ADR-0011-event-partial-orders-and-spacetime-projections.md`.
Original source SHA-256: `b9e3b0f43ef237c556d9560f553244c2ca8e34924be0c4cbe5f0ab3a20003152`.

74.1 ADR-0011 — Event partial orders and spacetime projections

Status: Accepted for experimental implementation under the user's request, 2026-09-22
Class: Information-model and application architecture decision
Extends: ADR-0008; does not adopt a Standard

74.1.1 Issue and authority

The ordinary graph describes retained records at a Git revision. The user also needs the topology of represented entities, states, relations and other operational roles at an event-defined temporal position. They explicitly distinguish occurrence order from recording order: a later occurrence can be recorded before an earlier one. Their clarification identifies space with the ontological topology at that position; geographical coordinates can be described through State or Property accounts.

The source-grounded design records actual manuscript passages and the proposed narrowing. FM-007 section 9.7, PDF p.42, explicitly identifies partial-order event records as an extension needing its own treatment of endpoints and linearizations. FM-005 section 5.14, pp.114–116, distinguishes continuity-based relational trajectories from causal-generative contributions. Neither source makes recording sequence the chronology of its target.

74.1.2 Alternatives

1. Replay Git commits as world changes. Rejected because recording revision and target occurrence are different histories, including retrospective corrections.
2. Sort `occurred_at` text or timestamps into one timeline. Rejected because the field is descriptive, uncertainty can be substantive, and unsupported ordering or simultaneity would be invented.
3. Simulate state transformations under every possible event linearization. Deferred because the records do not yet declare executable effects, commuting updates, or sufficient initial states.
4. Record explicit precedence and applicability, then project a selected consistent cut. Selected as a bounded addition that preserves the existing ordinary graph and historical storage.

74.1.3 Selected direction

An event-order account is a first-class Relation record containing `gsp.event_order/1` and matching `gsp.relation/1` target incidences. `gsp.temporal_extent/1` scopes any record using event, unknown or explicitly unbounded start/end boundaries and a stated basis. An optional subject reference groups accounts for a trajectory without proving identity or continuity.

Both new module envelopes require `required: true`. Transaction preparation supplies true when omitted for these supported modules; explicit false is rejected. Stored schema validation requires the flag. An older implementation unable to interpret these constraints therefore refuses mutation under the existing required-module rule. Protocol, record schema, profile and Git binding identifiers remain at 0.2; the new modules and `gsp.spacetime/1` projection are additive capabilities, not a silent legacy migration.

Event references are operational boundary markers. This does not redefine extended or consequential GR events as instantaneous. Start is inclusive and end exclusive. Two event bounds need supported strict precedence; unknown or inconsistent extents remain indeterminate. Missing scope remains unscoped, and explicit unboundedness is limited to the stated inquiry scope.

A cut is the predecessor closure of selected events. The projection identifies both the recording revision and included event set. No rank, UUID ordering, layout coordinate, Git

position, or descriptive date asserts otherwise unsupported temporal order. Incomparable events are not declared simultaneous.

Contradictory strict-order accounts remain retained. A cycle yields diagnostics, `consistent : false`, and no cut or topology result. Withdrawn order accounts do not constrain the active order. Contested and non-realized accounts remain visibly qualified. A withdrawn Event referenced by an active order remains inspectable with a warning rather than having its reference silently erased.

An unsupported retained event-order version also prevents a complete cut/topology result, even if its old envelope was optional; otherwise necessary order constraints could disappear silently. An unsupported temporal extent instead makes the affected account indeterminate without blocking an otherwise usable order. The `consistent` flag therefore concerns a usable interpreted ordering, not independent factual warrant.

The derived topology and trajectory boundaries are presentations of retained applicability assertions. The topology is the induced subgraph of active record nodes, retaining only edges with two active endpoints. Active Relation accounts remain inspectable even when some participant incidences are omitted; diagnostics disclose that boundary and any declared participant incompleteness. This preserves an applicable account without inventing a complete relationship. The projection does not execute events, choose a unique true State, supply causal attribution, or infer target persistence from record retention. The ordinary graph remains available for all records, including those without temporal scope.

74.1.4 Binding and preservation

The pure projection consumes one snapshot. The generalized application's authenticated GET/POST spacetime endpoint resolves one authorized revision; POST supplies a bounded event selection and requires anti-forgery protection despite being read-only. Projection creates no commit, receipt, layout record, or migration. Late insertion of an earlier occurrence can revise the present reconstruction while earlier Git snapshots remain available.

No automatic change is made to user records or academia's native protocol. Broader academia alignment remains its separate work item. Source changes follow the existing nested repository boundaries.

74.1.5 Rationale and limits

This choice implements the user's topology-over-event-order requirement while preserving uncertainty and the distinction between a recorded account and its target. It directly develops GR-110 R110-008/049 and the existing information/presentation Working Draft needs through a separate experimental Specification.

Alternative coherent chronologies, event durations and overlaps, calendar/coordinate systems, formal state-effect execution, identity adjudication and measured usability remain open. The FM-004 consequential relational-event formulation and FM-007 occurrence-record formulation remain separately traceable; the application does not settle their full theoretical relationship.

74.1.6 Affected artifacts and assessment

Affected artifacts are GR-120, GR-140, GR-SPEC-121, additive references in GR-SPEC-120/130, shared module schemas and projection code, generalized application controls/API, open questions and changelog. Historical TeX editions remain unchanged.

Assessment cases include reversed recording/occurrence order, incomparable events, ancestor closure, retained cycles, uncertain extents, subject grouping, historical labels, relation-boundary omissions, authorization and absence of writes during projection. This decision states the intended assessment boundary; it does not itself establish that those checks have passed or that the programme has adopted a Standard.

75 GR background

Original source: `docs/background/GR_background.md`.
Original source SHA-256: `28cdc8edc3a1b2d3a2336ed5188adefc0472bd3ce3c38a7e5f486e12e2feaeb4`.

75.1 Generative Relational Background

Status: Informative / evolving

75.1.1 1. Role of this document

This document provides a project-level orientation to Generative Relational (GR) thought for contributors working on the standards programme.

It does not replace the foundation manuscripts. When a precise GR claim, definition, notation, or historical development matters, contributors should consult the relevant source in `foundation_manuscripts/`.

75.1.2 2. General orientation

GR treats many apparently stable objects, categories, values, and institutional forms as historically and relationally generated rather than as self-explanatory starting points.

The programme has repeatedly emphasized:

- relations and relational conditions;
- generativity and changes in future possibility;
- emergence and manifestation;
- differences and constraints;
- self-reinforcing relational realities;
- historical trajectories;
- contingency and recognition;
- generativity return;
- preservation of conditions that permit future generation.

75.1.3 3. Deep metamodel and operational ontology

A recurring architectural distinction is maintained between:

75.1.4 Deep metamodel

- Change
- Structure
- Constraint
- Difference

75.1.5 Operational record ontology

- Entity
- State
- Event
- Process
- Relation
- Property

The six operational record classes should not be treated as a claim that reality fundamentally consists of six kinds of things.

75.1.6 4. Relational and historical sensitivity

GR-oriented recording should remain capable of representing:

- changes in relations;
- changes in available distinctions;
- changes in possibilities;
- changes in interpretive frames;
- multiple perspectives;
- unrealized branches;
- later reinterpretation;
- the conditions under which something became recognizable or actionable.

75.1.7 5. Standards implication

GR theory supplies conceptual motivation, but a standard requires additional constraints:

- clarity;
- interoperability;
- implementability;
- testability where appropriate;
- stable versioning;
- explicit conformance language.

The standards programme therefore translates GR concepts into operational structures selectively and transparently.

75.1.8 6. Source discipline

When this overview conflicts with a foundation manuscript, treat this file as secondary. Record the discrepancy and consult the manuscript and relevant ADRs before changing a normative document.

76 background

Original source: `docs/background/background.md`.
Original source SHA-256: `388c32e0a503c9ad6c76c0dc7f584fb120bba352ab37df9d24b7f632479c02a7`.

76.1 Background

76.1.1 1. Purpose

This document records the conceptual background motivating a standards program for generativity records and their presentation.

It is informative, not normative.

76.1.2 2. Problem setting

Conventional archival, provenance, and publication practices often preserve outputs more reliably than the processes through which those outputs became possible.

A finished paper, policy, institution, artwork, dataset, or decision may survive while the following become difficult to reconstruct:

- enabling conditions;
- contingent encounters;
- changes in interpretation;
- unrealized branches;
- transformations of relations;
- losses of possible continuations;
- later reinterpretations;
- the role of infrastructures, tools, communities, and non-human systems.

The program therefore investigates standards for recording and presenting generativity as trajectory rather than only as output.

76.1.3 3. Existing metamodel background

The current theoretical background uses a deliberately weak highest-level formalism built around:

- a carrier of states;
- mechanisms acting on states;
- an equivalence relation or observational indistinguishability structure;
- a notion of action/composition.

At that level, four central formal dimensions have been emphasized:

- Change
- Structure
- Constraint
- Difference

The protocol and standards program should remain compatible with that abstract layer while avoiding the assumption that the operational recording vocabulary is itself metaphysically fundamental.

76.1.4 4. Candidate operational record ontology

The current candidate operational ontology contains six classes:

1. Entity
2. State
3. Event
4. Process

5. Relation
6. Property

These classes are intended as standardized forms for recording and exchange. They remain provisional until GR-100 defines them.

76.1.5 5. Important conceptual distinction

The program currently distinguishes:

$$\text{formal substrate} \neq \text{record ontology} \neq \text{record instance} \neq \text{presentation}$$

This prevents, for example:

- identifying formal change directly with an Event;
- treating a Process as simply a mechanism;
- treating every Property as an intrinsic essence;
- treating a presentation as identical to the archived record.

76.1.6 6. Generativity and evolving distinctions

A future record model may need to represent not only changes of state but changes in what distinctions are available to an observer or system.

This suggests possible representations of:

- evolving equivalence or discrimination structures;
- emergent vocabulary;
- newly recognizable possibilities;
- transformed ontology or classification regimes.

This remains a research issue.

76.1.7 7. Why a standards program

The aim is not merely to write a single protocol.

A durable public standard requires:

- transparent development procedures;
- stable document classes;
- public review;
- recorded objections and dispositions;
- versioning;
- maintenance;
- conformance criteria;
- implementation guidance;
- technical interoperability.

Accordingly, the project is organized as a standards-development program rather than a single manuscript.

77 epistemic background

Original source: `docs/background/epistemic_background.md`.
Original source SHA-256: `c164468d68e0ef4acad3319e7955a31171f6c8d7f4f609cbb6857435ebdd88a9`.

77.1 Epistemic Background

Status: Informative / evolving

77.1.1 1. Problem

Generativity records are not direct copies of reality.

They are produced through observation, selection, interpretation, categorization, memory, measurement, documentation, and later reconstruction.

The standards programme therefore requires an explicit epistemic layer.

77.1.2 2. Candidate distinctions

The programme should preserve distinctions among:

- Trace
- Observation
- Claim
- Evidence
- Interpretation
- Judgment
- Attribution
- Retrospective interpretation

These categories are provisional and may become classes, relations, profiles, or metadata structures.

77.1.3 3. Epistemic provenance

A record should be capable of expressing:

- who or what produced the observation;
- by which method;
- at what time;
- from which source;
- under which interpretive frame;
- with what uncertainty;
- whether it is direct, inferred, reconstructed, or disputed;
- whether later evidence modified its status.

77.1.4 4. Contestation

Different observers may maintain incompatible interpretations of the same underlying traces.

The standard should support plurality without requiring immediate collapse into a single canonical narrative.

77.1.5 5. Historical revision

Later interpretations should not erase earlier epistemic states.

A record system should be capable of representing:

- what was believed at time t1;
- what evidence was available at t1;
- what changed at t2;
- how the interpretation was revised.

77.1.6 6. Epistemic justice

The programme should remain attentive to asymmetries in whose observations are recorded, whose categories become authoritative, whose records survive, and whose interpretations become institutionally visible.

Detailed normative treatment belongs in later standards and technical reports.

78 era background

Original source: `docs/background/era_background.md`.
Original source SHA-256: `2daf178e6cd8a9be81170be4879f7dda6b6e7c4ace84ef3beeef2594ef2d9c69`.

78.1 Era Background

Status: Informative / preliminary

78.1.1 1. Purpose

This document records the historical and technological context motivating the Generativity Standards Program.

It should evolve as the programme develops.

78.1.2 2. Proliferation of generated outputs

Contemporary research, administration, communication, education, and creative work increasingly produce large volumes of outputs through combinations of:

- human work;
- AI systems;
- automated agents;
- digital platforms;
- distributed collaboration;
- machine-mediated search, synthesis, and transformation.

The existence of an output increasingly reveals less about the trajectory that generated it.

78.1.3 3. Heterogeneous agency

Many domains previously organized around predominantly human participants now include heterogeneous actors and quasi-actors:

- humans;
- institutions;
- AI models;
- software agents;
- automated pipelines;
- data infrastructures;
- algorithmic decision systems.

This complicates conventional accounts of authorship, action, responsibility, provenance, learning, and contribution.

78.1.4 4. Compression of generative history

Digital workflows often optimize for the current state:

- latest document;
- final answer;
- accepted version;
- current database row;
- published artifact.

Intermediate possibilities, rejected branches, contextual judgments, accidental encounters, and changing interpretations may disappear.

The programme treats this historical compression as a standards problem as well as an archival problem.

78.1.5 5. AI-era provenance

Simple declarations such as “AI was used” often provide little information about:

- what was supplied to a model;
- what role a model played;
- how outputs were selected;
- which judgments remained human;
- how ideas changed through interaction;
- which later steps depended upon earlier AI-mediated encounters.

A richer generativity record may therefore become increasingly useful.

78.1.6 6. Knowledge abundance and recognizability

As the quantity of generated material grows, future significance may depend less on preserving outputs alone and more on preserving enough relational and historical context for later actors to:

- recognize why something mattered;
- distinguish independent emergence from repetition;
- reconstruct a generative pathway;
- reinterpret earlier judgments;
- continue unrealized possibilities.

78.1.7 7. Institutional relevance

Potential application areas include:

- scholarly research;
- cultural archives;
- AI-assisted knowledge production;
- education;
- organizational decision making;
- policy development;
- collaborative design;
- scientific discovery;
- historical reconstruction.

78.1.8 8. Caution

This document provides motivating context. It should not be used to justify strong empirical claims without appropriate evidence. External factual claims intended for formal publication should be separately researched and cited.

79 jurisprudential background

Original source: `docs/background/jurisprudential_background.md`.
Original source SHA-256: `71797a5fefe307d7d32a1d94cb50be677cdad2684f2d45634cd491334fab96be`.

79.1 Jurisprudential Background

Status: Informative / preliminary

79.1.1 1. Purpose

This document identifies legal and jurisprudential questions that arise when generativity records move from research or archival tools into institutional practice.

79.1.2 2. Core distinction

A technical standard can define data structures, procedures, and conformance conditions.
It does not by itself determine:

- legal validity;
- legal responsibility;
- evidentiary admissibility;
- rights and duties;
- remedies;
- jurisdiction.

Those questions require jurisprudential and legal analysis.

79.1.3 3. Areas for development

Potential areas include:

- evidentiary status of generativity records;
- provenance and attribution;
- correction and reply rights;
- preservation duties;
- privacy and confidentiality;
- institutional accountability;
- due process in automated or AI-mediated decision histories;
- legal treatment of contested or incomplete records;
- archival duties toward future publics;
- legal recognition of heterogeneous participation.

79.1.4 4. Jurisprudential questions

The programme should ask, among other things:

- When may a record be relied upon?
- What does procedural fairness require when a record is disputed?
- Who may correct, annotate, restrict, or challenge a record?
- When does preservation conflict with privacy or erasure interests?
- How should legal institutions distinguish observed facts from interpretations or attributions?
- How should legal responsibility be handled when human and computational participation are deeply entangled?

79.1.5 5. Relation to standards

These questions may lead to:

- technical requirements;
- implementation guidance;
- legal profiles;
- policy proposals;
- model institutional procedures.

They should not be resolved by ontology design alone.

80 git repository layers

Original source: `docs/development/git_repository_layers.md`.
Original source SHA-256: `3d4bf617e907506c5402d855a4e6f366ae7b1139096371986c42339abc3cc851`.

80.1 Repository layers and contributor workflow

Class: Development and operation guide
Status: Repository arrangement authorized 2026-09-22; hosted SSH remotes configured for publication

ADR-0010 records the decision. Source histories have four boundaries:

```
generativity_standards_program/               Git repository, main
└── applicative_infrastructure/               submodule, own repository
    ├── common/                              ordinary infrastructure source
    ├── gr_generalized_application/           submodule, own repository
    └── gr_academia_application/              submodule, own repository
```

The programme contains canonical manuscripts, governance, standards-track drafts, specifications, policy proposals and programme decisions. Infrastructure owns shared Python packages and orchestration. Domain repositories own their applications and domain packages. The four repositories retain distinct contributor and MIT licensing files.

Private project repositories used by the applications are a separate recording layer. They remain under ignored `.runtime/` alongside accounts and native identity material. Creating source submodules neither publishes those records nor changes their accepted commits, access controls or licences.

80.1.1 Hosted repository addresses

Each source repository has its own `origin`. Both `.gitmodules` files use the matching SSH addresses, so recursive cloning can retrieve all referenced source commits.

Repository	SSH address
Programme	`git@github.com:huangwanhong-maker/Generativity-Epistemic-Infrastructure.git`
Infrastructure	`git@github.com:huangwanhong-maker/Generativity-Relational-Epistemic-Applicative-Infrastructure.git`
Generalized application	`git@github.com:huangwanhong-maker/Generalized-Generativity-Relational-Social-Science-Application.git`
Academia application	`git@github.com:huangwanhong-maker/Generative-Relational-Academia-Application.git`

80.1.2 Obtain the complete workspace

With GitHub SSH access configured for all four repositories:

```
git clone --recurse-submodules git@github.com:huangwanhong-maker/Generativity-Epistemic-Infrastructure.git
↪  generativity_standards_program
cd generativity_standards_program
```

For an existing checkout, including one originally created from the local repository layout:

```
git submodule sync --recursive
git submodule update --init --recursive
git submodule status --recursive
```

Synchronizing updates local submodule URL settings from the committed `.gitmodules` files within this checkout. Unrelated clones retain their own settings; inspect their origins separately when repurposing an older clone. The hosted URLs do not need a file-transport allowance.

Submodules normally check out the revisions pinned by the parent. This often gives a detached HEAD; before developing inside one, select or create a branch deliberately. Do not use `update --remote` as a substitute for restoring the committed parent snapshot.

80.1.3 Windows SSH identity

The maintainer's Windows identity is `~/.ssh/serendip_id_ed25519`. Its contents remain outside the repositories. Other contributors use their own GitHub-authorized identities. The following PowerShell example selects Windows OpenSSH and the named key without changing global Git or SSH configuration:

```
$sshExecutable = 'C:/Windows/System32/OpenSSH/ssh.exe'
$identityPath = ($env:USERPROFILE -replace '\\', '/') + '/.ssh/serendip_id_ed25519'
$sshCommand = '"' + $sshExecutable + '" -i "' + $identityPath + '" -o IdentitiesOnly=yes -o StrictHostKeyChecking=yes'

git config --local core.sshCommand $sshCommand
git -C applicative_infrastructure config --local core.sshCommand $sshCommand
git -C applicative_infrastructure/gr_generalized_application config --local core.sshCommand $sshCommand
git -C applicative_infrastructure/gr_academia_application config --local core.sshCommand $sshCommand
```

These commands run from the programme root after its submodules are initialized. The settings are local machine configuration and do not accompany source clones. They select the identity, not the key's contents. Strict host checking expects a previously verified GitHub host key in the local known-hosts file; verify a new or changed host key before accepting it. A passphrase-protected identity can still prompt because `BatchMode` is not persisted.

For the first recursive clone with this identity, define the same variables and pass the command for that operation:

```
git -c core.sshCommand="$sshCommand" clone --recurse-submodules
↪  git@github.com:huangwanhong-maker/Generativity-Epistemic-Infrastructure.git generativity_standards_program
```

After entering the clone, use the repository-local settings above if this identity should remain selected for future fetches and pushes. On another operating system or with another SSH installation, substitute that system's executable and identity path.

80.1.4 Commit from children to parents

For an application change, work inside that application's repository, review and commit its changed files, then review and commit the new gitlink in infrastructure. Finally review and commit infrastructure's new gitlink in the programme. From the programme root:

```
git -C applicative_infrastructure/gr_generalized_application switch main
git -C applicative_infrastructure/gr_generalized_application status --short
## Stage the intended application files and commit there.
git -C applicative_infrastructure diff --submodule=log
git -C applicative_infrastructure add gr_generalized_application
git -C applicative_infrastructure commit -m "Update generalized application revision"
git diff --submodule=log
git add applicative_infrastructure
git commit -m "Update infrastructure revision"
```

Academia follows the same order. Common-package changes begin in infrastructure. Programme-only changes begin in the programme root. Review a changed child pointer as a substantive source dependency change, including its actual commits and tests.

These commands do not commit application files automatically: a parent records the child commit identifier, not uncommitted changes inside that child. Use `git status` in each affected repository and `git submodule status --recursive` from the root.

80.1.5 Maintain remotes and publish

The configured origins and submodule URLs can be inspected from the programme root:

```
git remote -v
git -C applicative_infrastructure remote -v
git -C applicative_infrastructure/gr_generalized_application remote -v
git -C applicative_infrastructure/gr_academia_application remote -v
git config --file .gitmodules --get-regexp '^submodule\..*\.url$'
git -C applicative_infrastructure config --file .gitmodules --get-regexp '^submodule\..*\.url$'
```

If an existing clone still has local origins, update them to the hosted addresses. Use `remote add origin` instead of `remote set-url origin` only when that repository has no origin:

```
git -C applicative_infrastructure/gr_generalized_application remote set-url origin
↪  git@github.com:huangwanhong-maker/Generalized-Generativity-Relational-Social-Science-Application.git
git -C applicative_infrastructure/gr_academia_application remote set-url origin
↪  git@github.com:huangwanhong-maker/Generative-Relational-Academia-Application.git
git -C applicative_infrastructure remote set-url origin
↪  git@github.com:huangwanhong-maker/Generativity-Relational-Epistemic-Applicative-Infrastructure.git
git remote set-url origin git@github.com:huangwanhong-maker/Generativity-Epistemic-Infrastructure.git

git -C applicative_infrastructure submodule set-url gr_generalized_application
↪  git@github.com:huangwanhong-maker/Generalized-Generativity-Relational-Social-Science-Application.git
git -C applicative_infrastructure submodule set-url gr_academia_application
↪  git@github.com:huangwanhong-maker/Generative-Relational-Academia-Application.git
git submodule set-url applicative_infrastructure
↪  git@github.com:huangwanhong-maker/Generativity-Relational-Epistemic-Applicative-Infrastructure.git
git submodule sync --recursive
```

Commit any infrastructure `.gitmodules` change before committing the root's `.gitmodules` and infrastructure pointer. Before publishing, fetch existing remote branches and inspect their relationship to local work. Preserve existing ancestry; if a normal push would reject divergent history, reconcile that history deliberately. The publication commands below use ordinary pushes.

Publish in dependency order so every referenced commit is available:

```
git -C applicative_infrastructure/gr_generalized_application push -u origin main
git -C applicative_infrastructure/gr_academia_application push -u origin main
git -C applicative_infrastructure push -u origin main
git push -u origin main
```

Use each command only after that repository's intended changes are committed and reviewed. Verify that the remote `main` commit matches the intended local `HEAD` in every repository after publication. A parent push cannot publish an unpublished application commit on its own.

A Git archive of the root alone does not contain submodule source; distribute the four repositories or an explicitly assembled recursive source snapshot when complete offline source is needed. Trusted offline clones can still use command-scoped file transport, but hosted `.gitmodules` URLs need explicit local overrides if network access is unavailable.

80.1.6 Preservation and verification

Academia's original source history is real ancestry of its new branch, with its original complete bundle retained as independent import evidence. New licensing and layout changes are later commits. Historical migration manifests retain their recorded baseline; compare later work through Git history rather than overwriting earlier evidence.

Each repository ignores its own generated and private files. Keep the full runtime separately backed up; source Git commits do not back up accounts, native record histories or signing keys. Do not use recursive `git clean` as a housekeeping command over a working application installation.

From the programme root after committing:

```
python tools/check_repository_layers.py
git submodule status --recursive
```

The checker examines repository identities, committed child pointers, clean trees, attribution artifacts and bounded private-path exclusions. It does not read user records or scan every source blob for secrets. The initial verification record records repository creation and local clone checks; the hosted publication record records remote-history integration and publication.

These procedures follow Git's official submodule command reference and .gitmodules format. In particular, relative child URLs resolve against the parent's default remote repository; they are not arbitrary paths relative to wherever a terminal happens to be opened.

81 multilayer architecture

Original source: `docs/framework/multilayer_architecture.md`.
Original source SHA-256: `7a538b8e8114cd25a3a894afca2ea879d4ad0d49ee9427c76baccb27dc1e3821`.

81.1 Multilayer Architecture of the Generativity Standards Program

Status: PROVISIONAL
Purpose: Expand the programme beyond a narrow ontology-and-data-model approach.

81.1.1 1. Rationale

A generativity record cannot be adequately designed by specifying recordable beings or structures alone.

The programme must also address:

- how a phenomenon becomes knowable;
- how observations, claims, interpretations, and judgments are distinguished;
- how evidence is generated, transmitted, contested, and revised;
- how normative significance is assigned;
- how law and jurisprudence recognize, classify, protect, or constrain generative relations;
- how institutions use generativity records in governance;
- how political and economic structures shape what can be generated, preserved, recognized, or returned.

Accordingly, ontology is only one layer of the programme.

81.1.2 2. Proposed layers

81.1.3 L0 — Generative metamodel

Concerned with highly abstract formal dimensions such as:

- change;
- structure;
- constraint;
- difference.

81.1.4 L1 — Record ontology

Candidate operational classes include:

- Entity;
- State;
- Event;
- Process;
- Relation;
- Property.

These remain open to extension.

81.1.5 L2 — Epistemic layer

Concerned with how a record comes to be known, asserted, interpreted, and revised.

Candidate concepts include:

- Observation;
- Trace;
- Claim;
- Evidence;
- Interpretation;

- Judgment;
- Attribution;
- Perspective;
- Confidence;
- Uncertainty;
- Contestation;
- Revision;
- Retrospective reconstruction.

The epistemic layer should prevent a record from collapsing occurrence, observation, and interpretation into one field.

81.1.6 L3 — Normative and ethical layer

Concerned with:

- value;
- harm;
- benefit;
- justice;
- fairness;
- recognition;
- responsibility;
- generativity return;
- preservation obligations;
- competing claims over records and their uses.

This layer should distinguish descriptive records from normative evaluations.

81.1.7 L4 — Jurisprudential and legal layer

Concerned with how generativity-related records interact with legal concepts and procedures.

Potential topics include:

- legal status of records;
- admissibility and evidentiary weight;
- authorship and contribution;
- attribution and provenance;
- rights of access, correction, objection, and reply;
- privacy and data protection;
- confidentiality and privilege;
- retention and destruction;
- procedural fairness;
- institutional accountability;
- legal recognition of heterogeneous human/AI participation;
- preservation of contested histories.

The programme should avoid assuming that a technical standard itself creates legal rights or duties.

81.1.8 L5 — Institutional and governance layer

Concerned with how organizations use records in:

- research governance;
- public administration;
- international cooperation;
- education;
- cultural heritage;
- scientific collaboration;
- AI governance;
- institutional memory;
- accountability and review.

81.1.9 L6 — Political-economy layer

Concerned with:

- ownership and control of generative infrastructure;
- extraction of value from generative relations;
- asymmetries in capacity to record and preserve;
- concentration of archival power;
- access to knowledge infrastructure;
- generativity return;
- resource allocation;
- institutional incentives.

81.1.10 L7 — Technical implementation layer

Concerned with:

- information models;
- identifiers;
- graph structures;
- serialization;
- APIs;
- validation;
- interoperability;
- cryptographic integrity;
- versioning.

81.1.11 3. Cross-layer principle

The layers should interact without being collapsed.

For example:

- an Event record is ontological/operational;
- a statement that the Event occurred is epistemic;
- a judgment that the Event was unjust is normative;
- a finding that it violated a legal duty is jurisprudential;
- a requirement that an institution preserve the record is governance/legal;
- a JSON representation of the record is technical.

These should remain distinguishable even when represented together.

81.1.12 4. Standards implication

The programme should develop coordinated standards rather than one ontology-only specification.

A future conformance claim may need to state which layers it implements.

81.1.13 5. Political and institutional proposals

The programme may also publish policy proposals for international organizations and other public-interest institutions.

Those proposals should be grounded in the standards work but remain a separate publication class.

A standards document defines interoperable requirements.

A policy proposal may recommend institutional adoption, pilot programmes, governance arrangements, capacity-building, or legal/policy experimentation.

The two should reference each other without being conflated.

82 publication taxonomy

Original source: `docs/framework/publication_taxonomy.md`.
Original source SHA-256: `99f67d5411ff85cc38f14299ea547bed7f8397f488282c2bcf358f91e5f2b8eb`.

82.1 Publication Taxonomy

82.1.1 Specifications, Standards, and International Political / Policy Proposals

Status: PROVISIONAL
Document class: Informative programme framework
Purpose: Define the principal publication classes of the Generativity Standards Program.

82.1.2 1. Why the distinction matters

The programme produces documents with different kinds of authority.

A technically precise document is not automatically a standard.

A formally adopted standard is not automatically law or public policy.

A proposal addressed to an international organization is not a technical conformance document.

Accordingly, the programme distinguishes at least three primary publication families:

1. **Specifications**
2. **Standards**
3. **International Political / Policy Proposals**

The three families may reference one another, but their authority, review process, and intended use remain distinct.

82.1.3 2. Specification

82.1.4 2.1 Definition

A **Specification** defines a technical, informational, procedural, semantic, or interoperability model with enough precision to be implemented, tested, or compared.

A specification may be:

- experimental;
- provisional;
- candidate;
- stable;
- implementation-oriented.

A specification may contain normative technical language such as `shall`, `should`, and `may`, but it does not become a programme Standard merely by doing so.

82.1.5 2.2 Typical purposes

Specifications may define:

- data models;
- ontologies;
- record structures;
- schemas;
- interchange formats;
- API behavior;
- identifier rules;
- conformance tests;
- mathematical or computational semantics.

82.1.6 2.3 Authority

A specification has **technical authority within its declared scope**, but not the institutional status of an adopted Standard unless formally promoted through the standards-development process.

82.1.7 2.4 Examples

Possible examples include:

- Generativity Information Model Specification
- Generativity Interchange Specification
- Epistemic Record Specification
- Validation Specification

82.1.8 2.5 Maturity path

A specification may remain a specification indefinitely, or may later become part of a Standard.

A possible promotion path for a specification is shown below. It is not the programme's default starting sequence; section 5A and accepted ADR-0002 establish Standards-first development.

Research Draft → Specification → Pilot Specification → Candidate Standard → Standard

Promotion is not automatic.

82.1.9 2.6 Protocols and procedures

A **protocol** specifies behavior among participants: roles, inputs, interactions, states, transitions, outcomes, failure handling and applicable obligations. A protocol can be described in a Specification and referenced by a Standard. Protocol is a technical subject, not an additional publication authority class.

Institutional procedures describe responsibilities, grounds for action, review, contestation and disposition. Machine protocols describe interactions that implementations can execute and test. A network exchange does not itself establish the institutional authority or evidential warrant of the act it carries.

Schema validity alone does not demonstrate protocol conformance. Protocol assessment can examine allowed transitions, authorization, duplicate or conflicting requests, unsupported features, disclosure boundaries and failure behavior, according to the declared scope.

The candidate allocation to existing publication families is in the protocol and specification plan. New protocol bindings are proposed only when draft requirements identify a reusable technical need.

82.1.10 3. Standard

82.1.11 3.1 Definition

A **Standard** is a formally adopted normative publication developed according to the programme's standards-development procedures.

A Standard specifies requirements, recommendations, permissions, terminology, procedures, or conformance conditions intended to support consistent practice across multiple independent users or institutions.

82.1.12 3.2 Minimum conditions

A document should normally become a Standard only after:

- approved work-item initiation;
- defined scope;
- technical review;
- relevant horizontal review;
- public review;
- comment disposition;
- demonstrated implementation or pilot evidence where applicable;
- formal approval;
- assigned edition and maintenance responsibility.

82.1.13 3.3 Authority

A programme Standard establishes **programme-level normative authority** for conformance.

It does not by itself create:

- statutory law;
- treaty obligations;
- international legal obligations;
- governmental duties;
- jurisdictional authority.

External institutions may voluntarily adopt, reference, incorporate, or legally recognize a Standard through their own procedures.

82.1.14 3.4 Examples

Possible examples include:

- Generativity Recording Standard
- Generativity Preservation and Access Standard
- Generativity Conformance Standard
- Institutional Generativity Record Standard

82.1.15 4. International Political / Policy Proposal

82.1.16 4.1 Definition

An **International Political / Policy Proposal** is a non-standard publication that presents policy, governance, institutional, legal, or cooperative options for consideration by international organizations or other transnational public-interest actors.

For formal publication, the programme should normally use the label **International Policy Proposal (IPP)** or **International Institutional Proposal (IIP)**. The broader phrase “international political proposal” may describe the family, but should not imply partisan advocacy.

82.1.17 4.2 Typical purposes

Such proposals may address:

- institutional adoption of generativity-record practices;
- international pilot programmes;
- research-integrity infrastructure;
- AI provenance and accountability;
- cultural and scientific preservation;
- institutional memory;
- capacity-building;

- cross-border interoperability;
- model governance procedures;
- international cooperation mechanisms.

82.1.18 4.3 Authority

An international policy proposal is **recommendatory and deliberative**.

It does not define technical conformance merely by recommending a practice.

It does not acquire legal or political authority unless adopted through the procedures of the relevant organization or jurisdiction.

82.1.19 4.4 Required distinctions

Each proposal should clearly distinguish:

- factual background;
- analytical interpretation;
- normative objectives;
- policy options;
- legal or mandate constraints;
- implementation implications;
- technical dependencies;
- unresolved questions.

Where more than one reasonable institutional option exists, proposals should describe the alternatives without presenting one as technically inevitable.

82.1.20 4.5 Relationship to political neutrality

The programme may formulate institutional options, model procedures, implementation pathways, and comparative consequences.

Policy proposals should avoid converting a technical standard into a claim that one political choice is mandatory.

82.1.21 5. Relationship among the three families

The relationship can be represented as:

$$\text{Specification} \longrightarrow \text{possible technical basis} \longrightarrow \text{Standard}$$

and separately:

$$\text{Specification or Standard} \longrightarrow \text{possible input} \longrightarrow \text{International Policy Proposal}.$$

Neither arrow implies automatic promotion or adoption.
A policy proposal may recommend use of a Standard.
A Standard may reference a Specification.
A Specification may implement concepts motivated by policy needs.
The three remain separate publication classes.

82.1.22 5A. Default development direction

The programme generally begins from a Standard work item.

The Standard defines the normative objective and requirements. When those requirements reveal a need for reusable technical infrastructure, the programme initiates one or more Specifications.

Typical dependency:

Standard requirement → technical need → Specification

During development, feedback may flow in both directions:

Standard Working Draft ↔ Specification + Pilot

Thus, Specifications are subordinate in purpose but may be essential to demonstrating that the Standard is implementable.

82.1.23 6. Authority matrix

Publication class	Technical precision	Conformance authority	Formal adoption by programme	Policy recommendation	Creates law
Specification	High	Within declared spec scope	Not necessarily	Usually no	No
Standard	High	Yes	Yes	Not primarily	No
International Policy Proposal	Variable	No	Published, not standards-adopted	Yes	No

---

82.1.24 7. Proposed identifiers

The programme may use class-sensitive identifiers:

- `GR-SPEC-xxx` — Specification
- `GR-STD-xxx` — Standard
- `GR-TR-xxx` — Technical Report
- `GR-G-xxx` — Guide
- `GR-M-xxx` — Manual
- `GR-IPP-xxx` — International Policy Proposal
- `GR-IIP-xxx` — International Institutional Proposal

Existing `GR-100`, `GR-110`, etc. numbers may be retained as project-family numbers while publication-class prefixes identify the document's current status.

Example:

- `GR-SPEC-120:2027` — Generativity Information Model Specification
- `GR-STD-110:2028` — Generativity Recording Standard
- `GR-IPP-001:2028` — International Research Provenance Infrastructure Proposal

---

82.1.25 8. Promotion and cross-reference rules

82.1.26 Specification to Standard

Promotion requires an explicit standards-development decision.

A Specification should not silently become a Standard through editorial renaming.

82.1.27 Standard to policy use

A policy proposal may recommend adoption or piloting of a Standard, but should specify:

- intended institution;
- mandate;
- expected benefits;
- costs and burdens;
- legal implications;
- safeguards;
- alternatives.

82.1.28 Policy proposal to Standard

Political or institutional preference alone should not determine technical conformance requirements.

If a policy proposal identifies a new technical need, that need should enter the standards process as a separate work item.

82.1.29 9. Repository placement

Recommended repository structure:

- `specifications/`
- `standards/`
- `policy_proposals/`
- `manuals/`
- `technical_reports/`
- `foundation_manuscripts/`

During the current transition, existing standards-track drafts may remain in `standards/`, but each document should declare its publication class and maturity status explicitly.

83 NWIP 001 generativity recording and presentation

Original source: `docs/planning/NWIP-001-generativity-recording-and-presentation.md`.
Original source SHA-256: `e527d808520b93d302635f2c0bf43652e422ac9d7f83ba6cedb625723d34fe6a`.

83.1 GR/NWIP-001 — Generativity Recording and Presentation Infrastructure

Document class: New Work Item Proposal
Status: PROVISIONAL — draft for review; not submitted or approved
Version: 0.1
Date: 2026-09-22

83.1.1 Identifier and proposer

The identifier and title were proposed in the earlier preliminary plan and are retained. Proposer, project lead and participating institutions remain to be assigned. This draft does not represent an external institution's commitment.

83.1.2 Problem statement

People and institutions act through records and representations whose grounding, interpretation and history are often difficult to inspect. Symbolic crisis makes the connections among referents, claims, evidence, classifications and practical trust a central programme concern. Final artifacts also underdescribe the relations, judgments, alternatives and changes in future possibilities through which they emerged.

The initial work item investigates what shared recording and procedural requirements make these connections inspectable and revisable without equating provenance, institutional acceptance, technical validation or consensus with truth.

83.1.3 Scope

A coordinated, bounded development package for representing a situation, attributing claims, identifying evidence and limitations, tracing relevant generative conditions, presenting competing interpretations, receiving a challenge, recording a reasoned response or revision, and preserving usable history under declared access and retention conditions.

The first case is proposed to be the programme's own documented decision history, paired with a synthetic institutional decision case. Both can expose methodological and implementation problems before real external participants or sensitive institutional data are involved.

83.1.4 Out of scope for the first package

- A universal metaphysics, truth certification, or numerical score for trust or generativity.
- Exhaustive capture of lived experience or every unrealized possibility.
- Automated adjudication of disputed substantive claims.
- General legal admissibility, jurisdiction-independent rights, or binding policy adoption.
- A mandated platform, distributed ledger, global identity provider or federated network.
- Completion or adoption of every publication in the portfolio.

83.1.5 Need for standardization

Independent records and implementations need a shared account of what an assertion means, whose assertion it is, how evidence bears on it, which histories and disagreements are preserved, and what an exchange or presentation omits. Common procedural expectations can make review and correction usable across institutions while permitting scoped local decisions and legal profiles.

83.1.6 Intended users and stakeholders

Initial users include researchers, record custodians, reviewers, implementers, institutional decision makers and people represented or affected by records. Relevant participation includes people with limited recording resources, users needing accessible presentations, epistemic and archival expertise, and protection and procedural expertise. Representation and recruitment arrangements are governance work, not established facts.

83.1.7 Existing standards and related work

The standards-development comparison informs how the work is governed; the cross-domain programme identifies substantive epistemic, ethical, legal, institutional, policy and political-economy questions. Source mechanisms and local adaptations remain distinct. The first package is a bounded test within that wider programme.

See the verified candidate landscape. Candidate reuse does not imply compatibility, selection or conformance. The work item will document gaps, dependency editions and the cost of extensions before selecting a technical binding.

GR conceptual sources and unresolved mappings are in the foundation traceability map.

83.1.8 Proposed deliverables

Deliverable	Publication responsibility	Evidence expected
Bounded vocabulary and operational definitions	GR-100 with GR-TR101	Source mapping, examples, counterexamples and OPEN questions
Recording and epistemic requirements	GR-110/200/210	Attribution, evidence, disagreement, generative history and revision cases
Presentation, protection and procedural constraints	GR-140/160/400, with GR-300/310 boundaries	Restricted and contested presentations; practical review and response
Conformance scope and methods	GR-150	Distinct claims for records, implementations, views and procedures
Minimum implementable representation and behavior	GR-SPEC-120/200/130 only where requirements justify them	Portable examples, protocol traces, errors and loss-aware exchange
Guidance and pilot findings	GR-M101, examples and pilot reports	Recording burden, interpretability, contestability and failures

Approval can split this coordinated proposal into linked work items while retaining traceability to GR/NWIP-001. It does not automatically approve all parent publications or assign them a new lifecycle stage.

83.1.9 Required expertise and organization

Roles include a coordinating editor, source/terminology reviewer, epistemic reviewer, implementer, archival/protection reviewer, procedural reviewer and affected-user participants. Names and availability are OPEN. The existing GR/TC 1 mandate and working-group structure are candidates for assignment after governance launch; no additional committee is presumed.

83.1.10 Risks and controls to evaluate

Evaluate misleading truth signals; category reification; forced agreement; erased uncertainty; exposure of sensitive content; burdens on underrepresented participants; malicious or repetitive challenges; and unmaintainable technical complexity. Protection measures are use-case-specific and evaluated alongside usability. Retaining a revision trail does not imply indefinite retention of deleted sensitive content.

83.1.11 Expected implementation and pilot evidence

Use the initial cycle and proposed gates in the comprehensive plan and governance and pilot plan. Evidence includes a full challenge/revision cycle, preserved disagreement, a change in available evidence or categories, a traced enabling or constraining relation, restricted or absent evidence, and explicit failure handling.

Interoperability maturity requires independently implemented exchange of the declared features. Two datasets processed by one implementation do not demonstrate independent interoperability. A conforming structure does not establish substantive truth or legal validity.

83.1.12 Dependencies and schedule

Formal initiation depends on coherent programme governance and a recorded decision. Source work and synthetic preparation can proceed earlier. Delivery follows milestones M0–M5 rather than committed dates; capacity, funding and external participation remain OPEN.

83.1.13 Decision

- ☐ Accept
- ☐ Revise
- ☐ Defer
- ☐ Reject

No decision recorded. The initial review considers scope, responsible people, evidence needs and whether the proposal is best administered as one coordinated package or several linked work items.

83.1.14 Rationale

Pending work-item decision. The planning rationale is recorded in ADR-0003, which remains Proposed.

84 comprehensive development plan

Original source: `docs/planning/comprehensive_development_plan.md`.
Original source SHA-256: `49ba67c606cd2161523abbeb63291f8dc5d7ce69d66d8299342cdc788fd14e27`.

84.1 Comprehensive Development Plan

Document class: Informative programme planning
Status: PROVISIONAL — proposed work, not project approval or adopted requirements
Version: 0.1
Planning date: 2026-09-22
Basis: Confirmed programme orientation; Programme Brief; ADR-0002
Decision record: ADR-0003

Implementation update, 2026-09-22: The initial working-draft package implements the first authoring cycle: five governance drafts and GR-100/110/200/210, templates, synthetic cases and recorded review. M1 governance adoption, formal NWIP approval, independent domain review and participant pilots remain incomplete. No milestone is advanced solely because documents compile.

84.1.1 1. Purpose and intended outcome

This plan organizes development of epistemic and practical infrastructure for warranted recognition of reality, evaluation and revision of factual claims, and preservation of relational and generative trajectories. Its motivating problem is the symbolic crisis: instability in the connections among representations, their referents, institutional classifications, and practical trust. This is the programme's source-grounded diagnosis, not a claim that all representations or institutions have become unreliable.

The intended outcome is a family of shared practices and interoperable implementations through which people and institutions can investigate what happened, explain the grounds of a judgment, contest an interpretation, reconstruct changes over time, and understand how action changed conditions for further generation. Future re-recognizability, reinterpretability, and regenerability remain orienting capacities rather than guarantees of complete reconstruction.

The programme follows three distinguishable histories:

1. changes in the situation, relations, capacities, constraints, and possibilities under inquiry;
2. changes in evidence, claims, interpretations, judgments, and institutional responses;
3. changes in categories, methods, models, and recording or recognition regimes.

Their interactions matter. A classification can affect access and subsequent behavior; its efficacy does not establish its truth or legitimacy. A missing record does not establish nonexistence. An authenticated assertion can still be mistaken. Generativity can include maintenance, depletion, domination, or foreclosure as well as beneficial creation.

84.1.2 2. Scope, authority, and planning boundaries

This is a development plan, with candidate allocations and exit criteria for review. It does not adopt Standards, authorize external pilots, decide legal obligations, establish a certification body, or resolve open GR theory.

Publication or artifact	Role in this plan	Authority boundary
Governance directive or policy	Establish the programme's development, review, decision, and maintenance process	Authority depends on recorded programme adoption
Standards-track draft	Define purpose, scope, requirements, and conformance expectations	A draft becomes a Standard only through the established adoption process

Publication or artifact	Role in this plan	Authority boundary
Specification	Define implementable models, representations, algorithms, or interactions needed by draft requirements	Technical requirements apply within its declared scope and maturity; no automatic Standard status
Protocol	Specify participants, interactions, states, transitions, outcomes, and failures	A technical subject described in a Specification or adopted Standard, not a separate authority class
Manual and examples	Explain practical use and demonstrate intended behavior	Informative; examples do not add conformance requirements
Technical Report	Develop theory, unresolved semantics, comparisons, and research findings	Informative or experimental; no hidden normative dependencies
Policy or institutional proposal	Offer mandate-specific adoption, capacity-building, and governance options	Recommendatory; separate institutional decisions remain necessary

No storage platform, universal trust score, universal generativity metric, cryptographic system, or centralized truth authority is selected. External standards are candidate resources pending gap analysis and tests. Existing publication numbers and paths remain stable. Planning package labels below are not new publication codes.

84.1.3 3. Starting position and historical continuity

The repository contains a programme scaffold: governance outlines, preliminary standards scopes, three specification placeholders, an experimental mathematical report, and foundation manuscripts. No adopted technical Standard, validated schema, independent implementation, or completed pilot is evidenced by the present repository.

The earlier preliminary plan is retained as a historical draft. Its specification-first sentence in section 12 conflicts with accepted ADR-0002 and its own section 13. Current sequencing follows ADR-0002: normative need first, technical specification when needed, with pilot feedback before adoption.

The present plan broadens the earlier emphasis on archival loss and AI provenance to the confirmed epistemic and practical purpose. It brings evidence, contestation, institutional uptake, access, and conformance into initial development rather than postponing them until a record model is complete.

84.1.4 4. Development architecture

84.1.5 4.1 Motivation and objectives

The full programme exceeds the first implementation package. Comprehensive development combines a theory of the problem, a justified institutional process, domain-specific inquiry, operational requirements, technical behavior and evidence of practical effects.

Motivating problem	Programme objective	Evidence of progress, without promising social outcomes
Unstable connections between representations and their referents	Make grounds, methods, uncertainty and alternative interpretations inspectable	Reviewers can reconstruct why a claim was made and identify limits or counterevidence
Authority and acceptance can conceal weak warrant	Separate evidential assessment, institutional decisions and normative or legal judgments	Cases preserve those distinct judgments and responsible decision makers
Histories disappear behind final outputs and current classifications	Preserve relational, generative and epistemic trajectories under explicit limits	Later readers recover consequential changes, historical categories, alternatives and known gaps
Recognition and record control shape participation and resources	Support accessible challenge, correction and accountable practical response	Affected participants can exercise the procedure; barriers and unequal burdens are reported

Motivating problem	Programme objective	Evidence of progress, without promising social outcomes
Standards themselves can concentrate interpretive and infrastructural power	Establish transparent development, meaningful participation, appeals and maintenance	Decisions, conflicts, objections, resource constraints and routes to revision are inspectable
Present action can deplete future generative conditions	Examine capacities, enabling relations, foreclosed options and distribution across time	Pilots trace supported consequences and preserve uncertainty about effects not yet observable

Restored social trust, epistemic justice and sustainable generativity are long-term aims requiring separate evaluation. Passing tests or publishing a Standard does not demonstrate that those aims have been achieved.

84.1.6 4.2 Conceptual and technical separation

The conceptual layers remain metamodel, operational record vocabulary, epistemic representation, normative assessment, jurisprudential interface, institutional governance, political economy, and technical implementation. A record can connect these layers while retaining their distinct sources of warrant and authority.

The six candidate record classes remain Entity, State, Event, Process, Relation, and Property. Their adequacy and identity criteria are research and design questions. Observation, Claim, Evidence, and Interpretation are candidate epistemic roles; their realization as classes, relations, or wrappers remains OPEN. Part II's use of Attribute is not silently equated with Property.

The working development loop is:

```
flowchart TD
    A[Governance and source orientation] --> B[Normative problem and use cases]
    B --> C[Coordinated Standards Working Drafts]
    C --> D[Identified technical infrastructure need]
    D --> E[Specifications and protocol definitions]
    E --> F[Pilots and implementation evidence]
    F --> C
    F --> G[Committee and public review]
    G --> H[Recorded adoption decision]
    H --> I[Maintenance and renewed review]
    I --> B
```

Source analysis, synthetic examples, and editorial drafting can begin during governance preparation. Formal project initiation follows coherent governance and a recorded work-item decision. Standards and Specifications can co-evolve; adoption is not a prerequisite for prototyping.

84.1.7 5. Coordinated publication portfolio

84.1.8 5.1 Substantive domain programme

Each domain has its own questions, sources and reviewer competence. A technically valid record cannot settle these domains by serialization. The cross-domain programme develops the following allocations, their external sources and a worked institutional case.

Domain	Initial research and design deliverable	Route into the publication family
GR foundations and ontology	Source concordance; bounded operational definitions; identity, emergence and formal limitations	GR-TR101/102 inform GR-100/120 through recorded decisions
Epistemology and research methods	Warrant, evidential roles, alternative explanations, uncertainty, historical revision and inferential limits	GR-200/210; scoped representation in GR-SPEC-200

Domain	Initial research and design deliverable	Route into the publication family
Archival and information science	Appraisal, provenance, preservation, absence, custody, description and long-term interpretability	GR-110/140/160 with manuals and preservation profiles
Ethics and normative assessment	Value plurality, recognition, harm, responsibility, distribution of burdens and generativity return; reasoned tradeoffs	Informative analysis and GR-110/160/210/400 requirements where operationally justified
Jurisprudence and legal procedure	Legal concepts, claimed authority, evidentiary standing, identity, responsibility, rights and remedy under declared contexts	GR-300/310; contextual profiles and separately labelled model rules or policy proposals
Programme governance	Participation, representational balance, independence, consensus, appeals, contribution rights and maintenance	Charter, Directives and supporting policies; comparative process study
Institutional and public governance	Mandates, decision authority, contestability, oversight, repair and evidence-to-action procedures	GR-400; institutional profiles and governance manuals
Public and international policy	Problem analysis, organization-specific mandates, adoption alternatives, costs, capacity, pilots and evaluation	Policy/institutional proposals; technical needs enter the work-item process separately
Political economy	Ownership and control, unequal recording capacity, infrastructural dependency, contributions and allocation of benefits	Cross-domain impact studies; requirements review and institution-specific options
Technical infrastructure and human use	Semantic interoperability, protocol behavior, security, accessible presentation, validation and maintenance	GR-120/130/140/150; justified Specifications and implementations

Policy analysis and ethical or jurisprudential research can begin in parallel with governance and source work. Binding legal conclusions, organizational mandates and political choices remain separately warranted. International policy work compares at least a voluntary pilot, shared stewardship where feasible, and use of existing infrastructures or deferral; it identifies the intended organization or class and its actual decision authority before recommending adoption.

84.1.9 5.2 Existing project allocation

All allocations below are PROVISIONAL. The current scopes are starting points for work-item review. “Initial” means a bounded contribution to the first demonstrator, not completion of the entire publication.

Existing project	Normative problem and planned scope	Specification or supporting output triggered by need	Initial evidence and dependency
GR-100 — Foundations and Vocabulary	Distinguish reality, manifestation, representation, claim, evidence, judgment, identity, time, trajectory, and generativity; scope operational definitions	GR-TR101 source analysis; vocabulary mapping used by SPEC-120/200	Initial: definitions with examples, counterexamples, identity criteria and unresolved cases; foundation traceability

Existing project	Normative problem and planned scope	Specification or supporting output triggered by need	Initial evidence and dependency
GR-110 — Generativity Recording Requirements	Establish the minimum record needed for stated reconstruction and review purposes; record enabling conditions, uncertainty, alternatives and losses	Capture guidance in GR-M101; SPEC-120 record structures	Initial: reconstruct a decision and its grounds without treating a current summary as its full history
GR-120 — Generativity Information Model	Define implementation-neutral semantics, identity, temporal relationships, versions, and extension boundaries	GR-SPEC-120 implementable model and identifiers	Initial subset only after GR-100/110/200 needs; test contested identity and loss-aware conversion
GR-130 — Generativity Interchange Specification	Existing title retained; standards-track role is interoperability requirements and declared preservation of meaning	GR-SPEC-130 encodings, exchange behavior, protocol bindings and migration rules	Initial portable package; later independent implementations; depends on agreed semantic subset
GR-140 — Generativity Presentation Requirements	Make occurrence claims, evidence, inference, uncertainty, disagreement, revisions, omission, and mediation understandable	View profiles and presentation fixtures; machine binding only if reuse requires it	Initial: readers can distinguish current judgment from historical views and a restricted view from a complete archive
GR-150 — Conformance and Validation	Define conformance subjects, versions, profiles, test methods, exclusions, and claims	Validation rules and fixtures linked to the relevant Specifications	Initial test design alongside requirements; conformance never certifies substantive truth
GR-160 — Preservation, Privacy, Access, and Retention	Preserve interpretability while governing restricted access, correction, sealing, retention, deletion and custodial change	Access and lifecycle behavior in Specifications; preservation profiles and manual guidance	Initial restrictions and unavailable evidence; later migration and continuity trials
GR-200 — Epistemic Recording Framework	Distinguish assertions and their authors, targets, methods, evidence roles, perspectives, scope, uncertainty and revisions	GR-SPEC-200 epistemic structures linked to SPEC-120	Initial: multiple claims about one situation remain attributable and separately revisable
GR-210 — Evidence, Interpretation, and Contestation	Make grounds, counterevidence, alternatives, replies, reviews and dispositions inspectable	Review/revision procedures; SPEC-200 interaction semantics where needed	Initial: a challenge can alter a judgment or receive a reasoned disposition without erasing the challenge
GR-300 — Jurisprudential Interface	Represent asserted legal context, jurisdiction, source, authority and procedural status without creating legal validity	Informative analysis first; scoped legal metadata profiles after expert review	Initial boundary statement; fuller work after a named institutional use case and relevant expertise
GR-310 — Rights, Duties, and Procedural Profiles	Relate access, notice, objection, correction, restriction and review to a declared institutional basis	Mandate- or jurisdiction-specific profiles, reviewed separately	Initial generic procedural needs inform GR-160/210; legal entitlements remain context-specific

GR-400 — Governance and Institutional Use	Connect evidence and judgments to accountable decisions, review, practical response, and recorded downstream effects	Organizational profiles, manuals and pilot reports	Initial synthetic decision procedure; later voluntary institutional pilot with a declared mandate

GR-200 covers representation of epistemic status; GR-210 covers practices of assessment and contestation. GR-120 describes the semantic contract; GR-SPEC-120 realizes it technically. GR-130 and GR-SPEC-130 similarly separate interoperability obligations from concrete exchange behavior. Review identifies duplication before scopes are stabilized.

Normative and political-economy concerns cross the portfolio: whose contributions receive recognition, whose evidence survives, who bears recording costs, who controls access, and whose future possibilities are affected. Initially these are addressed through GR-110/160/210/400 and informative research. A separate normative-assessment publication is DEFERRED until a distinct, testable need and review competence are demonstrated. Generativity return remains an explicitly scoped research and requirements question, not an assumed quantity.

Supporting work includes GR-M101, GR-TR101, GR-TR102, examples, validation artifacts, and later mandate-specific policy proposals. Category-theoretic semantics remain experimental and are not on the critical path for the first demonstrator.

84.1.10 6. First development package

Retain the existing proposed identifier and title: **GR/NWIP-001 — Generativity Recording and Presentation Infrastructure**. The draft proposal defines a coordinated package, not an omnibus adopted Standard. Its first objective is to demonstrate a complete cycle of warranted recording, interpretation, challenge, revision, presentation, and practical response.

Use the programme's own documented decisions as the accessible first case. Pair it with a synthetic institutional case so success is not inferred from a single cooperative author. The package draws bounded requirements from GR-100/110/140/150/160/200/210/400 and creates only the SPEC-120/130/200 components those requirements need.

The candidate minimum demonstration includes:

1. A represented situation, a claim, its responsible source, the record creation time, and the time or interval asserted about the situation.
2. A trace linked as evidence for a specified claim, with the method, relevant limitations and at least one materially plausible competing explanation where applicable.
3. A consequential relation or contribution, its proposed continuity criterion, and a grounded account of how it enabled, constrained, preserved, or closed a later possibility.
4. A distinct challenge and response, with a revised or maintained judgment, its reasons, and a recoverable account of what was known earlier where retention and access permit.
5. A distinction between a change in the situation, a change in knowledge, and a change in classification or method.
6. A presentation that exposes relevant uncertainty, attribution, revision, and evidence availability without leaking restricted content; a protected fixture exercises correction and an authorized retention, deletion or access-withdrawal decision, including its effects on derived views.
7. A portable representation and a validation report that declare supported features and preserve disagreement through exchange.
8. A recorded institutional or participant response, plus a follow-up question about consequences; the record does not fabricate evidence for effects not yet observed.

These are proposed demonstration criteria, not mandatory facts about every future record. Unknown, unavailable, restricted, not assessed, and not applicable need distinguishable treatment when relevant. Feasible alternatives and causal-generative claims need their own grounds; the presence of a branch or dependency field does not establish them.

84.1.11 7. Candidate requirement themes and traceability

The labels below are planning references only. Stable normative clause identifiers will be assigned in the corresponding Working Drafts.

Planning theme	Candidate obligation to investigate	Lead projects	Demonstrating case
Attribution and epistemic scope	Identify whose claim is represented, its target, grounds, method and limits	GR-110/200/210	Accurate provenance attached to a disputed or false assertion
Temporal and identity discipline	Distinguish subject continuity, record versions, asserted time and recording/review time	GR-100/120/200	Backdated report; disputed identity; late evidence
Generative trajectory	Ground connections between earlier relations and later conditions; preserve relevant alternatives and loss	GR-110/210	Same final output, different enabling history or foreclosed options
Contestation and revision	Record challenge, response, disposition and revision reasons without forced agreement	GR-210/400	Unresolved disagreement survives publication and export
Protection and availability	Express access, retention and absence without assuming universal disclosure or indefinite retention	GR-160/310	Restricted evidence, withdrawn access and justified deletion
Presentation and practical uptake	Distinguish summaries and reconstructions from the record; expose the basis of action	GR-140/400	Viewer distinguishes an allegation, a judgment and a decision
Interoperability and conformance	Preserve declared semantics and disclose unsupported features or transformations	GR-120/130/150	Import/export does not silently merge claims or convert unknown into false

For each candidate clause, the planning record links: motivating problem → source or operational proposal → alternatives → decision → responsible publication → specification dependency → example or test → pilot finding → revision. The foundation map begins the conceptual traceability; it does not confer normative authority.

84.1.12 8. Milestones and dependencies

There are no committed delivery dates or staffing assumptions. A milestone advances when its evidence is available; preparation can overlap without bypassing governance or review. These planning milestones do not replace the programme's 00–90 document stages.

Milestone	Main work and output	Proposed completion evidence	Next work enabled
M0 — Orientation and scope	Source index, conceptual tensions, use cases, objectives, portfolio, comparative standards-development study, cross-domain agenda and candidate NWIP	Sources linked; source practices distinguished from proposed adaptations; current claims distinguished from proposed requirements; sponsor reviews scope	Governance drafting, domain research and bounded conceptual examples
M1 — Governance launch	Charter, Directives 1/2, committee mandate, review/decision/appeals, ethics/IP, maintenance and records arrangements	Founding authority, adopted procedures, responsible roles and a simulated contested decision are documented	Formal work-item decisions and committee drafting

Milestone	Main work and output	Proposed completion evidence	Next work enabled
M2 — Requirements baseline	Coordinated vocabulary and minimum clauses for the first package; conformance subjects; evidence and protection scenarios	Every proposed initial requirement has a purpose, owner, example/ test method and known limitation; source conflicts logged	Demand-driven specification work and synthetic implementation
M3 — Pilot-ready Specifications	Small semantic model, epistemic binding, portable exchange and necessary interaction behavior	One implementation exercises the complete cycle; negative fixtures and restriction behavior checked; no silent conversion losses	Controlled pilots and independent implementation
M4 — Pilot and interoperability evidence	Programme self-pilot and synthetic decision case for the initial package; AI-assisted research and incomplete archive for broader claims as material and capacity permit	Results report usefulness, burden, exclusions, failures and revisions; a separately built consumer/producer pair exchanges declared features when interchange maturity is claimed	Committee stabilization and public-review readiness for the evidenced scope
M5 — Review and adoption readiness	Committee review, horizontal review, public review, comment dispositions, revised artifacts and maintenance assignment	Review history and objections are inspectable; significant changes receive appropriate re-review; formal decision and edition are recorded	Publication of only the approved scope
M6 — Maintenance and extension	Corrections, compatibility monitoring, periodic review, new domains and optional protocol profiles	Maintainer and review triggers active; migration and withdrawal histories preserved; new needs enter work-item process	Revised editions and evidence-backed expansion

Epistemic, ethical, jurisprudential, institutional, political-economy, accessibility and technical review begin with scope and requirement formation, with privacy and test design explicit by M2. Before pilots and publication, a review dossier records the applicable domain questions, reviewers and competence, affected perspectives, evidence, conflicts, findings, dispositions and residual limitations. A domain cannot be marked complete merely because a field exists in a schema. An unassessed domain remains visible and limits claims or progression where material.

No external institution is presumed to participate. Real data use depends on the pilot's actual permissions, governance, and protection arrangements.

The governance and pilot plan supplies detailed proposed gates and cases. Its local gate labels are supporting detail; M0–M6 are the programme-level sequence.

84.1.13 9. Conformance design

Conformance is scoped to a subject: record or package, producing implementation, exchange implementation, presentation, archive service, or organizational procedure. A claim identifies the publication and edition, profile, features, limitations, assessment method, and assessor. Passing a syntax validator is one form of evidence, not an assessment of all these subjects.

Assessment distinguishes structural validation, preservation of declared semantic distinctions, protocol behavior, presentation comprehension, procedural performance, and substantive evidential judgment. The last remains contestable and context-dependent; programme conformance does not certify truth, moral goodness, legal admissibility, or complete historical coverage.

The existing proposed Core, Standard, and Deep/archival profile names are retained as unresolved candidates. Profile design first separates capability from recording depth: a small record can still need attribution, uncertainty, restriction and correction. Terminology such as "Standard profile" needs review to avoid confusion with publication status.

First-release criteria concern the bounded cycle in section 6. Wider federation, registries, cryptographic attestations, credential ecosystems, automated confidence aggregation, generativity measurement, and domain-specific legal profiles are DEFERRED until a requirement and credible evaluation justify their cost.

84.1.14 10. Protocols, specifications, and external reuse

The protocol and specification plan defines candidate interactions and their implementation triggers. An institutional procedure can be tested through a manual workflow before a network protocol is justified. A portable package is sufficient for early exchange if it demonstrates the required semantics.

The external standards landscape records verified candidate sources and their limits. Before selecting a dependency, a work item records the exact edition, reuse or extension boundary, semantic mismatch, licensing review where needed, maintenance responsibility, and an interoperability experiment. A cited standard is not evidence of compatibility.

Security and integrity requirements derive from the use case: misleading attribution, alteration, unauthorized access, hidden loss during exchange, conflicting revisions, and abusive review requests are concrete test cases. Evidence integrity and source authentication remain distinct from the validity of a claim.

84.1.15 11. Responsibilities and working rhythm

84.1.16 11.1 Learning from established standards development

The ISO/IEC, IEEE and WTO comparative study is a design input. It separates official source practice from the programme's proposed adoption, adaptation or deferral. The programme does not claim ISO or IEEE affiliation or procedural conformity.

Governance drafting evaluates transparent scope and work-item initiation; meaningful stakeholder participation and balance; documented consensus with reasons for unresolved objections; review and decision records; independent appeals; clear drafting and conformance boundaries; contribution/IP arrangements; and maintenance. Exact voting rules, timelines, membership structures and patent policies remain explicit local choices.

Two organizational approaches receive comparison: participation by individual experts and affected people, and organizational representation with safeguards for less-resourced participants. A hybrid is a candidate rather than an assumed solution. For a small programme, combining administrative roles is possible only with disclosed conflicts and an actual route for independent consideration of contested decisions.

The first governance drafting dossier records each borrowed mechanism, its purpose, its source, why it is proportionate here, its cost, the alternative, and how its effectiveness will be tested. A list of well-known standards bodies is not evidence that the programme's governance is credible.

84.1.17 11.2 Responsibilities and work cycles

Roles are proposed and unassigned unless separately recorded. A programme sponsor coordinates scope; the founding authority establishes governance; a designated editor owns each active deliverable; conceptual and epistemic reviewers assess interpretation; implementers test realizability; affected participants assess contestability and burden; access/ethics reviewers assess protection; the maintenance role owns published artifacts. The programme documents combined roles and conflicts where a small team cannot separate every function.

Each work cycle selects a small set of requirements and cases, drafts the relevant text, tests the proposed behavior, records disagreements and decisions, and updates dependencies. Parallel work is useful for source analysis, governance and use-case preparation; mutually dependent normative clauses are reviewed together. External participation, organizational structures and sustained staffing remain planning questions rather than existing commitments.

84.1.18 12. Immediate work queue

Order	Concrete next deliverable	Responsible role, currently unassigned	Completion evidence
1	Review this plan, draft NWIP-001, foundation map, comparative study and cross-domain agenda; select the bounded first case	Sponsor and programme editor	Recorded objectives, scope, exclusions, adaptations, unresolved questions and chosen case
2	Draft Charter and Directives 1/2 with the missing governance procedures and source-to-local-choice rationale	Founding authority and governance editor	Coherent launch package and explicit decisions on participation, consensus, appeals, IP and maintenance
3	Build a synthetic example distinguishing situation, claims, evidence, interpretation, decision and revision	Epistemic editor and pilot lead	Two competing accounts, changed evidence, protected material and a traced generative consequence
4	Prepare the coordinated GR-100/110/200/210 requirements subset with GR-140/150/160/400 constraints	Assigned document editors	Requirement-to-case and source-to-definition maps; no premature schema dependence
5	After governance launch, decide NWIP scope and Specification work items	Established decision body	Recorded decisions, owners and technical needs; pending proposals remain pending
6	Implement the smallest representation and interactions needed for the chosen cycle	Implementer and reviewer	Demonstration plus failures and burden report; revision proposals returned to draft requirements

This table preserves the initial work sequence. Items 2–4 now have first authoring outputs in the working-draft package: governance texts, P1 and the four preparatory technical drafts. Their institutional decisions and empirical assessment evidence are still incomplete. Item 5 awaits governance launch; item 6 has not begun. The review record identifies what was checked and what remains unassessed.

84.1.19 13. Risks, decisions, and expansion criteria

Risk or unresolved choice	Planned response and evidence
Ontology or formalism dictates what counts as real	Preserve source distinctions and explicit operational scope; test overlooked and disputed cases
Records turn acceptance or consensus into truth	Separate claim, assessment, institutional action and grounds; use counterexamples
Scope expands beyond team capacity	Limit the first cycle, reuse existing publication families, defer independent work without a justified need
Rich recording becomes surveillance or excessive labor	Measure burden and participation; minimize data; test selective disclosure and proportionate retention
History preservation conflicts with correction or deletion	Decide content, metadata and audit retention separately; retain only permitted traces; never promise immutable sensitive history
More structure creates false precision	Support unknowns and scoped judgments; avoid uncalibrated numeric confidence or universal generativity scores
One implementation defines the semantics	Use independently authored examples and implementations before claiming interchange maturity

Risk or unresolved choice	Planned response and evidence
Legal or institutional diversity is flattened	Develop bounded profiles under declared authority; keep policy recommendations separate
Established standards-body procedures are copied without capacity or legitimacy	Compare mechanisms, document tailoring, test them with real role availability and an appeal rehearsal
Ethical or public-policy choices are disguised as technical inevitabilities	Record alternative values and institutional options, affected perspectives and the authority making the choice

Decision priorities and unresolved theory are maintained in open questions. Expansion requires a demonstrated gap, identified users, a responsible editor, review competence and pilot evidence appropriate to the new scope. A need for research can produce a Technical Report without forcing a new Standard.

85 cross domain programme

Original source: `docs/planning/cross_domain_programme.md`.
Original source SHA-256: `669c071ef6364871666cea84d52123ebdf0b1653a5b77ff32b543fa3ef226e0c`.

85.1 Cross-Domain Research, Standards, and Institutional Programme

Document class: Informative programme planning
Status: PROVISIONAL development proposal; no adoption or institutional endorsement
Version: 0.1
Date and source check: 2026-09-22, Asia/Tokyo (2026-09-21 UTC)
Programme context: Comprehensive development plan

85.1.1 1. Purpose and development approach

The programme's scope includes the conditions under which people recognize reality, assess evidence, make judgments, act together, and preserve or reopen possibilities. A comprehensive development programme therefore needs substantive work in epistemology, jurisprudence, ethics, governance, political economy, public policy, archival practice, and technical design. These domains contribute objectives and constraints, not merely metadata fields for an already selected ontology.

The proposed organizing question is: **what practices and institutions make a factual or practical judgment inspectable, contestable, revisable, and appropriately actionable, under unequal conditions of knowledge and power?** Technical recording is one part of the response. Better records alone do not establish warranted beliefs, legitimate authority, justice, or beneficial outcomes.

This plan extends the multilayer architecture. It uses existing GR families; domain headings are work areas, not new publication numbers or ontology classes. Standards-track work identifies the normative problem first. Specifications follow demonstrated infrastructure needs. Technical Reports develop unresolved concepts and comparisons; manuals support practice; international policy proposals compare institutional choices. No draft is an adopted Standard.

All programme actions below are **GR operational proposals** unless explicitly described as source-derived. Foundation manuscripts remain the conceptual sources for GR terms. External instruments offer questions and constraints for review; they do not establish equivalence with GR or automatically become programme requirements.

85.1.2 2. Bounded external orientation and authority

Structural role: distinguish the nature of relevant source material before using it. These sources supplement the technical reuse landscape; they are not a normative dependency list.

Primary source, edition, and status	Source-derived orientation	Proposed use and limit
UNESCO Recommendation on the Ethics of Artificial Intelligence, adopted 23 November 2021; Recommendation	Addresses dignity, diversity, fairness, social/economic justice, environmental effects, human oversight, and ethical impact assessment.	Review AI-mediated recognition and institutional use across more than privacy. Its AI scope does not establish a complete ethical framework for every GR use.
UNESCO Recommendation on Open Science, adopted 23 November 2021; Recommendation	Addresses equitable participation, access, diverse knowledge systems, shared infrastructures, and scientific practice.	Examine recognition, knowledge access, stewardship, and capacity differences. Openness requires contextual treatment of legitimate restrictions.

Primary source, edition, and status	Source-derived orientation	Proposed use and limit
OECD, Mobilising Evidence for Good Governance, 2020; analytical report	Separates evidence quality from the governance of its use; identifies contestability, representation, transparency, and accountability alongside ethical, economic, and political considerations.	Develop institutional evidence-use questions. The report is analysis, not an adopted GR requirement or universally applicable legal rule.
OECD, Building Capacity for Evidence-Informed Policy-Making, 8 September 2020; analytical report	Examines individual skills, organizational capacities, and conditions enabling evidence use.	Plan training, staffing, participation, and evaluation alongside technical infrastructure. Institutional feasibility needs local evidence.
OHCHR official ICCPR text, adopted 16 December 1966, entered into force 23 March 1976; treaty	Relevant provisions include remedy (article 2), courts/tribunals (14), privacy (17), expression/ information (19), public affairs (25), and equality before the law (26).	Orient rights and procedure questions. Application depends on the provision, parties, jurisdiction, context, and applicable legal interpretation; no applicability finding is made here.
UNCITRAL Model Law on Electronic Commerce, adopted 12 June 1996, additional article 5 bis in 1998; model legislation	Official overview identifies nondiscrimination against electronic form, technological neutrality, functional equivalence, attribution, and receipt of data messages.	Examine electronic-record legal interfaces where relevant. A model law supplies legislative options; a GR serialization does not enact it or establish evidentiary admissibility.

Recommendations, analytical reports, treaty provisions, model legislation, technical standards, and local institutional policies carry different authority. Record that distinction whenever a source informs a requirement or policy option. A source's use of "standard" does not confer the programme's adopted-Standard status.

Access limits: UNESCO texts and OECD overviews/executive summaries were accessible. OHCHR's principal instrument page/PDF failed to open; its official covenant microsite supplied the text. UNCITRAL's page/PDF returned access errors, so this review uses its official-domain indexed overview, not a full clause analysis. No jurisdictional enactments, reservations, case law, or inaccessible normative requirements were reviewed. Detailed legal profiles require those additional sources and qualified review.

85.1.3 3. Substantive development domains

Structural role: give each domain its own questions, outputs, dependencies, reviewers, and evidence of practical usefulness. Proposed roles are unassigned.

85.1.4 3.1 Epistemology and inquiry methodology

Objective and questions: develop practices of warranted recognition, not only labels for confidence. What differentiates observation, testimony, trace, inference, interpretation, and institutional acceptance? How do methods establish their scope and limitations? How are counterevidence, absent evidence, conflicting accounts, and changing categories handled? When is judgment sufficiently supported for a specified action, while remaining revisable?

Outputs and dependencies: GR-100/200/210 standards-track requirements; source analysis in GR-TR101; a methods/assessment manual contribution; GR-SPEC-200 only for reusable representation and interaction needs. Depend on foundation interpretation, domain methods, presentation design, and institutional decision contexts. Keep empirical, interpretive, and normative warrant distinguishable rather than imposing one confidence scale.

Review and validation: epistemologists, qualitative and quantitative researchers, domain practitioners, and affected knowledge holders examine an inquiry with competing explanations. Test whether an independent reviewer can reconstruct the grounds, limits, and reasons for changed judgment, including whether important testimony was excluded by the recording categories.

85.1.5 3.2 Ontology, concepts, and formal semantics

Objective and questions: establish enough conceptual precision for interoperability while exposing the limits of operational categories. What makes a recorded subject persist? How do event, relation, and record identity differ? What changes when an institution changes its classification? Which theoretical distinctions are lost in a proposed formalization?

Outputs and dependencies: GR-100/120 drafts, GR-TR101 interpretation, GR-TR102 experimental semantics, and bounded GR-SPEC-120 models. Definitions remain grounded in manuscripts; unresolved formulations are preserved. Formalism is evaluated against epistemic, archival, and institutional cases rather than deciding their ontology in advance.

Review and validation: GR scholars, philosophers, formal-methods researchers, and implementers compare ordinary, disputed, and counterexample cases. Evidence includes explicit assumptions, mapping limits, and failures of equivalence. Category-theoretic work remains exploratory until it demonstrates an operational need; no mathematical representation is treated as proof of empirical or institutional legitimacy.

85.1.6 3.3 Archival practice and information science

Objective and questions: preserve interpretable evidence and trajectories through changing custody, formats, and descriptions. What is selected, excluded, appraised, or lost? Whose history survives? How are restricted evidence, custodial changes, retrospective description, and documented destruction handled without suggesting completeness?

Outputs and dependencies: GR-110/140/160 requirements, GR-M101 archival guidance, and GR-SPEC-120/130 packaging and migration details when needed. Compare existing archival approaches through the technical landscape. Depend on legal retention context, ethical access decisions, temporal semantics, and resource limits.

Review and validation: archivists, records managers, information scientists, community archives, and access specialists test an incomplete collection and a migration. Evaluate interpretability, recoverable relationships, disclosed losses, selective access, and maintenance burden. Preservation quality is not measured simply by the volume retained or made public.

85.1.7 3.4 Jurisprudence, legal recognition, and procedure

Objective and questions: investigate how legal systems recognize records, persons, contributions, authority, and procedural acts. Separate authenticity, reliability, admissibility, evidentiary weight, and a competent body's finding. Examine notice, reply, correction, restriction, confidentiality, privilege, retention, and review without assuming identical rules across institutions or jurisdictions.

Outputs and dependencies: informative comparative legal analysis first; scoped GR-300/310 profiles after review; interfaces to GR-160/210/400. Each proposal identifies the legal concept, forum, relevant actors, legal source and edition, asserted application, procedural consequences, and unresolved conflicts. A data field saying "right," "consent," or "binding" is a recorded assertion, not a legal conclusion.

Review and validation: relevant jurisdictional counsel, evidence/procedure scholars, institutional legal officers, and affected-party representatives examine a synthetic dispute before real deployment. Test whether readers distinguish a party's legal claim, an institutional policy, a pending proceeding, and an operative decision. Use the profile worksheet in section 4; no generic conformance result substitutes for legal analysis.

85.1.8 3.5 Ethics, value pluralism, and justice

Objective and questions: examine who benefits, who bears costs, who is heard, and which relationships or future possibilities are damaged. Include distributive justice, recognition, epistemic exclusion, autonomy, care, non-domination, ecological effects, and intergenerational consequences. How are conflicting values represented and reasons for prioritization made answerable to affected people?

Outputs and dependencies: an ethical-assessment Technical Report and deliberation guidance; candidate process requirements within GR-110/140/160/210/400 where testable. Cross-reference UNESCO's AI ethics and open-science recommendations within their scope.

Keep descriptive consequences, value commitments, and proposed remedies distinct. No universal ethical ranking or generativity score is proposed.

Review and validation: ethicists, disability/access specialists, labor and community representatives, and people bearing the proposed practice's costs examine alternative designs. Test inclusion of dissent, unjustified credibility discounts, unequal recording burdens, coercive visibility, and meaningful refusal. Evaluate whether review changes decisions and remedies harms, rather than treating completion of a checklist as evidence of ethical adequacy.

85.1.9 3.6 Institutional and public governance

Objective and questions: specify accountable uses of evidence in decision-making. Who sets categories, appoints assessors, controls access, can contest a finding, and provides remedy? How are conflicts of interest, unequal participation, institutional capture, urgent decisions, and failures to act exposed? Distinguish governance of this standards programme from governance of an institution using its outputs.

Outputs and dependencies: programme governance procedures; GR-400 organizational requirements; GR-210/310 review interfaces; decision-record and oversight manuals. OECD evidence-governance analysis motivates examining the conditions of evidence use alongside evidence quality. Depend on legitimate mandates, resourced review roles, ethics, and practical access.

Review and validation: public-administration specialists, institutional practitioners, civil-society participants, and independent oversight reviewers conduct a contested decision exercise. Assess who can trigger review, whether reasons address the challenge, whether remedial action occurs, and whether downstream effects are examined. More documentation alone is not evidence of accountability.

85.1.10 3.7 Political economy, contribution, and generativity return

Objective and questions: investigate ownership, infrastructural control, incentives, labor, access, and distribution of benefits. Who funds recording and preservation? Who can extract value, control classifications, or exclude contributors? How do documentation requirements alter bargaining power? Which maintenance, care, community, or environmental contributions remain invisible?

Outputs and dependencies: source-grounded research on contribution and generativity return; comparative institutional/economic Technical Reports; GR-110/160/400 candidate requirements for disclosure and contestable attribution; separate policy options for funding and stewardship. Generativity return remains a theoretical and operational research question, not an assumed monetary amount, entitlement, or contractual distribution rule.

Review and validation: political economists, labor researchers, infrastructure operators, community stewards, and contributors compare centralized custody, distributed stewardship, and existing repositories. Record cost allocation, exit/migration capacity, uncompensated work, access barriers, and concentration of control. A policy decision about benefit-sharing remains distinguishable from an empirical claim about contribution.

85.1.11 3.8 Public policy and international institutional options

Objective and questions: determine whether a public intervention is justified, for whom, under which mandate, and with what alternatives. Separate evidence about a problem and expected effects from political choices about priorities, funding, authority, participation, and acceptable risk.

Outputs and dependencies: mandate-specific proposals in the international-organizations track, using its policy template; options appraisal, theory of change, capacity-building plan, and evaluation design. Standards supply referenced technical requirements only after adoption; pilot Specifications are explicitly identified as experimental. Section 5 supplies initial options.

Review and validation: policy analysts, relevant institutional mandate/legal specialists, development and capacity-building practitioners, affected communities, and evaluators compare benefits, costs, alternatives, failure conditions, and exit paths. No organization is presumed to sponsor or participate; real pilots follow its own authorization and governance.

85.1.12 3.9 Technical implementation, security, usability, and accessibility

Objective and questions: implement the agreed practices without losing semantic distinctions or excluding participants. Can people inspect, challenge, correct, restrict, and move their records? What happens under forgery, coercive access, link failure, malicious submissions, conflicting updates, or inaccessible interfaces? Which tasks remain feasible offline or with limited resources?

Outputs and dependencies: GR-120/130/140/150/160 drafts, GR-SPEC-120/130/200, protocol behavior, conformance evidence, and user guidance. Use the protocol plan and verified external candidates. Security mechanisms follow threat analysis; accessibility assessment includes assistive technology, language, comprehension, bandwidth, and supported human alternatives.

Review and validation: independent implementers, security/privacy specialists, interaction designers, accessibility practitioners, and users test positive and failure cases. Combine semantic exchange tests with task-based comprehension and contestation exercises. Technical validation, source authentication, evidential assessment, ethical judgment, and legal status receive separate results.

85.1.13 4. Legal and institutional profile worksheet

Structural role: make proposed legal interfaces reviewable without universalizing a local conclusion.

Element	Information to establish for a concrete profile
Concept and action	For example electronic writing, evidentiary weight, notice, confidentiality, access, correction, preservation, or remedy; precise operation affected
Context and competence	Named jurisdiction, institution/forum, actors, territorial and temporal scope, and decision-maker's asserted authority
Basis and status	Exact instrument/provision/version; treaty, enacted rule, case, institutional policy, model rule, or proposal; application and interpretation verified separately
Evidence and procedure	Material relied on, evidentiary assessment method, ability to respond, relevant deadlines, notice route, review/appeal and remedies
Tensions and exclusions	Conflicting duties, confidentiality versus disclosure, preservation versus disposal, cross-border issues, unresolved authority, and unavailable evidence
Technical implication	Limited record/protocol behavior implementing the reviewed profile; distinctions and assumptions retained in exchange and presentation

The initial output is a worksheet completed for a synthetic institution, with legal applicability left OPEN. A live profile needs named expertise and current primary legal sources. Treaty guarantees are not mechanically converted into software permissions, and UNCITRAL's commercial-law model is not presumed applicable to noncommercial archives or public decision processes.

85.1.14 5. International policy options and institutional fit

Structural role: compare institutional arrangements rather than presenting technical adoption as an inevitable political choice. The audiences below are possible recipients, not partners or endorsers.

Possible audience and relevant remit	Candidate proposal	Mandate boundary to verify
UNESCO-related science, education, culture, and information communities	Voluntary research/knowledge-preservation pilots, inclusive participation, and capacity-building, informed by the two recommendations above	Specific programme authority, funding, participant protection, and relation to existing open-science infrastructure
OECD public-governance and policy-evaluation communities	Comparative study of evidence-to-decision practices and organizational capacities	Participation arrangements and policy-learning remit; no assumption of legal authority over national decisions
Institutions considering electronic-record legislative reform, informed by UNCITRAL work	A bounded comparison of technical record functions with locally relevant legal requirements	Commercial scope, actual enactment, competent lawmakers and courts; no claim that GR itself supplies a model law
Human-rights and oversight bodies within their respective mandates	Review of participation, unequal recognition, disclosure, and remedies in proposed pilots	Competence, independence, procedural basis, and protection of affected people; no assumed infrastructure-operating mandate

Every policy proposal compares at least these plausible options where relevant: improve practices using **existing infrastructure**; run a **voluntary bounded pilot** with reversible commitments; develop **shared stewardship** with explicit representation, funding, custody, and exit arrangements; or **defer adoption** while improving evidence, capacity, or safeguards. A broader rollout depends on demonstrated benefits, burdens, and institutional authority.

Appraisal records the baseline, intended beneficiaries, theory of change, costs and opportunity costs, distributional effects, implementation capacity, procurement/control arrangements, safeguards, independent evaluation, and conditions for stopping or revising the intervention. Empirical findings inform these choices; they do not resolve value conflicts or determine the politically legitimate option by themselves.

85.1.15 6. Worked case: contested research-funding decision

Structural role: demonstrate cross-domain distinctions in one synthetic example, without alleging facts or legal duties about a real institution.

A fictional public research fund rejects a community-led project after an AI-assisted summary describes its water-monitoring evidence as unreliable. A reviewer had treated missing instrument-calibration metadata as evidence that no calibration occurred. Community participants provide a restricted maintenance log and oral testimony. They also challenge the funding criteria's treatment of local knowledge. A reconsideration panel later changes its assessment; a small contributor's work still lacks recognition.

Layer	Distinct account and proposed recording/review question
Situation and trajectory	Equipment use, measurements, collaboration, rejection, and later reconsideration are subjects of inquiry. What records support each account, and what capacities were interrupted by the delay?
Evidence and interpretation	The initial reviewer inferred unreliability from missing metadata; the log and testimony offer counterevidence. Record method, provenance, limitations, and rival explanations; neither a missing field nor a valid signature decides the factual question.
Categories and methodology	The fund's scoring rules privilege certain evidence formats. Examine their purpose, validity, and exclusions separately from whether the project satisfied them. A changed rule needs its own history.

Layer	Distinct account and proposed recording/review question
Normative assessment	Participants argue that dismissal of local testimony was unjust and burdens were unequally allocated. Preserve their reasons and counterarguments; the record does not translate this judgment into a universal ethics score.
Legal/procedural position	A participant asserts a right to reconsideration. Record the asserted basis, relevant forum and unresolved applicability; a legal reviewer identifies actual rules before representing an entitlement or violation as determined.
Institutional decision	The panel records authority, recusals, evidence considered, reasons, notice, and disposition. A revised funding decision is distinct from accepting every factual or normative argument.
Political economy and return	Document uncompensated evidence-production labor, repository control, contribution disputes, and funding effects. Recognition, compensation, and future access are separate policy choices requiring reasons.
Preservation and implementation	Maintain authorized access to earlier assessments and the restricted log, disclose public-view limits, and exchange the revised account without erasing dissent or leaking contributors' details.

Pilot evaluation asks whether a participant can understand and challenge the initial reasoning; an independent reviewer can recover the change; protected contributors remain protected; and the institution can demonstrate its response. Follow-up examines actual effects on research participation and capacity. It does not infer restored trust, justice, or generativity from a corrected database entry.

85.1.16 7. Cross-domain review and sequencing

Structural role: make interdisciplinary review part of development decisions, before institutional use and publication.

At requirements development, each work item identifies its conceptual, epistemic, ethical, legal, institutional, economic, archival, and implementation dependencies. Editors document alternatives and disagreements jointly; a technical convenience does not silently settle a dispute about rights, values, authority, or knowledge.

Before a real-data pilot, proposed readiness evidence includes a scoped purpose and institutional basis; affected-participant involvement; proportionate data/custody arrangements; ethics and rights review; accessible challenge and remedy routes; security assessment; resourced oversight; and explicit stop/revision conditions. Missing expertise leads to a narrower synthetic case or deferred live use, not an unsupported assurance claim.

Before public review or publication, each relevant domain supplies a review record with reviewer competence, conflicts of interest, examined cases, unresolved objections, and disposition. Technical exchange, evidential usefulness, procedural legitimacy, accessibility, burdens, distributional consequences, and preservation remain separately assessed. Significant cross-domain changes return to affected reviewers.

Immediate outputs are a domain responsibility/dependency map, the synthetic funding case, initial legal-profile and policy-options worksheets, and a common issue register. Subsequent work develops the smallest coordinated GR-100/110/140/150/160/200/210/400 requirements subset; scoped GR-300/310 legal profiles advance when a concrete context and expertise exist. New independent publications follow demonstrated needs rather than multiplying family numbers now.

OPEN: reviewer recruitment and representation; which institutional context to study first; appropriate evidence for practical benefits and burdens; contribution/return operationalization; differences among knowledge traditions and methods; and when unresolved value or legal conflicts require narrowed scope. Record dispositions in open questions and architecture decisions where appropriate.

86 event spacetime design

Original source: `docs/planning/event_spacetime_design.md`.
Original source SHA-256: `fc4885d0eaacfd3329f45325aff5ae86a2470d30697fdaefc702c720eb148e18`.

86.1 Event order, trajectories, and relational configurations

Document class: Informative design proposal
Status: PROVISIONAL; EXPERIMENTAL version 1 implementation scope
Date: 2026-09-22
Purpose: Explain the source basis, distinctions, and limits of an event-defined spacetime presentation for the generalized application.

This document is an operational design proposal. It is not an adopted Standard, a complete formal semantics of GR, or a claim that the application reconstructs reality without interpretation. The Programme Brief, foundation manifest, and record graph review supply its programme context. The companion implementation Specification defines the exact machine contract.

86.1.1 1. The requested view

The requested space is the topology of the represented ontological configuration at an event-defined temporal cut: which Entity, State, Event, Process, Relation, and Property accounts apply, and which represented connections can be shown together. It is not necessarily geographic space. A physical location or coordinate can be recorded through the existing State or Property roles, with its subject, reference system, context, grounds, and temporal applicability made explicit.

The view has three coordinated parts:

- an event-order graph showing explicit precedence assertions;
- a graph of records whose temporal applicability supports inclusion at the selected cut;
- trajectories showing how related descriptions enter and leave applicability across event boundaries.

The ordinary record graph remains available. Its full inventory is useful even when temporal scope has not been supplied. A temporal view does not retrospectively supply that missing information.

86.1.2 2. Foundation passages and their operational consequences

Page numbers refer to one-based pages of the supplied PDFs. Findings below distinguish what the manuscripts say from the new engineering choices.

Source read	Finding	Consequence proposed here
FM-007, Metamodel II, section 9.2, pp.38–39	Occurrence indices, transition descriptions, and records of occurrences have different roles. Several records can concern one occurrence; repeated occurrences can share a transition description.	Record UUIDs identify retained accounts. Matching timestamps, labels, or effects do not automatically merge events or establish target identity.
FM-007, section 9.5, p.41	A database change can reflect corrected observation of an earlier target event. Inquiry history and target history have distinct carriers and update meanings.	Separate Git revisions from represented event order and temporal applicability.

Source read	Finding	Consequence proposed here
FM-007, section 9.7, p.42	The text explicitly proposes “A partial-order event record” that retains known precedence while leaving unrelated events unordered. It leaves the extension as a modeling obligation beyond the sequential base.	Adopt a bounded explicit precedence graph. Do not claim that the manuscript already supplies the proposed interchange module.
FM-007, section 9.7, p.42	Coarse timestamps can give apparent simultaneity; overlapping events can resist a faithful total order. Deriving an endpoint from a partial order requires justified treatment of its linearizations and any commutation assumptions.	Do not equate an order layer with physical simultaneity. Version 1 projects applicability assertions without executing event effects.
FM-007, section 12.6, p.59	Sequence position, elapsed duration, calendar position, and historical periodization answer different questions.	An event frontier is not a measured duration, calendar timestamp, or universal historical period.
FM-007, section 15.3, p.72	Joining transitions with mismatched endpoints can conceal an unrecorded intermediate step. Coherence of an event chain does not establish actual occurrence.	Do not invent intermediate states, replay unsupported transformations, or equate projection consistency with factual warrant.
FM-007, sections 15.4–15.5, p.73	A continuing entity can have different states. Attributes and incidence require context to preserve change.	A subject can group several temporally scoped descriptions; grouping does not make their contents timeless.
FM-005, GRE Chapter 5, section 5.14.1, pp.114–115	Relational trajectories require a continuity criterion, observational horizon, temporal resolution, boundary, and scale. Latency and gaps remain possible.	Explain the basis of subject grouping. Preserve unknown intervals and distinguish disappearance from the screen from historical dissolution.
FM-005, section 5.14.2, pp.115–116	Generative trajectories concern historically connected contributions; precedence alone is insufficient, and alternatives can remain unrealized.	The view is a temporal reconstruction aid. It does not label every displayed path a causal or generative explanation.
FM-005, section 5.20.4, pp.172–173	Historical revision changes present knowledge of the past while preserving earlier claims and their evidential conditions.	Select both a recording revision and a temporal cut. Later insertion can change a current reconstruction without changing earlier Git snapshots.

86.1.3 2.1 An event-scope difference that remains explicit

FM-004, GRE Chapter 4, section 4.15.2, pp.116–117, describes a relational event as a temporally delimited reconfiguration consequential for later relations. It permits extended duration and retrospective recognition. FM-007, sections 9.5–9.6, pp.40–41, also retains renewals and failed attempts that can leave a selected state unchanged.

These formulations address different analytical questions. The application does not silently replace either. Its Event role identifies an operational occurrence account. Version 1 uses selected Event references as boundary markers for a declared reconstruction. That narrower use does not assert that every GR event is instantaneous, consequential at every scale, or fully understood by its recorded transition.

86.1.4 3. Three independent coordinates of a view

Every projection identifies the following:

1. **Recording revision:** the Git snapshot containing the accounts and their versions.

2. **Event cut:** a selected downward-closed set under that snapshot's usable precedence assertions.
3. **Presentation selection:** filters, layout, grouping, and omitted or unresolved records.

For example, a user first records a dissolution event and later discovers the formation event that preceded it. The later Git revision can contain both events and an explicit formation-before-dissolution account. The represented chronology follows that assertion. The earlier Git revision still records what had been retained before the discovery.

Git commit timestamps do not determine target time. The descriptive `occurred_at` field remains useful context, but version 1 does not parse it into mandatory event precedence. Drawing one node above another likewise adds no precedence assertion.

The account's modality and epistemic basis remain visible. A hypothetical occurrence can be recorded; it does not become actual because its graph has no cycles. Mixing incompatible scenarios can require a narrower account selection in a future profile.

86.1.5 4. Explicit event-order accounts

An order assertion is a first-class Relation record. Its `gsp.event_order` version `1` module carries `before` and `after` Event-record references. Its ordinary `gsp.relation` module carries the matching two target incidences. The required module declares that temporal interpretation is needed to handle the account correctly; it does not turn the assertion into an established fact.

The ordinary record retains attribution, epistemic mode, modality, assessment/dispute status, evidence, uncertainty, revision reasons, and relevant qualifications. The temporal projection therefore remains connected to the statement responsible for an edge.

The selected interpretation is strict precedence between operational boundary markers. Its transitive closure can support additional precedence conclusions. The implementation distinguishes submitted edges from derived reachability and does not create extra source assertions merely because a path exists.

An untyped navigation link, an arbitrary Relation predicate, and a directed incidence are insufficient to assert precedence. Event order also does not establish causal influence or a generative contribution.

86.1.6 4.1 Contradictions and disputed assertions

Structural checks establish whether the typed references and module shapes are interpretable. They do not establish that every temporal assertion is compatible with every other one.

Contradictory precedence accounts remain recordable. A directed cycle prevents the selected edge set from defining a strict partial order. The projection reports `consistent: false`, identifies the affected assertions, and provides no admissible-cut projection until the conflict is resolved or the selected account changes. It does not silently drop an edge or impose an arbitrary order.

Withdrawn order accounts are omitted from the active ordering, while their records and histories remain available. Contested order accounts remain included with visible qualification. Inclusion means that the projection is conditional on those assertions; it is not an endorsement. User-selectable alternative chronology sets and richer adjudication are future work.

Unsupported retained event-order versions also prevent a complete cut/topology projection, even if an older producer marked that module optional. Their constraints cannot safely be omitted from a claimed complete ordering. The result identifies `unsupported_event_order` and `consistent: false`; this flag concerns a usable interpreted order, not truth. Unsupported temporal extents instead make the affected account's presence indeterminate, with a diagnostic, while leaving an otherwise usable event order available. Opaque modules remain retained.

86.1.7 5. Cuts, frontiers, and the limits of "same time"

For a selected acyclic event relation, write `a < b` when there is a directed precedence path from `a` to `b`. A cut `C` includes all predecessors of each included event:

```
b is in C and a < b  =>  a is in C
```

This is a downward-closed set, also called an order ideal. The frontier is its set of maximal included events. Including a later event includes its known predecessors; removing an included predecessor requires removing its included successors. These are consistency rules for navigating an account, not rules governing reality.

If neither `a < b` nor `b < a` is supported, the events are incomparable in this account. This does not by itself establish simultaneity, physical independence, overlap, or absence of a causal connection. An unrecorded order can still exist.

Topological layers can arrange the event graph compactly. Their layer numbers are display coordinates. Equal layer numbers do not assert equal occurrence times; different layer numbers do not establish precedence between every pair.

A frontier describes a configuration relative to the available order and applicability claims. It need not correspond to one uniquely identified physical instant. There can be several admissible cuts through unordered activity. Version 1 keeps the event graph and selected cut explicit instead of presenting one arbitrary total replay as the recovered history.

86.1.8 6. Temporal applicability and trajectories

The required `gsp.temporal_extent` version `1` module can accompany any record role. It contains `start`, `end`, `basis`, and an optional `subject_record_id`.

Each boundary has one of these forms:

Boundary form	Interpretation
`{kind: event, event_id: ...}`	Applicability is bounded by the referenced operational Event marker.
`{kind: unknown}`	The boundary has not been sufficiently established.
`{kind: unbounded}`	No limiting boundary is asserted on this side within the declared account's scope.

An unbounded boundary is a positive scope statement. It is not the default meaning of missing data and does not establish that a target has existed or will exist throughout all time. The `basis` explains the grounds and scope of the applicability account, including relevant continuity assumptions or uncertainty.

Version 1 uses start-inclusive, end-exclusive applicability: an included start marker opens the interval, and an included end marker closes it. If both boundaries name events, their strict start-before-end order needs support in the selected event relation. Without that support, the extent remains indeterminate and receives a diagnostic. The extent itself does not invent the missing precedence edge. Equal or reversed markers do not receive an invented positive duration.

86.1.9 6.1 Classification at a selected cut

The projection distinguishes:

- `active`: the declared boundaries support applicability at this cut;
- `not_started`: the supported opening boundary has not been crossed;
- `ended`: the supported closing boundary has been crossed;
- `indeterminate`: supplied temporal information is insufficient or inconsistent for a definite applicability result;
- `unscoped`: no temporal extent was supplied;
- `withdrawn`: the account is withdrawn and remains available for inspection outside active topology.

Unknown and absent boundaries remain visible. They are excluded from the active topology by default, with counts and an inspection path. A display can include them as explicitly qualified context; it cannot silently promote them to active. Missing temporal data is not a claim of nonexistence.

An unknown boundary can prevent a positive active result even when the other boundary is known. Where a known bound supports a narrower statement, the interface can identify it without treating the unknown bound as resolved. Exact classification priority and diagnostics belong to the implementable projection contract.

86.1.10 6.2 Subject grouping and continuity

The optional `subject_record_id` associates a temporally scoped description with a subject account for trajectory presentation. For example, several State records can describe different conditions of the same organization under a stated continuity criterion.

The reference is a supplied grouping claim, not an identity proof. Its basis matters, especially across renaming, merger, dissolution, succession, or disputed continuity. The renderer does not merge records automatically because their titles match, their endpoints coincide, or they occur in adjacent layers. Without a grouping claim, a record can retain its own temporal trace.

Competing State accounts can both remain visible. This version does not select a unique true state, impose property exclusivity, calculate a next world state, or decide which account defeats another.

86.1.11 6.3 An Event boundary is not its record's lifetime

The Event marker used by the ordering graph identifies a represented boundary in the inquiry. Its recording account can remain available in every later Git snapshot. Availability of that account does not mean the event is still occurring.

Likewise, attaching a temporal extent to an Event-role record scopes the account's applicability under this profile. It does not silently redefine the represented event's physical duration. The separate event-order diagram continues to show the selected event inventory and cut frontier. This avoids disappearing historical occurrences merely because an ontology configuration uses a narrower applicability filter.

Extended events, onset/completion distinctions, interval overlap, and the relation between an event's occurrence interval and its use as a boundary require a richer profile. They remain explicitly deferred rather than being approximated through creation timestamps or arbitrary zero-length intervals.

86.1.12 7. Constructing the topology

At a consistent cut, the primary topology is induced by the records classified as active. Every active record remains a node, including a Relation whose participants are not all established active. An edge is retained only when both endpoint records are active. A Relation with omitted participant incidences or an explicitly incomplete participant account receives a `partial_relation_at_cut` diagnostic identifying the omitted incidences. The interface preserves its full account for inspection and does not present the displayed subset as a complete relation.

This induced-subgraph policy preserves access to an active relational account instead of removing it because another account lacks temporal scope. It also avoids inventing active participants to complete the picture. Keeping the Relation node is a presentation of its scoped account, not a claim that every part of the relationship has been reconstructed.

Relations retain their own IDs and histories. An independently recorded relation can appear, change through a separately scoped account, or cease to apply without changing its participants' identities. The existing incidence representation continues to support n-ary relations and relations whose participants are relations.

Record scope, relation participant completeness, and hidden display filters remain separate limitations. An active Relation with an explicitly incomplete participant account still needs that qualification even when every retained participant is active.

The graph is a projection of temporal assertions at one recording revision. It is not produced by replaying Git edits as world events, and it is not a simulation of all event effects. In particular, unordered events with potentially incompatible effects do not receive a fabricated outcome through identifier sorting.

86.1.13 8. External reference boundaries

Lamport's 1978 paper, pp.559–560, supplies a precise comparison for partial event order and logical-clock displays. Its concurrency relation does not require equal physical time. Its assumptions concern distributed processes and messages; the application does not infer that those assumptions hold for historical or social records. The proposed cut and applicability rules are this programme's declared operational choices.

The 2017 W3C Time Ontology Recommendation, sections 3.1–3.3, distinguishes instants, intervals, interval relations, temporal reference systems, and temporal granularity. It is a useful comparison for a later interval profile. Version 1 neither implements the full ontology nor claims RDF/OWL interoperability. The version-specific citation matters: the generic OWL-Time publication URL currently resolves to a 2022 Candidate Recommendation Draft.

86.1.14 9. Discriminating review cases

Case	Expected design result
A later event is recorded before an earlier event	Explicit precedence determines represented order; Git retains insertion order independently.
Two events have no supported order	They remain incomparable; shared display position does not assert simultaneity.
Two accounts assert opposite strict orders	Both survive; the selected ordering is diagnosed as inconsistent and no cut topology is asserted.
An order account is contested	Its qualifications remain visible and the projection discloses its conditional inclusion.
A State has two boundary events with no supported precedence	The extent is indeterminate; no order is inferred from the extent alone.
An old agreement has no temporal module	It appears as unscoped context, rather than being assigned the date of its first commit.
A Relation is active while a participant's applicability is unknown	The relation's boundary context is exposed; the active graph does not display a complete unsupported arrangement.
Two scoped State accounts make incompatible claims about one subject	Both remain inspectable; temporal projection does not silently adjudicate them.
A later correction changes the claimed onset	The current reconstruction changes; the earlier Git revision still shows the earlier claim.
An Event record remains in later snapshots	Record retention does not imply continued event occurrence.

86.1.15 10. Remaining questions

- **OPEN:** How should users select competing coherent chronology accounts while preserving the sources, exclusions, and reasons for each selection?
- **DEFERRED:** How should extended events, intervals, overlap, approximate calendar dates, and multiple temporal reference systems interact with event boundaries?
- **OPEN:** Which subject-continuity and relation-continuity criteria are suitable for particular domains, and how should competing criteria be compared?
- **DEFERRED:** When should a profile interpret event effects as transformations, and what evidence or formal conditions justify equal outcomes across different linearizations?
- **OPEN:** Do users understand the distinction between a cut, an order layer, an actual time, an unknown interval, and a recording revision? Browser correctness alone does not establish that comprehension.

The implementation advances a bounded presentation capability under the existing temporal and epistemic requirements. It leaves causal inference, complete historical reconstruction, and the broader theory of generativity available for further work.

87 external standards landscape

Original source: `docs/planning/external_standards_landscape.md`.
Original source SHA-256: `44657068d390d7b236756d3558d4ed7776f84ba31f59dfb220e121ae7b33b969`.

87.1 External Standards and Specifications: Candidate Reuse Landscape

Document class: Informative research and planning document
Status: PROVISIONAL candidate assessment; no dependency selection
Version: 0.1
Checked on: 2026-09-22, Asia/Tokyo (2026-09-21 UTC)

87.1.1 1. Purpose and evidence boundary

This bounded review identifies external resources worth evaluating for the protocol and specification plan. The source descriptions below report published scope; proposed GR uses and limitations are programme planning judgments. They do not establish a mapping, conformance, interoperability, or endorsement claim.

This is the technical reuse component of the research. The standards-development comparison covers ISO/IEC, IEEE and WTO procedural approaches; the cross-domain programme covers normative, legal, institutional and policy sources.

Official publisher pages and freely available technical documents were checked. This is an initial scope/status review, not a clause-by-clause compliance or intellectual-property assessment. No inaccessible or paywalled normative requirements are inferred. Dates identify the editions inspected, not a guarantee that each is the newest available edition.

A reuse decision still needs a motivating GR requirement, a precise version/section, candidate mappings and counterexamples, licensing and maintenance review, implementation evidence, and an explicit decision record. External terms retain their own definitions: matching names do not establish conceptual equivalence.

87.1.2 2. Verified source register

Structural role: record the exact primary sources inspected and candidate programme destinations. The checked-on date above applies to every entry.

Source and inspected edition	Official source and observed scope/status	Candidate GR destination
PROV-O, 30 April 2013	W3C Recommendation: PROV-O. OWL representation of provenance with entities, activities, agents, derivation, attribution, and qualified relations.	GR-110/120/200/210; GR-SPEC-120/200 provenance mappings
Web Annotation Data Model, 23 February 2017	W3C Recommendation: Web Annotation Data Model. Annotation bodies and targets, including targeting parts or states of resources.	GR-140/200/210; GR-SPEC-200 annotation and evidence targeting
Time Ontology in OWL, 19 October 2017	Published 2017 OWL-Time Recommendation. Temporal instants, intervals, ordering, durations, and reference systems.	GR-100/110/120/140; GR-SPEC-120 temporal representation
JSON-LD 1.1, 16 July 2020	W3C Recommendation: JSON-LD 1.1. JSON serialization of Linked Data, with contexts and identifier/term interpretation.	GR-130; GR-SPEC-130 candidate serialization
SHACL, 20 July 2017	W3C Recommendation: Shapes Constraint Language. Validation of RDF data graphs against shapes and production of validation reports.	GR-150; validation artifacts for GR-SPEC-120/130/200 if an RDF representation is selected

Source and inspected edition	Official source and observed scope/status	Candidate GR destination
HTTP Semantics, RFC 9110, June 2022	RFC Editor: RFC 9110. IETF Standards Track, STD 97; methods, representations, request conditions, and responses.	GR-130; eventual GR-SPEC-130 HTTP binding
C2PA Technical Specification, version 2.4	C2PA: Content Credentials technical specification 2.4. Technical architecture for signed content provenance manifests, validation, and trust-model handling.	Optional GR-110/130/140 evidence/provenance import; GR-SPEC-130 adapter if a media pilot requires it
PREMIS Data Dictionary, version 3.0	Library of Congress: PREMIS version 3.0. Official indexed overview identifies preservation Objects, Events, Rights, and Agents; full dictionary updated November 2015.	GR-160 and GR-SPEC-120/130 preservation/migration metadata mapping

Version observations: the unversioned OWL-Time publication URL displayed a later Candidate Recommendation Draft dated 2022, so it is not interchangeable with the 2017 Recommendation cited above. The C2PA site exposed 2.4 alongside earlier versions; this review inspected the 2.4 technical specification without claiming programme adoption. PREMIS overview content was available through the official-domain search index; direct page opening failed, and its full dictionary/errata have not been reviewed here.

87.1.3 3. Candidate uses, boundaries, and mapping experiments

87.1.4 3.1 PROV-O

Proposed use: test whether shared provenance vocabulary can express capture, transformation, contribution, and revision without inventing equivalent mechanisms. Its qualified-relation patterns are relevant where a relationship itself needs descriptive detail. Source

Boundary: `prov:Entity`, `prov:Activity`, and `prov:Agent` are source terms, not declarations that GR Entity/Event/Process have identical admissibility or identity criteria. Provenance attribution does not establish the truth of attributed content or its ethical/legal legitimacy.

Experiment: map one observation record, its recorder, an inference, a revision, and two competing interpretations. Record unsupported GR distinctions and reverse-mapping losses. Keep any extension local and explicit until review.

87.1.5 3.2 Web Annotation Data Model

Proposed use: target a claim version, document passage, or evidence fragment with an attributed interpretation, objection, or reply. Inspect selectors and states for durable references to the relevant material. Source

Boundary: an annotation model does not by itself provide an institution's review authority, required response, adjudication process, or a settled account of evidentiary weight. A reference to a changing resource needs an explicit version/selection policy. Annotation content and the occurrence it discusses remain distinguishable.

Experiment: transport an objection about one passage, then revise or restrict the source. Test correct targeting, accessible historical context, and informative handling of unavailable material. Evaluate network annotation protocols separately only if the pilot needs them.

87.1.6 3.3 OWL-Time

Proposed use: represent ordered or overlapping intervals, instants, durations, and temporal reference systems. Source

Boundary: temporal vocabulary does not select which times a GR record needs. Occurrence time, observation time, recording time, assessment time, and version/publication time remain different roles. A precise timestamp format does not warrant precision in the underlying knowledge.

Experiment: map an approximately dated historical account, an observation interval, a retrospective assessment, and a later correction. Test unknown bounds, inconsistent chronology, and partial order without manufacturing certainty. Record which cases require a GR profile beyond the source vocabulary.

87.1.7 3.4 JSON-LD 1.1

Proposed use: evaluate a graph-oriented interchange option with explicit terms and identifiers that can be serialized as JSON. Contexts define how compact terms are interpreted. Source

Boundary: serialization does not supply GR semantics, access control, evidence assessment, validation rules, or preservation policy. Familiar JSON appearance does not eliminate the need to test linked-data processing and context management.

Experiment: exchange the minimum pilot package between two implementations; preserve terms, identifiers, language information, and defined extensions. Assess context versioning, offline interpretation, dependency availability, and loss on conversion. Compare total implementation burden with a simpler documented interchange before selection.

87.1.8 3.5 SHACL

Proposed use: express selected structural constraints and produce inspectable validation reports if an RDF representation is adopted. The source distinguishes validation failure from reported constraint results. Source

Boundary: passing a shapes check does not establish that an event occurred, evidence is adequate, a procedure was fair, access was authorized, or a presentation is intelligible. Cross-system behavior and institutional practice need additional evaluation.

Experiment: test required attribution, allowed reference patterns, and version links against positive and negative fixtures. Keep input defects, processor failure, unsupported validation features, and substantive disagreements distinct in the GR conformance report. Document any constraints checked outside SHACL.

87.1.9 3.6 HTTP Semantics

Proposed use: if a network binding becomes necessary, reuse method semantics, status codes, validators/preconditions, and the distinction between idempotent and non-idempotent operations. Source, especially sections 9 and 13

Boundary: HTTP does not define the GR review procedure, application authorization policy, record meaning, synchronization strategy, or safe retries for an arbitrary application operation. Successful delivery is distinct from successful application processing and substantive acceptance.

Experiment: after batch exchange works, test interrupted submission, repeated delivery, stale revision, partial import, and denied access using a concrete proposed binding. Document application-level receipts and conflict handling. No API endpoint design is selected by this landscape.

87.1.10 3.7 C2PA

Proposed use: evaluate importing or referencing media provenance manifests when an evidence pilot already encounters Content Credentials. Its scope includes cryptographically verifiable provenance and validation under a specified trust model. Source, sections 1.2 and 14–15

Boundary: successful signature/manifest validation does not settle whether depicted events happened as described, a source was candid, a claim is justified, or a signer has institutional authority to decide it. Absence of credentials is not proof of falsity.

Experiment: preserve the credential, validation time/result, applicable trust context, and limitations separately from an assessor's evidentiary judgment. Test missing, invalid, and unavailable credentials and a valid credential attached to contested content. Defer mandatory signing infrastructure pending a demonstrated threat-model need.

87.1.11 3.8 PREMIS

Proposed use: evaluate preservation metadata for retained objects, preservation actions, agents, and relevant rights statements. This review uses the official version 3.0 overview; detailed unit-level selection awaits the dictionary and errata review. Source

Boundary: PREMIS preservation Events and Objects are not automatically the GR operational classes of the same names. Preservation metadata and recorded rights statements do not themselves establish lawful retention, unrestricted disclosure, or legal authority.

Experiment: after source review, map an ingest, format migration, access restriction, and disposal action. Examine the difference between preserving content, preserving permitted evidence of an action, and limiting access. Record information loss and institutional assumptions.

87.1.12 4. Evaluation sequence and decision record

Structural role: limit dependency work to what the next pilot requires.

1. From GR-110/200/210 and early GR-140/150/160 requirements, identify the smallest provenance, epistemic, temporal, exchange, validation, and restriction needs.
2. Evaluate PROV-O, annotation, and temporal mappings against those needs. Preserve mismatches as issues rather than expanding the GR ontology to mirror an external vocabulary.
3. Compare candidate interchange approaches, including JSON-LD; assess SHACL only in conjunction with an RDF-based option. Keep an offline, bounded package within the comparison.
4. Inspect PREMIS's full dictionary and errata before detailed preservation mappings. Evaluate C2PA only for a relevant media case and HTTP only for a demonstrated network requirement.
5. Record costs, unsupported distinctions, loss, implementation evidence, accessibility, security/privacy, licensing, edition pinning, maintenance, and migration implications before selecting a dependency.

For each candidate, the evaluation record includes: GR requirement reference; external edition and exact sections; mapping direction and limits; alternatives; fixture set; independent results; known defects; selected direction or reason for deferral; and affected documents. A selection becomes an architecture decision where it constrains programme design.

OPEN: sufficient semantic preservation for a mapping claim; treatment of external version changes; availability and licensing of supporting artifacts; implementation burden for small institutions; and boundaries between shared GR semantics and domain-specific profiles.

This landscape is deliberately bounded. Later pilots can identify other metadata, identifier, security, accessibility, archival, or domain standards for separate verified review. Inclusion here is an evaluation priority, not a normative reference list for a future Standard.

88 foundation traceability

Original source: `docs/planning/foundation_traceability.md`.
Original source SHA-256: `b4da3d423abe7684064f645da17f2eff7f8db435ba43eac9ba60dc6b5f58cd39`.

88.1 Foundation Traceability for Development Planning

Document class: Informative planning and source-analysis document
Status: PROVISIONAL; proposed operational translations and prospective evidence
Date: 2026-09-22

88.1.1 1. Purpose and limits

This map supports the comprehensive development plan. It connects the foundation corpus to questions for standards, protocols, specifications, and pilots. Its organizing problem is the reliability of relations among reality, manifestations, claims, institutional recognition, and action under symbolic abundance and representational instability.

The manuscript manifest assigns stable FM identifiers to all seven supplied PDFs, including both Chapter 3 variants. Source passages supply conceptual grounds; the candidate requirements below are programme proposals. None is an adopted clause, a claim of completed validation, or a replacement definition of a GR concept.

Existing publication codes route potential work without establishing project approval or maturity. Protocol names describe candidate procedures whose publication placement remains subject to the plan. A protocol is a subject of a Specification or Standard, not a separate authority class. Requirements begin in standards-track work; reusable technical needs can then produce a Specification and a pilot. GR-300/310 routing identifies questions for contextual legal and procedural review, not a legal effect derived from the foundation manuscripts.

88.1.2 2. Reading the trace

Each FT identifier follows this chain:

`manuscript passage → distinction at stake → candidate requirement or question → discriminating evidence → drafting decision`

The evidence column describes a future test or pilot artifact. It does not assert that evidence has been collected. Useful results include failure: an example the proposed record cannot reconstruct, a distinction it silently merges, unmanageable recording burden, or a safeguard a participant cannot actually exercise.

Page numbers are one-based PDF pages. Chapter and section numbers identify the argument more durably than page numbers alone. Source links point to the exact file entry in the manifest. Candidate requirements are expressed as drafting tasks, not normative clauses.

88.1.3 3. Motivation, recognition, and epistemic warrant

ID	Source and actual distinction	PROVISIONAL operational translation and routing	Prospective test or pilot evidence
FT-01	FM-001, §1.14.2–1.14.5, pp. 79–83: authenticity, provenance, evidential adequacy, and epistemic trust answer different questions.	GR-110/140/150/200/210: preserve separate provenance checks, evidential assessments, and reliance decisions, with their scopes and responsible actors. A provenance validation result does not become a truth verdict.	A genuine document containing an incorrect claim and an accurate document lacking verifiable provenance produce distinguishable results. Reviewers can identify what each check establishes and what remains unresolved.

ID	Source and actual distinction	PROVISIONAL operational translation and routing	Prospective test or pilot evidence
FT-02	FM-004, §§4.2, 4.6–4.9, pp. 11–19, 43–74: reality, manifestation, and mediated access are distinct; the registers are not exclusive object kinds.	GR-100/110/120/200: represent claimed target, manifestation or trace, recording activity, and resulting assertion through explicit links. Avoid one undifferentiated “fact” field.	A practice predates recognition; two observers describe it differently; later recognition changes its operation. The record preserves these temporal and epistemic differences without requiring a final metaphysical classification.
FT-03	FM-005, §§5.2–5.4, pp. 13–36: manifestations constrain a compatibility set under conditions, evidence, and assumptions.	GR-200/210, supported by GR-110/120 and a claim/evidence assessment procedure: link a material claim to evidence, method, assumptions, context, inferential mode, and live alternatives at a proportionate level of detail.	Two reconstructions fit the same trace. A reviewer distinguishes elimination through new evidence from elimination through a modeling assumption and recovers alternatives left unresolved.
FT-04	FM-005, §§5.7–5.8 and 5.17, pp. 53–70, 141–150: observation is partial; boundaries, scale, and uncertainty dimensions matter.	GR-110/140/200: declare observational scope, observer position, relevant omissions, boundary, scale, and uncertainty type. Investigate qualified confidence dimensions rather than assume one mandatory score.	Reviewers compare a narrow direct observation with a broad retrospective inference. Missing observations are not displayed as non-occurrence; changing boundary or scale is visible.
FT-05	FM-005, §§5.15–5.16, pp. 122–141, and FM-007, §16, pp. 75–78: mathematical coherence and institutional uptake do not themselves establish factual warrant.	GR-150/210/400: separate syntax/model validation, evidence sufficiency review, and institutional determinations. Define what a conformance result covers.	A structurally valid but unsupported claim passes only the structural check. Review output exposes its missing evidential basis; no “validated fact” badge conflates the assessments.
FT-06	FM-005, §5.18, pp. 150–160: evidence production, preservation, credibility, and contestation are unequally available.	GR-160/210/400 and a contestation procedure: support attributed testimony, challenges, responses, unresolved disagreement, and access-sensitive evidence handling. GR-310 investigates applicable procedural bases separately.	An affected participant challenges a classification, supplies an alternative account, and receives a traceable disposition without exposing restricted evidence. Measure participation barriers, not only field presence.
FT-07	FM-005, §5.19, pp. 160–168: machine mediation adds representational and inferential conditions; computational confidence is not independent authority.	GR-110/140/200/210: record material machine contributions, supplied sources, transformations, human uptake, and limitations needed to examine a claim. AI-specific fields form a profile, not the definition of the programme.	A generated summary contains an unsupported link between events. A reviewer traces it to the machine step, distinguishes source evidence from generated inference, and follows correction into dependent records.

88.1.4 4. Trajectories, revision, and praxis

ID	Source and actual distinction	PROVISIONAL operational translation and routing	Prospective test or pilot evidence
FT-08	FM-005, §5.20, pp. 168–176: new evidence, intervention, historical reinterpretation, and category revision are different sources of revision.	GR-110/120/130/160/200/210 and revision/migration procedures: keep target change, evidential update, and descriptive-regime change distinguishable, allowing combined reasons. Link prior formulation, revision grounds, resulting formulation, and affected dependents.	Three cases use the same visible field update: the world changed; a prior report was corrected; a category changed. The record and exported view preserve which happened and when.
FT-09	FM-005, §§5.14 and 5.20.4, pp. 113–122, 172–173: later knowledge of the past differs from the past and from historical effects of earlier representations.	GR-110/140/160/200/400: preserve evidence available at the time, later interpretation, and consequences of the earlier claim, under declared retention and access conditions. Specify reconstruction scope rather than promise complete recovery.	A disputed claim influenced a decision before correction. A historical view recovers earlier grounds and the decision; a current view displays correction and remaining uncertainty.
FT-10	FM-003, §§3.9, 3.12, pp. 94–104, 129–141; FM-002, §3.12, pp. 128–139: selection and intervention alter future conditions, and praxis is iterative.	GR-110/210/400 and a praxis protocol: preserve diagnosis, alternatives, intended effects, decision grounds, intervention, monitoring, feedback, and revision or repair where relevant. The source does not impose one universal workflow.	A bounded institutional pilot changes action after unexpected downstream effects. The record explains the change, whose evidence mattered, which alternatives remained available, and the cost of recording.
FT-11	FM-003, §§3.10, 3.13, pp. 115, 141–152; corresponding FM-002, pp. 113, 139–151: generativity is not intrinsically beneficial.	GR-110/140/210/400 and evaluation guidance: distinguish attributed generative effects from judgments under specified values, affected groups, boundaries, and horizons. Avoid a compulsory universal generativity score.	An intervention expands one group’s capacity and restricts another’s. Both effects and competing evaluations remain available; a positive output count does not erase loss or dependence.
FT-12	FM-003, §3.2.3, p. 15, compared with FM-002, §3.2, pp. 11–22: access to outputs differs from access to generative capacity and conditions; the dedicated subsection occurs only in FM-003.	GR-110/400 and institutional/policy work: distinguish output distribution from participation in inquiry, tools, institutions, and decision capacities. Retain the source variant explicitly.	A pilot supplies outputs widely while restricting ability to question, revise, or generate them. Evaluation exposes this difference and does not claim that interoperability alone remedies it.

ID	Source and actual distinction	PROVISIONAL operational translation and routing	Prospective test or pilot evidence
FT-13	FM-004, §§4.10–4.11, pp. 74–89; FM-005, §5.6, pp. 44–53; FM-007, §16.2, pp. 75–76: representation can enter action through classification and institutional uptake.	GR-200/400: link a claim or classification to its uptake and later effects. GR-300/310 identify any asserted authority, jurisdiction, applicable source, and procedural status; technical conformance does not supply these.	A classification changes eligibility in a synthetic institutional case. The record distinguishes evidence, classification, institutional decision, and asserted legal basis, including a dispute over authority or procedure.

88.1.5 5. Record roles and technical loss

ID	Source and actual distinction	PROVISIONAL operational translation and routing	Prospective test or pilot evidence
FT-14	FM-007, p. 2 and §§7–12: six analytical categories have overlapping uses and no established exhaustiveness or metaphysical priority.	GR-100/120: document purpose, identity, admissibility, temporal behavior, relations, metadata, examples, and counterexamples for operational roles. Decide how overlap is represented before choosing exclusive schema types.	A relation has its own history and attributes; an occurrence participates in a process. The model represents these views without claiming the roles partition reality.
FT-15	FM-007, §§7, 19.2, pp. 26–32, 87–88: reidentification uses a declared criterion; branching lineage can differ from equivalence-based identity.	GR-110/120/200 and an identity procedure: separate identifiers, continuity claims, identity criteria, and succession/lineage links. Permit disputed identity judgments with evidence.	A merger, a split, and an unchanged name after organizational replacement distinguish continuity from identifier reuse. Reviewers reconstruct the selected criterion and alternatives.
FT-16	FM-007, §§8, 19.3, pp. 32–37, 88: relation formation and potential effects under continuations need different evidence.	GR-110/120/210: keep participants, roles, formation claims, conditions, and prospective effect claims independently attributable.	Two relations have the same current outcome but different histories or responses to a later request. The record preserves the historical and prospective questions separately.
FT-17	FM-007, §§9, 12, 19.4, 19.7, pp. 37–43, 56–61, 88–89: equal effects can hide repeated occurrences, failed attempts, ordering, and intermediate conditions.	GR-110/120/130: distinguish occurrence identity from transition, process from composite effect, and attempted from completed action. Preserve supported partial order and temporal uncertainty.	Repeated idempotent authorizations share an endpoint but retain distinct occurrence counts. A failed intermediate step survives export/import; uncertain ordering remains uncertain.

ID	Source and actual distinction	PROVISIONAL operational translation and routing	Prospective test or pilot evidence
FT-18	FM-007, §§10, 19.5, pp. 43–52, 88–89: Attribute has value, interpretation, scale, and definedness conditions.	GR-100/120: resolve Attribute/Property through an ADR before harmonization. Investigate explicit states for unavailable evidence, inapplicability, disputed classification, and unperformed measurement.	A round trip keeps zero, false, unknown, inapplicable, disputed, and not measured distinguishable where relevant. Numeric recoding does not justify arithmetic unsupported by the measurement scale.
FT-19	FM-007, §§11, 19.6, pp. 52–56, 89: state sufficiency is relative to observations, operations, and a comparison horizon.	GR-120/150 and formal-semantics research: state the questions a reduced record supports and the distinctions it omits. Predictive adequacy and historical recoverability need different tests.	Two cases with identical current records behave differently under a declared continuation. The pilot identifies missing memory or an invalid assumption instead of treating current-record equality as identity.
FT-20	FM-007, §17.1–17.2, pp. 78–80: transition between declared regimes needs alignment; a coarse record cannot recover omitted information merely by switching notation.	GR-120/130/160 and migration specifications: identify source/target regime versions, transformation rules, retained evidence, and known information loss. Leave unsupported fine-grained results unknown.	A new classification splits an old category. Migration marks unrecoverable membership rather than inventing it; retained evidence supports recovery only where sufficient.
FT-21	FM-006, §§3, 7, pp. 5–6, 10–11; FM-007, §§3.4, 17, pp. 12, 78–83: fixed-carrier collapse, preserved equivalence, declared regimes, and normative judgments have different scopes.	Technical reports first: document assumptions and limits of proposed formal semantics. No automatic mapping from mechanism to Process, formal change to Event, or collapse to harm.	Counterexamples contrast loss of distinction, harmless aggregation, a new descriptive distinction, and actual emergence claims. Each result identifies the applicable construction and the question outside it.

88.1.6 6. Decisions and research questions kept open

These questions affect later requirements and belong in the programme's open-question register. This document supplies source context and proposed decision evidence, without assigning conformance authority.

Question	Alternatives needing assessment	Evidence or decision needed
OPEN — Property / Attribute	Scoped operational equivalence; separate concepts; future terminology revision.	Definition comparison and counterexamples from FM-007 §10, impact analysis, and an ADR before changing established terminology.
OPEN — Six-role representation	Overlapping roles; types with declared combinations; profile-specific restrictions.	Cases showing necessary overlap and where restriction improves interoperability without an ontological claim.
OPEN — Claim and evidence structure	Separately identified claims; attributed assertions within records; a hybrid.	Disagreement, correction, provenance, access, and round-trip cases before a schema choice. Manuscript distinctions alone do not prescribe serialization.

Question	Alternatives needing assessment	Evidence or decision needed
OPEN — Revision semantics	Linked histories for target, evidence, and regime; one revision structure with explicit multiple reasons.	FT-08/09/20, including an unrecoverable migration and representation that changes its target through uptake.
OPEN — Formal and normative preservation	Distinct technical and evaluative vocabularies; narrowly justified bridges for specified applications.	Account of FM-006/FM-007 differences; no inference from preservation of equivalence to protection of every valued difference.
OPEN — Emergence and possibility	Records of reported new possibilities; models of declared regime changes; research on unanticipated novelty.	Domain evidence and explicit assumptions. Neither the fixed carrier nor declared regime family establishes universal mathematics of emergence.
OPEN — Chapter 3 precedence	Preserve both variants pending authorial designation; select one for a named drafting task with the choice recorded.	Editorial provenance and substantive collation. Filename and build timestamp alone do not establish authoritative supersession.
OPEN — Burden and scope	Minimal claim/trajectory core with profiles; more demanding domain-specific obligations.	Participant time, privacy exposure, omitted distinctions, query recoverability, and correction usability measured together. More data alone is not success.

88.1.7 7. Evidence package for the next drafting cycle

The plan's first demonstrator can use programme decisions plus a synthetic institutional case, supplemented by counterexamples from FM-007 §19. A later bounded institutional or research pilot provides different evidence. Synthetic cases test a design property; they are not evidence of successful institutional adoption.

For each selected FT row, the drafting record can contain:

1. Manuscript identifier, exact section/page, and the distinction retained.
2. Candidate requirement, intended publication, scope, and conformance target.
3. A normal example, a failure case, and a counterexample to an overbroad interpretation.
4. Evidence collected, including recording burden and unresolved access restrictions.
5. Test result and limits, including differences between independent implementations or reviewers.
6. Disposition: retain, revise, split into a profile, move to a technical report, or defer; with rationale and affected documents.

External mappings require separate verification of the exact external edition and claimed relationship. This map establishes no compatibility, legal effect, factual guarantee, or automatic equivalence between a foundation formulation and a programme requirement.

89 governance and pilots

Original source: `docs/planning/governance_and_pilots.md`.
Original source SHA-256: `1f9e29e21552a6bfaa8335a6c34a6b94e0dac0e75dbfdf9d4661486f49c88069`.

89.1 Governance launch and pilot evidence plan

Document class: Informative programme planning document
Status: PROVISIONAL
Version: 0.1
Authority: Proposed work and evaluation criteria; no governance adoption, project approval, or conformance requirements are established by this document.

89.1.1 1. Role and planning basis

Authoring update, 2026-09-22: Substantive governance drafts, expanded templates, P0 arithmetic/design rehearsal and P1 disputed-record fixture are available. The original outline links in the checklist below now point onward to those drafts. Actual appointments, review, participation, adoption and live pilot evidence remain pending; authored cases do not satisfy the operational completion criteria.

This plan connects the programme's governance infrastructure to the evidence needed to develop standards, protocols, and specifications. It accompanies the programme brief, the comprehensive development plan, and the publication taxonomy.

The planning objective is an inspectable practice of recognizing, recording, contesting, revising, and presenting generative trajectories. Archival preservation and AI-assisted work are important cases within that objective. Recording final outputs alone is insufficient to exercise it.

The standards-development comparison supplies verified ISO/IEC, IEEE and WTO source practices and proposed adaptations for governance drafting. The cross-domain programme supplies substantive epistemic, ethical, jurisprudential, institutional, policy and political-economy work and review. Neither is reduced to a technical validation checklist.

Existing publication numbers remain project-family identifiers. References below to GR-100, GR-110, and other families identify preliminary scopes, not adopted Standards or approved projects. Protocol experiments acquire their publication class and authority from their containing Specification, Standard Working Draft, or other declared publication; the word "protocol" does not itself confer authority.

Named roles below are proposed responsibilities. Their holders, availability, institutional mandates, and resources are **UNASSIGNED**. The existing repository does not establish that the proposed Council, committee, or working groups are constituted. Sequencing is based on evidence and capacity, without committed dates, budgets, or external partners.

89.1.2 2. Governance launch checklist

Role: Identify the difference between repository preparation and an operational development process. The checklist is open; inclusion of an item is not evidence of completion.

Launch item	Existing repository evidence	Proposed completion deliverable and evidence
Programme charter	Working outline	Scope, publication authority, membership, appointments, accountability, amendment route, and founding authority; explicit adoption record and published current text.
Directives Part 1	Procedural skeleton	Executable procedures for proposals, review, decisions, publication, maintenance, appeals, and withdrawal; worked rehearsal showing who acts and what records result.

Launch item	Existing repository evidence	Proposed completion deliverable and evidence
Directives Part 2	Drafting skeleton	Publication classes and maturity labels, requirement identifiers, normative/informative boundaries, references, profiles, conformance claims, and coordinated document/artifact versioning; example reviewed against the rules.
Technical committee charter	Draft GR/TC 1 charter	Bounded mandate, participation routes, appointment/removal, reporting, delegation, and liaison limits; actual role assignments before committee powers are exercised. Working groups activated only where capacity exists.
Work-item initiation	NWIP template	Add publication class, proposed conformance subjects, dependency links, source basis, stakeholder impact, capacity, maintenance ownership, and pilot evidence; trial proposal with recorded accept/revise/defer/reject rationale.
Public review and comment	Comment template; process not yet written	Draft distribution, notice and response periods, accessible submission routes, confidential submissions where justified, comment identifiers, disposition, reply, and re-review triggers; sample comment-to-change trail. Review periods remain a governance decision.
Consensus, decisions, and appeals	Topics listed in Directives Part 1	Define participation eligibility, quorum if voting is used, handling of sustained objections and abstentions, decision criteria, recusal, escalation, appeal grounds, independent consideration, and remedies; rehearse an unresolved objection and an appeal. Numerical rules remain OPEN.
Ethics and conflicts of interest	Topics in outlines; no operational policy	Declarations, updates, recusal, handling of domination or retaliation, complaints, and protected participation; conflict register with disclosure limits and an exercised recusal case.
Intellectual property and licensing	Topic listed in Directives Part 1	Contribution terms; separate choices for publications, code, schemas, examples, and third-party material; handling of known patent or other rights claims; recorded review of redistribution and implementation implications. Licensing choices remain OPEN.

Launch item	Existing repository evidence	Proposed completion deliverable and evidence
Maintenance and versioning	Lifecycle and maintenance topics in outlines	Edition/version authority, correction versus amendment versus revision, compatibility/deprecation notices, issue intake, review triggers, supersession, and withdrawal; simulated correction and incompatible revision with assigned maintenance responsibility.
Records and transparency	ADRs, changelog, and public-comment structure already available	Decision, issue, ballot where applicable, objection, disposition, and release registers; public/restricted handling, retention, correction, and deletion procedures; demonstration that a public reader can follow a decision without unnecessary personal disclosure.
External liaison and exceptional procedure	Topics listed in Directives Part 1	Limits on representation, authorization to make commitments, expedited decisions and subsequent review, continuity if a role becomes vacant; no external representation presumed by this plan.

These deliverables can be clauses or annexes within a small number of coherent governance documents. Separate policies are useful where distinct review or maintenance is needed; document proliferation is not a launch objective.

89.1.3 3. Founding sequence and accountable roles

Role: Avoid treating draft governance as already operative or using a technical project to manufacture its own approval authority.

89.1.4 3.1 Proposed founding sequence

1. **Declare the founding basis.** Record who is proposing the programme, in what capacity, and through which explicit founding decision governance can be adopted. Select a provisional stewardship arrangement or a constituted governing body after examining available participation. Neither arrangement is established by this plan.
2. **Prepare the coherent governance package.** Resolve dependencies across the charter, directives, committee mandate, review/decision/appeal procedures, contribution policies, maintenance, and transparency. Preliminary drafting, source studies, and synthetic rehearsals can proceed during this step without formal standards-project status.
3. **Review the package and rehearse its procedures.** Invite relevant perspectives, document participation gaps, and exercise a proposal, contested comment, conflict recusal, appeal, correction, and withdrawal. Record failures and revisions. Avoid presenting an internal rehearsal as independent public review.
4. **Record explicit founding adoption.** The identified founding participants record the authority, text versions, decision basis, dissent, and remaining limitations. A transitional arrangement includes its scope, limits, review trigger, and replacement route. The adoption record remains separate from an architecture ADR.
5. **Constitute and assign.** Appoint actual accountable holders; publish participation and contact routes; establish a functioning comment, complaint, and appeal route with appropriate confidentiality. Multiple responsibilities can be combined in a small team, with conflicts recorded and independent review arranged for contested decisions.
6. **Approve bounded work items through the operative procedure.** Only after governance coherence is evidenced, consider formal approval of GR-100/GR-110 and coordi-

nated dependent work. A family-wide NWIP can provide context, while each deliverable retains a bounded scope, owner, dependencies, and progression decision.

An unresolved founding-authority question, unusable appeal route, or unfilled approval responsibility keeps formal project/adoption decisions pending. This does not prevent preliminary research and openly labelled experiments. The founding decision is a future governance action, not an outcome claimed by this planning revision.

89.1.5 3.2 Proposed responsibility allocation

Responsibility	Accountable role to assign	Supporting or reviewing roles	Current assignment
Founding basis and governance adoption	Identified founding decision authority	Governance editor; participating stakeholders	UNASSIGNED
Governance coherence and procedural oversight	Authorized programme governance lead/body	Secretariat; procedural reviewer	UNASSIGNED
Work-item scope and standards-track progression	Authorized project approval authority	Project lead; affected-family editors	UNASSIGNED
Draft integrity and source traceability	Document editor	Foundation/source reviewer; technical reviewers	UNASSIGNED
Pilot purpose, execution, and evidence	Pilot lead	Participants; implementation and usability reviewers	UNASSIGNED
Participant/data stewardship and access decisions	Pilot data steward	Privacy/ethics reviewer; authorized institutional contact when applicable	UNASSIGNED
Bounded legal or jurisdiction-specific review	Qualified reviewer selected for the identified context	Data steward; institutional representative	UNASSIGNED
Comment disposition and consensus assessment	Authorized review chair or decision authority	Editors; commenters; procedural reviewer	UNASSIGNED
Appeals and conflicts that compromise a decision	Independent appeal reviewer/body established by governance	Secretariat with restricted access as appropriate	UNASSIGNED
Publication, compatibility, and maintenance	Release/maintenance owner	Editors; validation and preservation reviewers	UNASSIGNED

Independence is a property to document, not a title. Where the same person performs several roles, the decision record identifies the overlap. If impartial consideration cannot be arranged for a consequential contested decision, that decision remains pending under the proposed process.

89.1.6 4. Evidence gates

Role: Define proposed exit evidence for planning. These are not substitutes for the future adopted directives or automatic promotion rules.

Gate	Evidence considered for progression	Accountable decision role, once assigned	Consequence of an unresolved material gap
GOV — governance ready	Adopted coherent package; founding record; assigned authorities; usable review/appeal/contact routes; completed procedural rehearsals and dispositions	Founding decision authority, then constituted oversight role	Continue preliminary work; defer formal standards-project approval.
SCOPE — work item ready	Defined normative problem, users, conformance subject and exclusions, sources, dependencies, alternatives, affected stakeholders, pilot plan, and feasible ownership	Project approval authority	Revise or defer the proposal.
PILOT — experiment ready	Versioned candidate clauses and protocol/specification dependencies; scenario questions; minimal data plan; participants and access authorization when relevant; stop/recovery procedure	Pilot lead, with data-steward clearance for the proposed data	Use synthetic material or defer dependent data collection.
REVIEW — draft ready for public review	Integrated pilot evidence; source/requirement/test traceability; negative cases; known limitations; privacy, accessibility, and institutional impacts; disposition of material internal defects	Authorized review/progression authority	Narrow scope or revise; do not conceal failed cases.
ADOPT — publication ready	Public review and dispositions; justified treatment of sustained objections; completed technical and horizontal review; precise conformance claims; operative normative dependencies; formal approval under adopted procedure; maintenance ownership	Adoption authority defined by governance	Retain draft or Specification status, or defer adoption.
MAINTAIN — release remains supportable	Issue and incident handling; correction/revision history; compatibility evidence; maintenance capacity; reasons for confirmation, revision, supersession, or withdrawal	Maintenance owner and authorized decision authority	Publish limitations and use the adopted maintenance/withdrawal procedure.

There is no universal pass percentage or fixed pilot count in this plan. Reviewers examine whether the evidence supports the specific claim and whether failures change that claim. Future numerical thresholds need a stated purpose, baseline, and rationale. Passing a pilot is evidence for review, not procedural approval.

89.1.7 5. Pilot sequence and first integrated release

Role: Exercise the programme's epistemic and practical purpose before multiplying formats or institutional commitments.

The first integrated experimental release combines vocabulary and recording with epistemic representation, generativity-related trajectory, correction/contestation, presentation, and protection. It draws on the preliminary scopes of GR-100/110/140/150/160/200/210; GR-120 and technical Specifications supply infrastructure only where candidate requirements need it. GR-300/310/400 inform bounded institutional and procedural questions without asserting legal authority.

Pilot	Proposed material and question	Distinctive evidence and limits
P0 — programme decision history	The programme's own publicly shareable proposal, alternatives, objection, source interpretation, decision, and later revision. Can another reader reconstruct what was known and decided at each point?	Links between issues, drafts, reasons, and changed scope; conflicting accounts preserved with attribution; restrictions applied to contributor information. Useful as a self-pilot, but its authors' familiarity limits independent usability evidence. A rehearsal before GOV does not imply a formal standards decision.
P1 — contested institutional decision	Synthetic allocation or eligibility decision involving conflicting accounts, incomplete evidence, disputed identity, and a revised classification. Can a participant challenge the representation and understand the resulting revision?	Separates occurrence claims, evidence, institutional acceptance, normative evaluation, and claimed legal status; demonstrates reply, correction, review, and differentiated access. Synthetic ground truth is confined to the scenario and does not establish a general truth-detection method.
P2 — AI-assisted research trajectory	A bounded research task with human and AI contributions, source checking, rejected suggestions, a change of judgment, and an enabling encounter or constraint.	Records consequential contributions and decisions, uncertainty about system behavior, and branches relevant to the research. No demand for inaccessible internal model reasoning or exhaustive interaction capture. AI output and detailed provenance do not establish factual correctness.
P3 — incomplete archive	Licensed/public or synthetic fragments with conflicting dates, missing material, retrospective interpretation, and uncertain attribution.	An account that remains useful while explicitly distinguishing surviving evidence, inference, unknown chronology, restricted access, loss, and retrospective reconstruction. It does not fill gaps with invented events or probabilities.
P4 — consenting external institution	A bounded workflow selected later with a willing partner, participants, appropriate access authority, and contextual review.	Tests ordinary work burden, contestability, power asymmetries, access, correction, and maintenance outside the authors' own setting. No partner, consent, mandate, or deployment commitment is currently assumed.

P0 and synthetic P1 preparation can begin as exploratory work. P2 and P3 depend on suitable material and access; neither needs to wait for a broad platform implementation. P4 follows satisfactory protected trials and an explicit partner arrangement. Pilot ordering can change with capacity, while preserving governance prerequisites and the integrated coverage

below.

The first release package consists of candidate clauses, a declared minimal profile, versioned fixtures, a worked recording-to-presentation example, correction/contestation and access exercises, a pilot report, and a known-limitations register. A field recording claims, an output log, or a graph screenshot alone is not evidence for the integrated package.

89.1.8 6. Scenario and failure-case coverage

Role: Make proposed requirements reviewable through concrete cases without pre-deciding whether epistemic elements become ontology classes or profiles.

Case	Exercise	Evidence sought and failure to detect
Fact and claimed fact	In P1, two participants give incompatible accounts of whether a meeting occurred; an institution accepts one for a specified purpose.	Record and display the assertions, sources, methods, uncertainty, and scoped institutional judgment separately. Failure: an accepted or signed assertion is displayed as unqualified truth.
Disputed identity	Two archive fragments in P3 appear to concern the same person or event; another account disputes the linkage.	Coexisting attributed identity hypotheses, link rationale, and reversible correction of an erroneous merge. Failure: canonicalization erases the dispute or silently propagates the mistaken identity.
Uncertain or conflicting evidence	P1/P3 combines direct testimony, inference, an unavailable source, and incompatible confidence assessments.	Explicit evidentiary relationships and appropriately scoped uncertainty without a fabricated common probability scale. Failure: missing evidence becomes evidence of non-occurrence or low numerical confidence becomes an objective fact.
Generative change and unrealized alternatives	In P0/P2 an encounter introduces a previously unused distinction, opens a research option, and closes another under a constraint.	Account of the changed options, conditions, contributors, and limits of the retrospective interpretation. Failure: options are presented as equally feasible, exhaustive, or directly observed when they were reconstructed.
Category revision	P1 revises an eligibility category after a challenge; P3 reinterprets an earlier classification.	Identify the category version and affected judgments, distinguish earlier recognition from later interpretation, and expose migration effects. Failure: old decisions appear to have used the revised category.
Restricted, missing, or destroyed data	P3 contains a restricted source, a never-collected record, and a known destruction event.	Distinguish the states only to the extent their disclosure is safe and supported; preserve uncertainty when the state is unknown. Failure: restriction is presented as nonexistence, or a marker exposes sensitive membership or existence.

Case	Exercise	Evidence sought and failure to detect
Correction, deletion, and withdrawal	P1 includes a mistaken attribution and a request for correction or deletion under the chosen scenario procedure.	Route the request, record authority and disposition, correct derived views, and test allowed retention/deletion consequences. No default immutable copy of sensitive original content; minimal audit information or tombstones only where justified and safe. Failure: history preservation silently defeats an applicable deletion decision.
Presentation and public access	Render P1/P3 for an authorized reviewer and a public reader.	Disclose selection, redaction, reconstruction, uncertainty, and revision where appropriate; test whether a reader can distinguish an account from its evidentiary basis. Failure: search, export, graph labels, or cached views disclose restricted information or conceal consequential mediation.
Procedure interruption and retry	Interrupt a correction or access change, retry a message, and deliver an older update after a newer decision in a protocol experiment.	Defined authorization, ordering/conflict handling, acknowledgments, failure reporting, and recovery for the declared protocol. Failure: retries duplicate consequential actions or an old message restores withdrawn access.

These exercises document both successful behavior and cases the chosen profile cannot represent. Unresolved differences remain visible rather than being normalized into one authoritative history.

89.1.9 7. Pilot evaluation and conformance boundaries

Role: Identify what evidence means before collecting it.

Each pilot report records its question, publication/artifact versions, participants and reviewer relationships, evidence provenance, data permissions, actions taken, failures, recording burden, and resulting draft changes. A traceability table links proposed requirement or protocol step to scenario, evidence, reviewer finding, disposition, and affected version. Unassessed requirements remain explicitly unassessed.

Evaluation covers:

- **Representation:** Can a reviewer locate the actor, claim, evidence, method, perspective, uncertainty, temporal scope, alternative, and revision relevant to the scenario without conflating them?
- **Generativity:** Can the account explain the recorded changes in conditions, relations, distinctions, or possible continuations, while identifying the evidence and limits of that explanation?
- **Practical use:** Can participants submit, contest, correct, restrict, and revisit records through the declared procedure? What expertise, time, cognitive burden, and inaccessible steps were observed?
- **Presentation:** Can readers distinguish source material from reconstruction, earlier from later judgment, and absence from restricted knowledge? Reader misunderstandings count as findings even when serialization validates.
- **Protection:** Do the exercised access, export, correction, deletion, retention, and failure paths have the stated effects, including derived views and known copies under the pilot's control?
- **Maintenance:** Can a later editor explain and apply a version change without losing the declared meaning or recreating content that was intentionally removed?

Interchange claims need additional evidence when GR-130 or a related Specification is ready. The proposed test uses independently developed implementations of the declared sender/receiver roles, with independence documented. Two datasets processed by the same implementation are insufficient. Exchange exercises cover preserved meaning, permitted loss, identifiers, epistemic scope, restriction metadata, revisions, invalid input, and version mismatch. Round trips are useful only where the format claims reversible exchange; no requirement for byte identity is presumed. Independent software implementations are not a prerequisite for a vocabulary or organizational procedure that makes no software-interoperability claim.

Conformance targets remain distinct: a record, dataset/package, recorder, presentation tool, protocol participant, organizational procedure, and preservation service have different observable obligations. A claim identifies its target, edition/profile, applicable requirements, exclusions, evidence, and assessment method. Automated schema checks establish only the constraints they actually check; human procedural or semantic review is reported separately.

A bounded conformance result does not establish the truth of an assertion, completeness of history, moral legitimacy, trustworthiness of an institution, beneficial generativity, or legal validity. Nor does an internal pilot establish certification or independent assurance. Evidence for those claims would require separately justified methods and authority.

89.1.10 8. Participant protection and contextual review

Role: Plan bounded review before real data use; this section does not give legal advice or interpret a jurisdiction's law.

Pilot preparation identifies the institutional context, intended purpose, affected participants and third parties, required data, access authority, permissions or consent where applicable, custody, retention, and available routes to challenge a record. Consent is not assumed to resolve every institutional or third-party issue. Synthetic and minimized materials provide an initial route when authority or protection is unresolved.

Before P4 or other sensitive real-data use, the proposed contextual review covers applicable correction/deletion/access duties, confidentiality, contribution and reuse permissions, records-management duties, participant vulnerability, and any cross-institution or cross-border handling actually planned. A qualified reviewer evaluates the identified jurisdiction and activity. Findings identify their scope, assumptions, unresolved conflicts, and limits; they are not generalized to other institutions.

The pilot plan also identifies who can pause collection or publication, restrict affected material, notify responsible participants, investigate a problem, and authorize resumption. Public pilot reports use appropriate minimization. Technical auditability does not require a public or permanent sensitive event history; even hashes, identifiers, and deletion markers receive review for disclosure risk.

89.1.11 9. Decisions to resolve before execution

Role: Provide inputs to the programme's open-questions register and subsequent governance decisions.

- Who participates in the founding decision, and what authority and limits are declared?
- Which responsibilities can be staffed now, and how are independent appeals and material conflicts handled with that capacity?
- What review periods, participation expectations, consensus criteria, and exceptional procedures are proportionate and credible?
- Which publication, software, schema, and contribution licensing terms support the programme's intended openness?
- What is the bounded first integrated profile, and which candidate assertions or generativity-related descriptions remain experimental?
- Which pilot materials are available with appropriate permissions, and which can safely be public?
- What evidence is sufficient for each proposed conformance claim, and what recording burden is acceptable to the affected participants?
- Which correction, deletion, retention, and access tensions require contextual legal review or a separate policy proposal rather than a universal technical rule?

The next concrete governance deliverable is a reviewable launch package with tracked alternatives and unresolved choices. The next concrete experimental deliverable is the P0/P1 integrated scenario package. Neither is represented here as completed, adopted, or externally endorsed.

90 graph semantics review

Original source: `docs/planning/graph_semantics_review.md`.
Original source SHA-256: `a7bd6f555a3b03d58c2f3a124801cdc13f2338ceb7e2b1f4e02a665f6dc5cd1e`.

90.1 Record graph semantics: source review and design proposal

Document class: Informative design review
Status: PROVISIONAL proposal; implementation decisions require a separate ADR
Date: 2026-09-22
Purpose: Identify a bounded graph model for the general application and a future shared implementation substrate for the academia application.

This review is grounded in the Programme Brief, the current experimental application design, the 0.3 Working Drafts, and passages read directly from FM-007. It is not a Specification, an adopted Standard, or a conformance assessment. The recommendations below are proposed operational choices. They do not redefine GR theory.

90.1.1 1. The central distinction

A project has at least three distinguishable structures:

1. **The semantic record graph:** records and the connections represented or asserted through them, at one declared project revision.
2. **The recording history:** Git commits that retain successive project snapshots and accountable changes.
3. **The displayed graph:** a selected rendering of a snapshot, with layout, filtering, and optional simplification.

A semantic cycle is compatible with a linear recording history. Two records can describe an earlier and a later occurrence in the opposite order from their creation. A new commit can change several graph nodes, a relation, and its associated files atomically. Graph layout or closeness does not assert identity, causal influence, temporal priority, or evidential support.

The Git commit identifies the project snapshot being examined. It is not the identifier of the real situation, the time that situation occurred, or proof of its represented content. The application currently publishes a single main reference. That operational choice need not prohibit recording alternative accounts or semantic branches within a snapshot.

90.1.2 2. Source findings

Page numbers below are PDF page numbers in FM-007.

Source passage read	Finding relevant to this design	Proposed consequence
Research Paper Note, p. 2; section 10.5, p. 46	The six categories form an overlapping analytical repertoire; exclusivity, exhaustiveness, and metaphysical priority are not established.	Record roles can overlap. An application can choose a primary display role without claiming that other roles are impossible.
Sections 7.1–7.3, pp. 26–28	A focal subject can be tracked under different declared criteria. A convenient database key settles only the identity question built into that database.	Separate record identity from target identification; preserve disputed identity and competing accounts.
Sections 8.1–8.2, pp. 32–33	Incidence describes participants or conditions with role positions. Binary incidence is a special case; formation and potential effect need further structures.	Represent a relation through a role-indexed participant list, not only source and destination columns.

Source passage read	Finding relevant to this design	Proposed consequence
Sections 8.3 and 8.8, pp. 33–34 and 36	Equal participants or types do not establish the same historical relation. Arity and terms can change under a continuity criterion.	Give each relation record its own identity and revision history. Do not deduplicate relations by endpoint pair and label.
Sections 8.5–8.9, pp. 34–36	Present incidence, formation history, possible efficacy, and causal interpretation answer different questions.	A saved connection is an attributed account. Add context and grounds rather than infer efficacy from the graph.
Section 8.11, p. 37	Relation accounts coordinate entities, formation events, attributes, states, and process histories.	Permit records about relations and relations whose participants are other relations.
Sections 9.9–9.10, p. 43	One happening can receive several descriptions; event/process segmentation depends on purpose and evidence.	Avoid automatic creation of six supposedly separate real things from one account.
Sections 10.1–10.5, pp. 43–46	Attribute domains, context, scale, definedness, and overlap carry meaning; unknown is not automatically false.	Distinguish interface/module properties from substantive Property assertions; preserve missingness and scope.
Section 16.4, p. 76	A registry entry, its asserted content, and warrant remain distinguishable.	Authenticated edits and valid Git content do not establish factual truth or institutional authority.

FM-007 uses **Attribute** where this programme provisionally retains **Property**. This review does not equate them. Nor does it identify the record graph with the deeper metamodel of constraint, change, structure, and difference.

90.1.3 3. Proposed minimum model

90.1.4 3.1 Records and subjects

A record is an identified retained representation. It contains a description of its target, applied recording roles, attributed content, qualifications, and technical recording metadata. Its stable identifier survives ordinary revisions. Different records can concern the same or a possibly identical target without being merged automatically.

The model can retain a primary role for color, icon, and default module selection while also recording additional applicable roles. Relation behavior depends on the presence of the Relation role, not on its being the sole role. The user can describe an agreement as both Relation and Entity. Its negotiation, signing, and time-specific terms can be separately linked descriptions where that distinction is useful.

A target designation can remain an unresolved description. The design does not need a universal target registry in the first graph release. It does need to state whether a participant reference concerns the **referenced record** or **the target described by that record**. Otherwise a link about a document's quotation can be confused with a claim about the document's subject. A profile can provide a clearly labeled default, but the distinction needs inspectable representation.

90.1.5 3.2 Relation records and incidence

A relation record uses the ordinary record envelope plus a relation component containing:

- a relation type or predicate, its local definition or vocabulary locator, and a human-readable title;
- participants, each with a stable participant-entry identifier, participant role, record reference or explicit unresolved designation, and reference interpretation;
- the stated context and represented temporal scope;
- the criterion for treating this as the identified arrangement, including whether continuity remains unresolved;

- the ordinary record's attribution, epistemic basis, modality, assessment/dispute status, grounds, and uncertainty.

Participant-entry identifiers distinguish two roles occupied by the same referenced record. For example, one organization could be both issuer and recipient under a stated arrangement. A duplicate exact participant entry is a validation error; repeated record references with different roles need not be. Self-reference or relations on relations are not universally invalid. Their admissibility depends on the declared relation meaning rather than a graph-wide acyclicity rule.

Direction is defined by participant roles or a declared relation type. An arrow is a rendering of that direction. It is not a universal meaning of Relation. The initial model can support directed binary relations, symmetric binary relations, and n-ary arrangements through the same participant structure. At least one participant incidence is a reasonable experimental profile boundary; there is no source basis for requiring two distinct target records in every admissible relation. A two-entry relation can refer to one record in distinct roles. Excluding an empty participant list is an implementation boundary rather than a universal theory of mathematical relations.

For an unknown party, an explicit unresolved participant preserves the limitation more accurately than a fabricated Entity. A narrower first implementation can accept a known subset of resolvable local participant references while recording that incidence is incomplete and explaining the limitation. It must not present that subset as a complete account. If the first implementation restricts the available forms, the restriction needs to be documented as a profile limit rather than generalized into GR. An unresolved identity criterion can be recorded for exploratory work, but it cannot receive a fulfilled result for a criterion-dependent obligation under V100-025.

An initial same-project reference boundary is appropriate for the application's private projects. Cross-project participant references require a later access and resolution design. An unresolved outside participant description is different from a resolvable cross-project record link.

90.1.6 3.3 Navigation links and other meanings

The existing `related_records` list is an untyped navigation aid. Migration can preserve it unchanged and render it with a visibly neutral style. It supplies no basis for creating a claim of collaboration, identity, causation, or evidential support. A user can explicitly create a Relation record with its own meaning and grounds.

An evidence file is not automatically accepted support. A structured evidence-role assignment needs a specified claim, material/version, attributing assessor, role, rationale, time, and limitations. If the current application has only account-level evidence text, the interface can expose that limit and preserve file references without inventing independent claim-level assessments.

Similarly, revision ancestry is technical history. A semantic relation such as "derived from," "revises an interpretation of," or "possibly the same target" requires separately stated meaning. Two records created in consecutive commits are not thereby connected semantically.

90.1.7 4. Projection and interaction

The most faithful general graph is an **incidence view**: every retained record is selectable; a Relation record has its own node; labeled spokes connect it to participant records. This naturally supports n-ary relations, relation properties, and relations on relations.

A simplified binary view can collapse an eligible two-participant Relation node into one labeled connection. That connection retains the relation record identifier and opens the same inspector. Collapsing is inappropriate where it would hide a relation that is itself a participant of another relation, hide additional participants, or merge separately identified parallel relations. The interface can allow the user to expand a simplified connection.

Creating a connection visually opens a small relation editor prefilled with the chosen participants. Saving creates a first-class Relation record. A form/list alternative supports keyboard, touch, and precise selection. Dragging nodes changes layout; drawing a connection changes represented content only after the user supplies its meaning and confirms the save.

Every graph request and inspector response needs one source snapshot. Opening a historical graph resolves participant names, roles, relation content, module data, and files from that same snapshot. The interface identifies filters and hidden records, so absence from the screen does not imply absence from the project or non-occurrence in the world. Selecting a historical version makes editing unavailable until the user returns to the current project or explicitly starts a supported revision operation.

Saved coordinates, viewport, collapsed state, and display preferences are presentation data. They are not target-time, epistemic status, or ontological properties. Shared versioned layouts can be stored separately from record content; transient panning need not generate a substantive history entry.

90.1.8 5. Modules and file custody

Modules are versioned record components: for example attachments, notes, a temporal account, relation participants, or a domain-specific academic annotation. A module descriptor identifies its type and version. An application registry determines rendering and validation. The common protocol can preserve extension data without claiming to understand its domain meaning. Unknown module types remain visible as unsupported data and are not discarded during an unrelated edit.

Choosing a recording role can suggest modules. It does not make those modules metaphysical constituents of the target. Attaching a PDF to a Relation record is storage associated with that representation; it does not turn the PDF into a participant or prove the relation. A richer material record can later describe source, acquisition, custody, transformations, and evidence use.

For the initial bounded local implementation, keeping immutable file bytes within the project Git object store offers a straightforward historical model. A file descriptor can retain a content digest, byte count, original display name, declared media type, creation/acquisition context where supplied, and the responsible uploader. Browser downloads use authenticated application routes; untrusted filenames are never repository paths or executable page content.

The descriptor and bytes need atomic publication with the associated record change. A historical download resolves the attachment as it existed in the requested reachable project commit. Removing a current attachment link does not claim erasure from retained commits or exported bundles. A filename match does not establish that two files are identical; identical bytes do not establish independent sources or identical acquisition histories.

Large-file storage, selective erasure, retention schedules, malware scanning, protected source identities, and external repository references require additional design. The first version can declare conservative file limits and safe download behavior without claiming those deferred features.

90.1.9 6. Commit protocol implications

The existing compare-and-swap publication of a new Git head is a useful primitive. The graph release needs an atomic **project transaction** above it:

1. Identify the expected project revision and submitted operation/revision reason.
2. Build the proposed next records, module descriptors, and file entries without publishing them.
3. Validate references and constraints against the complete proposed snapshot, including records created in that same transaction.
4. Retain transaction metadata identifying the protocol version, accountable actor, changed objects, reason, and applicable change categories.
5. Create one complete commit and publish it only if the expected parent still matches.

The transaction permits creating a new node and its connecting Relation together. Mutual references are validated against the final snapshot rather than an arbitrary write order. A rejected transaction exposes neither a partial node nor a partial relation. Preparing unreachable Git objects is different from accepting a project revision.

The transaction's recording timestamp and reason are distinct from target, observation, and assessment times. Change categories can distinguish a changed situation, new evidence

or interpretation, descriptive-regime change, and technical/presentation maintenance. More than one can apply. A stale expected revision is reported as a conflict; a new graph preview is obtained before a reconsidered save. Automatically merging relation endpoints can change substantive meaning and needs a later explicit conflict policy.

Existing records and commits retain their original schema and meaning. Reading old snapshots can provide a documented view adaptation; migration of current content is a new traceable commit. No migration converts neutral navigation links into asserted social or causal relations, supplies invented role criteria, or rewrites historical records in place.

90.1.10 7. Discriminating acceptance cases

These are proposed software tests and review cases, not evidence of whole-draft conformance.

Case	Expected behavior	Error exposed
Two agreements between the same two parties	Two independently selectable Relation records and histories survive export/reload.	Deduplication by endpoint/type silently erases historical tokens.
One agreement with three parties and distinct roles	One relation retains all participants; the inspector and graph reveal all roles.	Binary-edge conversion invents three independent agreements.
A relation constrains another relation	The second relation is an allowed participant; graph and export preserve it.	Relations are decorative edges with no independent reference.
An agreement described as both Entity and Relation	Both applied roles persist; relation features remain available.	Exclusive type selection makes role overlap an inconsistency.
A record cites a document about an organization	The relation identifies whether its participant is the document record or the described organization.	Record and referent are silently conflated.
A self-referential arrangement uses different roles	Participant entries remain distinct and named; a blanket cycle ban does not reject them.	Graph topology is mistaken for semantic admissibility.
An unknown participant in an asserted arrangement	An explicit unresolved designation appears without a fabricated identified person.	Structural completion is mistaken for factual knowledge.
A realized event is retrospectively inferred and disputed	Modality, epistemic basis, and dispute remain separately visible.	A single status field conflates three questions.
Two semantic records link both ways	Graph round-trips without a DAG constraint.	Git ancestry constraints leak into represented relations.
A new node and Relation are created together, then a concurrent writer wins	The losing save publishes neither partial object; the accepted snapshot remains valid.	Multi-object writes leave a dangling relation or overwrite a newer revision.
A participant is renamed after an older graph snapshot	The older graph retains the earlier label and relation version.	Historical content is rendered using present-day data.
A file is replaced, then removed from the current module	Earlier authorized snapshots download the earlier bytes; current removal is described as unlinking.	Historical attachments drift, or unlinking is misrepresented as erasure.
A current record with an unfamiliar module is edited in a familiar field	Unsupported module data survives unchanged and is identified to the user.	One application silently destroys another application's domain data.
Legacy `related_records` contains two records	Migration preserves a neutral cross-reference until a user supplies a typed relation.	Migration manufactures substantive claims.
The graph hides withdrawn records or an entire role	The filter and hidden-count boundary remain visible.	A reduced display appears to be the complete retained history.
A label says "supports" with an uploaded PDF but no assessment	The application does not declare evidential sufficiency, truth, or an examined claim.	Connection creation becomes an unearned assessment.

90.1.11 8. Traceability to Working Drafts

These are design relationships, not fulfilled-requirement claims. The implementation still needs a declared profile, field validation, examples, and explicit remaining gaps.

Draft locations	Design relationship
GR-100, V100-002/005; section 3 definitions of Record, Target, Record reference	Record identifiers, described targets, and reference interpretations remain distinct.
GR-100, V100-006/007; GR-110, R110-008/020/021; GR-200, E200-008/017/038	Recording history, represented time, revision grounds, and alternative accounts remain distinguishable.
GR-100, V100-009/010/025 and section 5 Relation	Role overlap, independently referenceable relations, contextual participants, temporal meaning, and declared criteria.
GR-110, R110-006/007/009/048/049	Stable record/version references; identity and continuity claims do not follow from keys, equal labels, or link patterns.
GR-110, R110-011/012/051/058; GR-200, E200-005/014	A diagram edge does not establish generative attribution; each asserted connection retains relevant grounds and qualifications.
GR-200, E200-003/010/011/012/016/019	Material, claim-relative evidence, dependence, assessment, and revision follow-up need more than a generic link or attachment.
GR-100, V100-011/012	Graph structure is an operational representation, separate from the metamodel and from legal, normative, or institutional authority.
GR-110, R110-025/026/029/030/093	Protection of content and metadata, explicit missingness, selected view boundaries, source revision, and refresh status.

90.1.12 9. Gaps in the proposed family

The existing GR-100/110/200 clauses already establish the relevant distinctions. Graph implementation does not by itself require changing their 0.3 normative text. More concrete work belongs in the following currently preliminary project outlines and the implementation Specifications they motivate.

Project	Current source state	Concrete requirements-development need exposed by this application	Technical detail for a supporting Specification
GR-120	Short implementation-neutral project outline	Define record, target, claim, version and participant-reference relationships; preservation of overlapping roles; first-class relations and partial incidence; identity, time, missingness and extension boundaries.	Exact JSON envelope; role and participant arrays; reference interpretation; namespaced module descriptors; validators and schema-version transitions.

Project	Current source state	Concrete requirements-development need exposed by this application	Technical detail for a supporting Specification
GR-130	Short interchange outline listing candidate representations	Declare exchange unit and source revision; preserve reference scope and extension data; expose unresolved dependencies; specify import failure, partial receipt and unsupported-version behavior; maintain original meaning through migration.	Concrete wire format; protocol manifest; transaction operation schema; canonical encoding; Git tree paths, commit metadata, conditional publication, and binary representation.
GR-140	Short outline listing possible views	Identify a presentation's source version, transformation, selection and refresh status; retain relation identity in simplified graphs; reveal n-ary/parallel/recursive structures without invented implications; keep mode, modality and dispute readable; provide an alternative to spatial gestures.	Incidence/collapsed-view algorithms, projection identifiers, user-interface contracts, saved layout format, and snapshot navigation endpoints.
GR-160	Short outline of preservation and access subjects	Define retention and availability states for records, files, metadata, derived views and audit trails; distinguish unlinking, withdrawal, restriction and erasure; authorize historical access; define reconstruction and custody limits.	File descriptors and digest rules; authenticated historical download resolution; size/type handling; retention/export manifests and future external-object protocols.

The standards-track drafts can state implementation-neutral expectations and assessment evidence while an experimental shared Specification implements the bounded profile. Neither needs to assert a comprehensive conformance result before pilot evidence exists. A minimal graph pilot does not solve the full GR-160 legal or institutional programme; unimplemented domains remain declared limitations.

90.1.13 10. Decisions still needed

- **PROVISIONAL:** Exact protocol identifier, field names, module registry, and transition from the existing `gsp-workspace/0.1` representation.
- **PROVISIONAL:** Whether the first interface exposes all relation forms immediately or declares a narrower initial profile with preserved extensibility.
- **OPEN:** Structured claim and material identifiers sufficient for claim-relative evidence and independent assessments.
- **OPEN:** Relation identity/admissibility criteria and typed vocabularies suitable for particular domains without imposing their meaning on every project.
- **OPEN:** Protected or cross-project references, shared access, governed retention, and genuinely independent implementation tests.
- **DEFERRED:** Semantically justified branch/merge workflows; Git's ability to represent a commit DAG alone does not settle those workflows.

The general and academia applications can share the record/transaction/file protocol and test fixtures while retaining different module registries, user journeys, and entry points.

That shared substrate is a proposed engineering boundary; it is not a claim that the existing academia model already implements these semantics.

91 graph workspace design

Original source: `docs/planning/graph_workspace_design.md`.
Original source SHA-256: `039f70856862fe48e9ffd44a523a2fd011421ac24ae424ab87941d25fb215545`.

91.1 Graph workspace and shared recording protocol

Class: Informative implementation design and delivery plan
Status: PROVISIONAL design selected for experimental implementation; 2026-09-22
Application: Generalized workspace first; academia adaptation is a subsequent project
Protocol identifier: `gsp-record-protocol/0.2`
Profile: `gsp.general/0.2`

91.1.1 1. Purpose, source precedence, and scope

The user requested a carefully designed graph workspace, visual creation of records and connections, modular record panels and file storage, with a protocol that can support a later independent academia application. The user explicitly prefers the current GR manuscripts where the older academia project conflicts, and authorizes revisions to our specifications and drafts when a concrete deficiency is identified.

The source review grounds graph semantics in actual foundation passages and current GR-100/110/200 requirements. The academia comparison identifies useful interaction patterns and differences between its design and implementation. The current programme remains the conceptual source; academia is a reference implementation of an older, narrower scholarly model. Its eight epistemic acts, append-only signed transition format, disclosure restrictions and prohibitions on some node kinds do not become universal GR rules.

The present implementation covers a general record graph, a reusable protocol package, atomic Git transactions, record modules, bounded retained attachments, consistent historical views and a migration path from the first workspace. It does not modify the academia repository, rewrite its signed records, or claim cross-application conformance. A later adapter needs independently exercised mapping and preservation fixtures.

91.1.2 2. Three distinct structures

Structure	Meaning	Constraints and authority
Record graph	Attributed representations and relationships, including relations whose participants are other relations	Cycles, parallel relations, repeated participants and several roles are possible; no Git DAG constraint is imposed
Revision history	Accepted changes to a project's stored representations and material	The initial Git binding publishes one parented project commit per accepted transaction on `main`; parentage is recording provenance, not causality or occurrence chronology
Display projection	A selected rendering of a particular project revision	Layout, zoom and selection do not change the records; filters and unsupported material remain visible limitations

A record identifier identifies a representation retained by this system. It does not establish the identity of the represented target. An attachment digest identifies bytes, not their independence, truth or evidential sufficiency. A transaction is a storage operation, not automatically a recorded Event or a substantive GRRP transition.

91.1.3 3. Record envelope and overlapping roles

The general profile retains the current descriptive fields so existing accounts remain legible: title, content, primary knowledge basis, modality, owner-assigned status, attributed source,

method, evidence text, uncertainty, alternatives, conditions, consequences and described time. Server-assigned IDs, creator/updater and recording timestamps retain their distinct meanings.

`record_type` remains the primary presentation role. `record_roles` contains one or more of Entity, State, Event, Process, Relation and Property and includes that primary role. Selecting multiple roles does not create additional targets or occurrences. The model does not introduce an ontology class for every user-interface module.

`related_records` remains a set of neutral navigation references. Its preservation is especially important during migration: an earlier untyped link cannot become a causal, evidential or social relation merely because the new interface draws edges.

Records declare `schema_version: gsp-workspace/0.2` and carry a namespaced `modules` mapping. Core descriptions and modules belong to one record revision; a module is not an independently trusted authority. The existing single primary epistemic mode remains limited, with mixed grounds stated in method and qualification text. A richer epistemic representation remains a separate work item.

91.1.4 4. Relations as records

A structured Relation is an ordinary record whose roles include Relation and whose `gsp.relation` module has version `1`. It can carry the same notes, files, attribution and history as other records. The module has:

- `predicate`: an attributed local relationship label; optional `predicate_definition` states its intended meaning;
- `participants`: one to 32 incidence entries, each with its own UUID `id`, `record_id`, descriptive `role`, `reference_scope` and `orientation`;
- `participants_complete`: an assertion about the listed scope, with `participant_limitations` required when false;
- `context`, `identity_criterion` and `temporal_scope`: descriptive text; empty text means not recorded, not false, timeless or resolved.

`reference_scope` is `represented_target` or `record`: relating two organizations differs from relating two records about them. `orientation` is `in`, `out` or `undirected` and controls the declared incidence orientation; it does not by itself mean cause, influence, superiority or evidential strength. Role and predicate interpretation remain inspectable.

Repeated references to one record are allowed as different incidences; incidence UUIDs distinguish them. Unary, self-referential, cyclic, parallel and higher-order relations are permitted. Zero listed incidences are excluded as an explicit first-profile limit. Unknown participants are expressed through incomplete-incidence qualifications; the software does not create fictional participant records to complete a diagram. The first binding permits participant references within one project only. Cross-project protected references need a further design.

No uniqueness constraint on predicate plus endpoints is imposed: two agreements between the same parties can be different historical relations. An existing unstructured Relation record remains valid as an unstructured account and is identified accordingly.

91.1.5 5. Modules and authority boundaries

The first registry implements three persisted record modules:

Module	Meaning	Editing behavior
`gsp.relation`, version `1`	Structured relation account	Available when Relation is among the record roles; complete module replacement validates participant references against the resulting snapshot
`gsp.notes`, version `1`	Retained supplementary notes, `data.text`	Explicit save with a revision reason; not a private scratchpad or independent assessment

Module	Meaning	Editing behavior
`gsp.files`, version `1`	Retained material descriptors, `data.items`	Changes only through file operations so descriptors and bytes cannot diverge

Module envelopes contain `version`, `required` and object `data`. An unfamiliar optional module remains intact during unrelated edits and is displayed as unsupported, read-only data. An unfamiliar required module prevents project mutation because its necessary constraints cannot be evaluated. Known modules at unsupported versions are also not silently normalized. No stored module installs code, runs scripts or selects arbitrary server paths.

An enabled empty files/notes module is distinguishable from an absent module. Module removal is an explicit transaction; removal of a files module with linked material is refused until the links are explicitly detached. Relation-module removal does not erase prior descriptions or the relation record's identity.

Graph layout is local view state, keyed by application, account and project. No credentials or record text are stored there. Record attachments differ from academia's mutable scratch workspace: saving an attachment deliberately retains its bytes in project history. Scratch folders, scheduling and domain-specific module registries can be added later with their own persistence and disclosure boundaries.

91.1.6 6. Shared package and application separation

An independent Python package under `applicative_infrastructure/common/packages/gsp_record_protocol/` provides constants, validation, schema resources, graph projection, transaction preparation and a command-line snapshot validator. It does not import Flask, SQLite or Git. JSON schemas and deterministic fixtures make the contract inspectable without a particular web client. ADR-0009 relocates the original root package and extracts the Git store into the adjacent `gsp_git_store` package without changing their record semantics.

The generalized application supplies authentication, authorization, server attribution, the Git adapter and its own interface. The academia application can later consume the same storage and exchange concepts through a profile adapter while preserving its original native envelope and signatures. UUIDs in the general workspace are not silently substituted for GRRP content identifiers. Shared infrastructure does not imply equal semantic types, equal mutation policy, or shared accounts.

Separate applications retain separate entry points, data roots and session namespaces. Different ports alone do not isolate browser cookies, so an eventual combined launcher needs explicit cookie naming and origin rules as well as port selection.

91.1.7 7. Transaction envelope

The experimental binding uses `POST /api/projects/{id}/transactions`. The logical request contains:

```
{
  "protocol_version": "gsp-record-protocol/0.2",
  "transaction_id": "client-generated UUID",
  "expected_head": "full project commit identifier",
  "reason": "Why these representations or materials are being changed",
  "change_categories": ["description"],
  "operations": []
}
```

Categories are `description`, `represented_change`, `evidence_or_interpretation`, `classification`, `maintenance` and `migration`. They describe the recorder's account of the change, not a verified event classification. Multiple categories can apply. `migration` is reserved to the migration operation.

Supported operations:

Operation	Input and effect
`record.create`	A caller-chosen record UUID and editable record fields; server adds recording attribution and time

Operation	Input and effect
`record.update`	`record_id` and partial `changes`; omitted fields/modules survive unchanged
`module.set`	`record_id`, `module_id`, complete module envelope; files content cannot be forged through this route
`module.remove`	`record_id`, `module_id`; explicit guarded removal
`file.attach`	New `file_id`, owning `record_id`, named binary `part`, filename, declared media type, SHA-256 and byte length
`file.replace`	Existing file descriptor ID with new material and metadata, preserving the descriptor's identity and previous historical versions
`file.detach`	Remove the current descriptor link; no claim of physical erasure
`project.migrate`	Sole operation of a legacy-project migration; explicit mapping and limitations recorded

One request can create several records and a relation among them. Validation examines the final candidate snapshot, so operation order does not manufacture missing participants. Repeated core mutations of one record or repeated mutations of one module/file descriptor are rejected rather than interpreted as last-write-wins. Creating a record and subsequently adding a distinct module or attachment is permitted.

Ordinary commands use JSON. File commands use multipart with one textual `transaction` JSON part and declared binary part names. Duplicate JSON members, duplicate multipart names, extra or missing binary parts, nonfinite numbers, malformed Unicode, unrecognized operation fields and invalid declared hashes are refused.

91.1.8 8. Idempotency and publication

The server authorizes the project before inspecting any receipt. It computes a request digest using RFC 8785 canonical JSON over the logical envelope and verified file identities, excluding multipart boundaries and server-generated attribution/time. A vetted canonicalization library implements the encoding; ordinary Python JSON sorting is not presented as JCS.

The receipt lives in the same tree as accepted changes at `.gsp/transactions/{transaction_id}.json`. It records protocol version, transaction ID, original expected head, authenticated actor, server recording time, reason, change categories, request digest, changed-resource summaries and validation limits. The resulting commit identifier is not embedded in its own tree; the adapter obtains it from the receipt path's introducing commit.

The adapter checks a committed receipt before rejecting an old expected head. Identical actor/request replay returns the original result and `replayed: true`, even after other changes advance the project. Reusing an ID for a different logical request is a conflict. An identical concurrent request rechecks the receipt after a failed publication attempt. A revised request after reconciliation receives a new transaction ID.

After validation, the adapter writes blobs and complete changed subtrees, creates one parented commit, and conditionally updates `refs/heads/main`. The single reference is the publication boundary. Failure before publication leaves no partial accepted graph. Unreachable prepared objects may remain and are not accepted revisions. An uncertain response near publication is recovered through the transaction receipt, not by claiming that no commit occurred.

91.1.9 9. File custody and budgets

Files are stored as Git blobs at `assets/{sha256}`. Filenames are descriptive metadata and never filesystem paths. A descriptor retains `file_id`, filename, media type, SHA-256, byte length, upload actor and upload time. New bytes and the owning record's descriptor publish together. Replacements and detached links remain reconstructable through older commits.

The initial binding limits a file to 10 MiB, combined binary parts to 20 MiB per transaction, binary parts to eight, operations to 100, participant incidences to 32, active records to 1,000, module payloads to bounded JSON and retained asset bytes reachable from the current project tree to 128 MiB. Asset entries are retained in the project tree for this first custody policy;

physical unreachable objects and Git metadata are not covered by that logical byte budget. Operational filesystem quotas and governed garbage collection remain hosting work.

Uploads are spooled and hashed with bounded reads. Downloads and bundles use bounded streaming or temporary files. Arbitrary content is offered as an attachment with `nosniff`, not rendered as active HTML. A digest is not an authorization token: the requested record, descriptor and chosen project revision determine access.

Preservation of a file does not make it assessed evidence. Identical bytes may have different acquisition histories; distinct descriptor IDs preserve those accounts while storage can reuse a blob. No antivirus, media interpretation, legal hold, selective erasure or remote object-store guarantee is implied.

91.1.10 10. Snapshot-consistent reads and exports

`GET /api/projects/{id}?revision={commit}` resolves one authorized reachable project revision and reads all records from that tree. A graph response and its inspector use the same revision. Participant labels, related-record labels, relation structure, notes and downloads do not silently resolve through today's head when viewing history. Historical screens are read-only; returning to the current project is explicit.

The graph projection exposes every retained record as a selectable node. Structured relations appear as relation nodes with incidence spokes; neutral references have a distinct dashed style. Predicate/role labels and reference scope remain inspectable. A selected relation has the same module panel as another record. A future collapsed binary view is optional and cannot discard relation identity, parallel edges or higher arity.

Filtering discloses that it is a selected view and reports hidden nodes/incidences. Layout and distance are not scores, time or causality. A list/form alternative provides creation, selection and connection without requiring precise spatial gestures. The server supplies warnings for unsupported/unstructured modules rather than silently presenting a complete semantic graph.

Current snapshot JSON identifies its source revision and excludes file bytes. A current snapshot ZIP includes only selected current records and their referenced material plus an export manifest. It omits the accumulating receipt ledger and detached assets; otherwise a supposedly current-only export would leak historical reasons and content. A full Git bundle deliberately carries all reachable history, receipts and retained assets. Neither export contains account credentials or restores ownership by itself.

Batch Git object reads replace one-process-per-record loading. Any derived cache is keyed by exact commit and is disposable; it cannot become a competing source of record truth.

91.1.11 11. Explicit legacy migration

Reads never migrate a project. Old commits are interpreted through a declared read adaptation: the primary role becomes the sole displayed role, missing modules are absent, and old navigation references remain neutral. IDs, original bytes and historical Git commits are retained.

An owner can preview and request migration of the current project through a dedicated transaction. The new commit upgrades project/record schema declarations, adds role arrays and module containers, and records the source revision and mapping limitations. It does not infer relation predicates, participant roles, new epistemic grounds or nonexistent attachment bytes. Existing unstructured Relation accounts remain unstructured.

New projects start with the new protocol. Compatibility record endpoints can translate their existing bounded commands into transactions while preserving extension modules; they do not bypass validation or promise the full retry contract of a caller-supplied transaction ID.

91.1.12 12. Academia migration boundary

The later academia upgrade begins with fixtures preserving original GRRP bytes, identifiers, signed-covered fields, registrations, disclosure sidecars and referenced material. The current manuscripts govern new conceptual choices, but old records are not rewritten to pretend they always used the new model. A correspondence explicitly distinguishes exact preservation, partial mapping and unresolved differences.

The reference review identifies concrete repair work: bind web sessions to acting identities; preserve absent references; validate imports for path, collision, size and partial failure; clarify mutable workspace versus retained material; separate administrative operations from substantive graph projections. These are queued migration concerns, not changes made to the academia application by this delivery.

91.1.13 13. Sequence and acceptance evidence

1. Complete source/design comparison and record architectural decisions.
2. Write experimental GR-SPEC-120/130 details and executable schema/fixture contracts. Develop bounded implementation-neutral requirements in the currently preliminary GR-120/130/140/160 projects where needed; leave adequate 0.3 clauses intact.
3. Implement and test the independent validator/projector, then atomic Git binding and HTTP adaptation.
4. Implement graph creation/connection, conditional modules, historical navigation and migration UI.
5. Exercise failure cases and browser journeys, inspect desktop/mobile views, document limits and restart the local application only after tests pass.

Required evidence includes: atomic node-plus-relation-plus-file creation; rollback on a bad final operation; same-batch cyclic/higher-order participants; parallel and unary relations; role overlap; invalid/cross-project references; identical/different replay across restart and advancing heads; racing writers; missing, extra, corrupt and oversized file parts; historic file replacement/detachment; legacy migration without invented semantics; opaque module preservation; current export selection; full bundle reconstruction; pinned historical graph/inspector; visual and nonspatial connection creation; draft preservation after conflict; and no semantic commit for node dragging.

No numerical test count substitutes for inspecting these distinctions. Independent academia interoperability, public deployment, institutional contestation and full GR conformance remain outside this release’s evidence.

92 open questions

Original source: `docs/planning/open_questions.md`.
Original source SHA-256: `27b35ad4879927e41794b876e5ece2042a69d8d9457dd296a4bcb1f8e89aba81`.

92.1 Open Questions

Document class: Informative issue register
Status: OPEN / evolving

92.1.1 Event time and spacetime projection, 2026-09-22

ADR-0011, the source-grounded design and GR-SPEC-121 define the bounded experimental extension. They do not establish historical truth, an exhaustive GR temporal theory or standards adoption.

ID	Status	Question and present treatment	Needed by
Q-45	EXPERIMENTAL	How should alternative coherent chronology accounts be selected without discarding evidence? Version 1 retains conflicting strict-order assertions, diagnoses cycles and provides no cut topology for an unusable ordering. Withdrawn order accounts are excluded; contested and non-realized accounts remain visibly qualified. User-selected competing account sets remain open.	Comparative temporal reconstruction
Q-46	DEFERRED	How should extended events, onset/completion distinctions, overlapping intervals, uncertain calendar dates and multiple temporal reference systems relate to operational event boundaries? Version 1 uses explicit Event markers and start-inclusive/end-exclusive applicability; it infers no ordering from dates, Git or layout and invents no duration.	Richer temporal profile

ID	Status	Question and present treatment	Needed by
Q-47	OPEN	Which identity/ continuity criteria and effect semantics justify a trajectory or reconstructed state? Version 1 groups scoped accounts by supplied subject references with a basis; it does not infer identity, execute effects, resolve competing states or assume all linearizations produce one outcome.	Domain trajectory models and formal semantics
Q-48	OPEN	Do users distinguish event cuts, order layers, physical time, unknown scope and recording revision, including partial Relation views? The induced active subgraph preserves applicable Relation accounts and diagnoses omitted incidences. Automated correctness checks do not establish comprehension or accessibility.	Participatory interface assessment

92.1.2 Graph protocol and modular application, 2026-09-22

ADR-0008, the design, source review and academia comparison record the selected experimental choices. They do not settle the corresponding conceptual or institutional questions.

ID	Status	Question and present treatment	Needed by
Q-38	EXPERIMENTAL	How should relation identity, unknown participants and cross-project references evolve without leaking protected targets or equating record identity with target identity? The first profile uses local UUID references, distinct incidences and explicit participant completeness; zero-incidence and cross-project structured relations remain outside the profile.	Wider graph profile and protected collaboration

ID	Status	Question and present treatment	Needed by
Q-39	OPEN	How should external material stores, physical quotas, selective erasure, sealing and independent preservation custody work with atomic transactions and existing history/bundles? The first binding retains bounded Git assets; detachment is not erasure and logical asset budgets are not disk quotas.	Sensitive records, hosting or larger material
Q-40	OPEN	Do intended users understand Relation nodes, reference scope, hidden incidences, historical selection and changes of epistemic basis? Canvas alternatives and browser tests do not establish accessibility or measured comprehension.	Participatory graph/ interface evaluation
Q-41	DEFERRED	Which academia GRRP records map exactly, partially or not at all to the shared profile while preserving native IDs, signed bytes, registrations, disclosure and material? ADR-0009 completes source/ runtime consolidation and independent entry points; an adapter fixture corpus and identity binding remain required. The original checkout remains unchanged and the imported application retains native GRRP.	Academia upgrade
Q-42	PROVISIONAL	Which optional-module, profile and registry governance preserves extension semantics across independent producers? Unknown optional module envelopes survive unrelated edits, unknown required semantics block mutation, and unsupported binding manifests are not rewritten. This is conservative pilot behavior, not a completed extension-governance system.	Second implementation and import design

ID	Status	Question and present treatment	Needed by
Q-43	OPEN	What deployment, host/cookie isolation, account recovery, dependency maintenance and backup-restoration procedures are required before operating the consolidated applications beyond local development? Separate ports and cookie names support independent local use but do not create a browser security boundary. The inherited academia dependency advisories and historical identity/custody findings require a dedicated upgrade.	Domain deployment and academia maintenance
Q-44	OPEN	Which access policies, CI checks and release procedures will serve the four source repositories? The user supplied all four GitHub URLs, and the submodule URLs now identify those hosted repositories; the current repository guide records their use. Release and repository-governance policies remain open. MIT repository licensing does not license private application records or adopt governance drafts.	Repository governance and releases

The new transaction categories partially address Q-36 without completing structured mixed epistemic grounds or source assessment. Q-34/35/37 remain open; a graph and receipt ledger do not supply shared governance, authorized erasure or actual contestation.

92.1.3 Experimental application, 2026-09-22

ADR-0007 records the private-project Git workspace; its design distinguishes working features from draft conformance. User authorization to implement a pilot does not adopt a technical Standard.

ID	Status	Question and present treatment	Needed by
Q-34	DEFERRED	What membership, invitation, contribution and historical-access rules should shared projects support? The first implementation authorizes only the project creator.	Collaboration release

ID	Status	Question and present treatment	Needed by
Q-35	OPEN	How should retention, erasure, account recovery, repository repair and backup restoration be operated and verified? Revision and withdrawal currently retain historical content, including in bundles.	Sensitive use or hosted deployment
Q-36	EXPERIMENTAL	Which richer claim/evidence objects, mixed epistemic bases, observation/acquisition times and semantic revision distinctions are needed beyond the current primary-role form? Optional prose preserves qualifications but does not enforce the complete draft model.	Pilot feedback and GR-SPEC-120/200 development
Q-37	OPEN	Which accountable actors and workflows can support an actual challenge, reasoned review, notification and practical remedy? Owner-assigned record status is not an independent contestation procedure.	GR-210 application pilot

92.1.4 Substantive validation cycle, 2026-09-22

The 0.2 validation dossier records review coverage, P0/P1 results and corrections implemented in the preparatory 0.3 edition. ADR-0006 explains the operational choices. Fixed drafting defects do not close the broader governance and theoretical questions below.

ID	Status	Question and present treatment	Needed by
Q-31	OPEN	May a final ballot open while the reply-to-disposition window is still open, or must the windows be sequential? P0/v2 uses a conservative sequential design; it does not adopt that choice.	Before a live review/ballot schedule
Q-32	OPEN	How are start events, closing instants and calendar days interpreted across time zones and daylight-saving transitions? Notices need exact times; synthetic elapsed-day examples do not establish a universal civil-calendar convention.	Before a live time-bound procedure

ID	Status	Question and present treatment	Needed by
Q-33	PROVISIONAL	Does conditional R110-112 adequately record recirculation stages and link-specific uncertainty without treating every generativity-return account as recirculation? Its source basis is FM-005 section 5.17.3, p.145; broader definition, valuation and entitlement remain unresolved.	Source/author review and relevant return-account pilot

Q-22/26/28 remain open: all requirements have editorial review coverage, but that supplies no actual founding authority or measured participant burden. P1/v2 leaves retention-decision applicability unresolved and supplies no actual notification, review or repair evidence. Its fulfilled documentary components do not establish whole-practice conformance.

92.1.5 Expanded working-draft review, 2026-09-22

The 0.2 package develops the existing proposals in greater detail. ADR-0005 records why ISO, IEEE, ITU and UN sources have different roles. The earlier questions remain open unless a separate decision closes them.

ID	Status	Question and current treatment	Needed by
Q-27	PROVISIONAL	Is the local formal publication structure suitable for this family? The draft uses ISO-like numbered clauses and labelled annexes, accessible IEEE drafting rules and ITU comparison without importing institutional authority. Full inaccessible external resources need review before more detailed reliance.	Editorial adoption and external release
Q-28	OPEN	Which expanded obligations are proportionate for different practices, and what justified profiles would reduce burden while preserving material uncertainty, protection and accountability? No reduced conformance profile is implied by a short form.	Participatory rehearsal and GR-150 development

ID	Status	Question and current treatment	Needed by
Q-29	PROVISIONAL	Is EIP-069's reasoned 'more likely than not' criterion appropriate for internal conduct findings, with fair-response and independent-review safeguards? Alternatives include a higher threshold, contextual criteria or non-adjudicative findings. Neither the criterion nor a finding establishes external legal liability.	Governance and ethics review before adoption
Q-30	OPEN	Which UN-system institutional model or potential counterpart fits an actual pilot purpose and mandate? ITU, UN/CEFACT and UN statistical guidance perform different functions; no sponsor, partnership or policy adoption is presumed.	Any international policy proposal

Normative schedules in the 0.2 drafts are operational proposals for review. Their presence does not establish that an actual institution can supply the stated evidence or that affected users find the procedure usable. P0/P1 retain their historical 0.1 scope until reassessed.

92.1.6 First working-draft review, 2026-09-22

The initial package supplies proposed operational answers, not resolutions of this register. ADR-0004 records alternatives and affected requirements. The following choices need focused review before progression:

ID	Status	Question and current draft treatment	Needed by
Q-21	PROVISIONAL	Are D1's 60-day public review, 30-day re-review/ballot/appeal periods, two-thirds returned-ballot quorum, three substantive votes and two-thirds substantive approval practicable and sufficiently inclusive? Numerical support alone does not establish stakeholder balance.	Governance adoption

ID	Status	Question and current draft treatment	Needed by
Q-22	OPEN	Who can sign the founding instrument with actual authority over programme resources and publications, accept roles and provide neutral review? The unsigned template does not create those capacities.	Governance adoption
Q-23	PROVISIONAL	Are preparatory GR-100/110/200/210 scopes the right first technical cycle, and do the dependency boundaries prevent hidden package obligations? All remain unapproved projects pending governance.	NWIP decision and next technical draft
Q-24	OPEN	What limited package/case conformance profiles are useful? This draft permits partial documentary assessment but does not treat it as observed practice or procedure fulfillment.	Pilot assessment design / GR-150
Q-25	OPEN	Which alternative reading format and accessibility target can be sustained? LuaLaTeX compilation, extracted text and source availability do not establish PDF accessibility or user comprehension.	Before external formal release
Q-26	OPEN	What are the measured recording/review costs and effects on affected participants? P0 arithmetic and P1 authored scenarios supply no observed staffing, elapsed effort, participation, review fairness or remedy evidence.	Participatory rehearsal / live pilot

Q-05/06/07 now have explicit candidate operational treatments in the TeX drafts, including overlapping roles, distinct modality/epistemic mode and three revision reasons. They remain open to source and pilot review; Property/Attribute, manuscript chronology and formal emergence assumptions are not settled. Q-03 rights choices also remain unresolved: the policy draft supplies a rights-clearance process, not a licence grant.

92.1.7 Decisions needed for the current development plan

These priorities supplement the earlier thematic questions below. Milestones refer to the comprehensive plan. Roles are proposed and unassigned. An operational resolution records alternatives, rationale, source mappings and affected documents; it does not retroactively resolve a philosophical question.

ID	Status	Decision or investigation	Needed by	Proposed accountable role
Q-01	OPEN	Who holds founding authority, and how are governance adoption, delegation, conflicts and independent appeals made credible for a small programme?	M1	Founding authority / governance editor
Q-02	OPEN	Which participation, consensus, review, objection and appeal rules are practicable? Which ISO/IEC or IEEE mechanisms are adopted, adapted or deferred, and why?	M1	Governance editor and stakeholder reviewers
Q-03	OPEN	What licensing and contribution terms apply separately to publications, schemas, examples, software and third-party source material?	M1	Governance and IP reviewers
Q-04	PROVISIONAL	Is GR/NWIP-001 one coordinated package or several linked work items, and which responsible editors have capacity for its first cycle?	M1–M2	Sponsor and established decision body
Q-05	OPEN	How do Part II's Attribute and the repository's Property relate? Are the six roles overlapping, and how are admissibility, identity and persistence scoped?	M2	GR-100/120 editors
Q-06	OPEN	How are claim, observation, trace, evidence, interpretation and judgment represented without conflating target reality, source records and institutional acceptance?	M2	GR-200/210 editors
Q-07	OPEN	What records distinguish world change, evidence change and category/regime change, including revised identity and retrospective recognition?	M2	GR-100/120/200 editors

ID	Status	Decision or investigation	Needed by	Proposed accountable role
Q-08	OPEN	Which version relationships among the foundation manuscripts are author-confirmed, and which apparent formal or terminological differences remain unresolved?	M2 for definitions relying on them	Source editor and author
Q-09	OPEN	How are Part I's fixed-carrier collapse results and stronger interpretive language qualified by Part II? Which emergence claims require additional assumptions?	Before reliance in a requirement	GR-TR101/102 editors
Q-10	PROVISIONAL	What is the smallest useful generative history: which changes in capacity, maintenance, constraints, alternatives and loss need grounds, and when is unknown the appropriate result?	M2–M3	GR-110/210 editors and pilot users
Q-11	OPEN	How are corrections, access withdrawal, retention, deletion and permitted audit traces reconciled without an unconditional immutable-history requirement?	M2 before sensitive pilots	GR-160/310 editors and contextual reviewers
Q-12	OPEN	Which conformance subjects and profiles separate capability from recording depth? Does the candidate name Standard profile confuse publication status?	M2	GR-150 editor
Q-13	PROVISIONAL	Which institutional procedures need machine protocols, and when do portable exchange, notifications or federation justify separate technical work?	M3	GR-130/200/400 editors

ID	Status	Decision or investigation	Needed by	Proposed accountable role
Q-14	OPEN	How will pilot burden, meaningful contestability, presentation comprehension and unequal access be evaluated, and what result warrants redesign?	M2, before measurement	Pilot lead and affected participants
Q-15	DEFERRED	Which jurisdictional profiles, generativity-return assessments, formal semantics or additional publications need development beyond the first cycle?	After relevant pilot evidence	Relevant editors and domain reviewers
Q-16	OPEN	How are ethical disagreement, distributive effects, recognition and responsibility assessed without implying one universal value ordering?	M2 and relevant policy analysis	Ethics reviewer and affected participants
Q-17	OPEN	Which legal concepts and sources of authority are relevant to the selected use case, and which unresolved conflicts require contextual analysis or a policy proposal?	Before contextual pilot claims	Jurisprudential and institutional reviewers
Q-18	OPEN	Which international organization or class of institutions has a suitable mandate, and how do voluntary pilots, shared stewardship, existing infrastructure or deferral compare?	Before any policy recommendation	Policy editor and mandate reviewer
Q-19	OPEN	How are ownership, access, funding, maintenance cost, infrastructural dependency and returns to contributors governed without concentrating recognition power?	M1–M4 as scope develops	Programme governance and political-economy reviewers

ID	Status	Decision or investigation	Needed by	Proposed accountable role
Q-20	OPEN	Which cross-domain review competencies can actually be supplied, and how do participation gaps limit scope or progression?	M1–M2	Sponsor and review coordinator

The foundation map preserves source tensions. The technical landscape, development comparison, and cross-domain programme distinguish external sources from proposed local choices. No external compatibility or institutional affiliation is assumed.

92.1.8 Ontology

- Are Entity, State, Event, Process, Relation, and Property sufficient for the core record ontology?
- Should Observation, Claim, Interpretation, or Agent be first-class ontology classes or profiles built from the six?
- How should identity and persistence be represented without assuming substance ontology?
- How should relation identity be handled through time?

92.1.9 Generativity

- How should a record represent the emergence of a distinction that was previously unavailable?
- How should changes in a possibility field be represented?
- How should unrealized branches be recorded without implying that they were equally feasible?
- How should generativity return be represented?

92.1.10 Formal semantics

- Which category-theoretic structures are most appropriate?
- Should the core information model remain formalism-neutral?
- How can state transition, relational change, and persistence coexist in one mathematical framework?

92.1.11 Standards governance

- What threshold constitutes consensus?
- Which stakeholder classes must be represented in public review?
- What is the minimum viable appeals process for a small NGO?
- What licensing model best supports open implementation and future formal standardization?

92.1.12 Conformance

- What does it mean for a record to conform?
- Should there be Core, Standard, and Deep conformance profiles?
- Which clauses can be automatically validated?

92.1.13 Privacy and ethics

- How should preservation be separated from publicity?
- How are sealed, restricted, anonymized, and destroyed records distinguished?

- How should third-party generative contributions be recorded without creating surveillance risks?

92.1.14 Foundation corpus

- Which GR manuscripts should be designated foundational rather than supplementary?
- Which terms have changed meaning across the GR corpus?
- Which notational conventions should GR-100 preserve?
- Where should a standards-specific operational definition deliberately diverge from a broader GR concept?
- How should manuscript-to-clause traceability be represented?

92.1.15 Epistemics

- Should Observation, Claim, Evidence, Interpretation, Judgment, and Attribution be first-class record classes, or epistemic wrappers/profiles around other records?
- How should evidentiary provenance and uncertainty be represented?
- How should conflicting interpretations coexist without premature canonicalization?

92.1.16 Jurisprudence and law

- Which legal concepts require dedicated profiles rather than generic metadata?
- How should correction, annotation, objection, access, restriction, and preservation rights be represented?
- How should the standards distinguish technical conformance from legal validity?
- What kinds of jurisdiction-specific legal profiles are appropriate?

92.1.17 International organizations and policy

- Which IO functions are plausible first-use environments: research integrity, cultural heritage, AI governance, institutional memory, scientific collaboration, or public administration?
- Which proposals should be global, and which should be mandate-specific?
- What pilot designs can test utility without imposing excessive recording burdens?

92.1.18 Publication classes

- Earlier question: which projects begin as Specifications versus Standards? The default direction is resolved by accepted ADR-0002: begin from the Standards track. The remaining question is which requirements justify particular Specification work items, including the boundaries of GR-120/130/200 and their corresponding Specifications.
- Should project-family numbers remain stable across promotion from Specification to Standard?
- When should a policy proposal be classified as an International Policy Proposal versus an International Institutional Proposal?
- What minimum evidence is required before a Specification may be proposed as a Standard?

93 preliminary plan

Original source: `docs/planning/preliminary_plan.md`.
Original source SHA-256: `17d3acf0abacabfab7866bbbcf0a26e8d9951e7c44c34150c74d5f1c3ce9ea00`.

93.1 Preliminary Plan

> **Historical planning draft.** Retained to preserve the programme's earlier development reasoning. The comprehensive development plan is the current planning proposal. The original text below remains unchanged, including the specification-first sentence in section 12; that sentence conflicts with accepted ADR-0002, which governs the current Standards-first sequence. Earlier maturity targets below are not reports of completed releases.

See also the project-level orientation in `PROGRAMME_BRIEF.md`, which summarizes why, what, and how the standards programme is being developed.
Status: PROVISIONAL
Version: 0.1

93.1.1 1. Objective

Establish a lightweight NGO standards program capable of developing, publishing, maintaining, and revising a family of standards for generativity records and presentation.

93.1.2 2. Development phases

93.1.3 Phase A — Standards governance

Deliverables:

1. Standards Programme Charter
2. Directives Part 1 — Development and Maintenance Procedures
3. Directives Part 2 — Structure and Drafting Rules
4. Technical Committee Charter
5. Public Review and Comment Procedure
6. Consensus and Decision Policy
7. Conflict-of-Interest and Ethics Policy
8. Intellectual Property Policy
9. Maintenance and Versioning Procedure
10. Records and Transparency Policy

93.1.4 Phase B — Foundations

Deliverables:

- GR-100 — Foundations and Vocabulary
- GR-TR101 — Theoretical Foundations
- GR-TR102 — Category-Theoretic Semantics

Primary work:

- define the six candidate record ontology classes;
- define their relations to the deep metamodel;
- identify identity, persistence, time, and perspective semantics;
- specify open theoretical questions.

93.1.5 Phase C — Core recording standard

Deliverables:

- GR-110 — Generativity Recording Requirements
- GR-M101 — Recording Manual
- worked examples.

Primary work:

- minimal and extended record profiles;
- provenance;
- generative dependencies;
- uncertainty;
- branches and alternatives;
- retrospective interpretation;
- contingent encounters;
- access metadata.

93.1.6 Phase D — Information model and interchange

Deliverables:

- GR-120 — Information Model
- GR-130 — Interchange Specification
- schemas and validators.

Primary work:

- identifiers;
- record typing;
- graph semantics;
- temporal semantics;
- machine-readable formats;
- compatibility strategy.

93.1.7 Phase E — Presentation and preservation

Deliverables:

- GR-140 — Presentation Requirements
- GR-160 — Preservation, Privacy, Access, and Retention.

Primary work:

- timeline and graph views;
- disclosure of mediation;
- public and restricted representations;
- retention and deletion;
- future interpretability.

93.1.8 Phase F — Conformance and pilots

Deliverables:

- GR-150 — Conformance and Validation
- implementation test suite;
- pilot reports.

Candidate pilots:

- individual research process;
- AI-assisted scholarship;
- collaborative research project;
- institutional decision process;
- archival reconstruction.

93.1.9 3. Lightweight standards lifecycle

Proposed stages:

Stage	Meaning
00	Preliminary
10	Proposal
20	Working Draft
30	Committee Draft
40	Public Review Draft
50	Final Approval Draft
60	Published Standard
90	Review / Revision / Withdrawal

93.1.10 4. Initial organizational structure

93.1.11 Standards Council

Responsibilities:

- procedural oversight;
- approval of work items;
- adoption and withdrawal of standards;
- appeals and governance.

93.1.12 GR/TC 1 — Generativity Records and Infrastructure

Initial working groups:

- WG 1 — Foundations and Ontology
- WG 2 — Recording Model
- WG 3 — Data and Interoperability
- WG 4 — Presentation and Reconstruction
- WG 5 — Ethics, Privacy, and Preservation
- WG 6 — Conformance and Implementation

93.1.13 5. Minimum viable launch package

The first public-capable version of the program should have:

- governance charter;
- development procedure;
- drafting rules;
- work-item proposal template;
- public comment process;
- issue tracker;
- change log;
- decision log;
- one pilot standard project.

93.1.14 6. First pilot work item

Provisional title:
GR/NWIP-001 — Generativity Recording and Presentation Infrastructure
Expected result:
A coordinated set of technical publications rather than one monolithic standard.

93.1.15 7. Design principles

- standards should remain implementable;
- philosophical foundations should not be hidden;
- philosophical foundations should not overwhelm normative clauses;
- machine readability should be supported without forcing one storage backend;
- relations should be first-class where their own histories matter;
- revision should preserve historical states;
- presentation should disclose mediation;
- records should support uncertainty and absence;
- privacy should be separable from preservation;
- standards development itself should be traceable.

93.1.16 8. Early success criteria

The project reaches a useful v0.5 when:

- governance procedures are coherent;
- GR-100 has stable terminology;
- GR-110 can be implemented by at least one pilot recorder;
- GR-120 supports a machine-readable reference model;
- at least two independent pilot datasets can be exchanged;
- comments and objections can be traced to their resolution.

93.1.17 9. Foundation manuscript integration

The repository shall maintain a `foundation_manuscripts/` corpus.

Before stabilization of GR-100, the project should:

- collect representative foundational GR works;
- index them in `foundation_manuscripts/MANIFEST.md`;
- identify recurrent concepts and notation;
- record historical changes and unresolved tensions;
- map concepts to candidate standards clauses;
- avoid using one later manuscript to silently overwrite earlier conceptual history.

A later tooling phase may add manuscript-to-standard traceability tables.

93.1.18 10. Expanded conceptual programme

The standards programme should now be developed across at least the following coordinated layers:

- metamodel;
- record ontology;
- epistemic representation;
- normative and ethical interpretation;
- jurisprudential/legal interface;
- institutional governance;
- political economy;
- technical implementation.

The project should avoid assuming that the six candidate record ontology classes are sufficient for the entire programme.

93.1.19 11. Policy-proposal track

In parallel with standards development, the project may develop policy proposals for international organizations and other institutions.

The policy track should:

- draw from the standards work;
- remain organizationally distinct from technical standards;
- identify intended institutional mandates;
- distinguish factual analysis from normative proposals;
- present alternatives where appropriate;
- specify pilots, safeguards, and implementation pathways.

93.1.20 12. Publication-class separation

The programme should maintain separate development tracks for:

- Specifications;
- Standards;
- International Policy / Institutional Proposals.

Each document should declare its class and maturity status.

Candidate early technical work should normally begin as a Specification unless there is a clear reason to enter the full Standards track immediately.

93.1.21 13. Standards-first implementation sequence

For each substantive domain:

1. open or refine the relevant Standard work item;
2. define the normative need and conformance boundary;
3. identify infrastructure dependencies;
4. create Specification work items only where reusable technical precision is required;
5. implement pilots;
6. feed implementation results back into the Standard;
7. stabilize dependent Specifications;
8. advance the Standard toward public review and adoption.

This sequence should reduce premature infrastructure design while preserving implementation realism.

94 protocol specification plan

Original source: `docs/planning/protocol_specification_plan.md`.
Original source SHA-256: `dcc8f123518bc66be795495653f35c007c1416aa31545a231cd88e169bf8675d`.

94.1 Protocol and Specification Development Plan

Document class: Informative planning document
Status: PROVISIONAL proposal for programme review
Version: 0.1
Date: 2026-09-22

Implementation update: The original planning text below remains the capability proposal. ADR-0008 subsequently selects a bounded shared record protocol and a Git/HTTP pilot binding. Requirements are developed in GR-120/130/140/160 WD 0.1; GR-SPEC-120 and GR-SPEC-130 contain the experimental details. This records the later infrastructure decision without implying that the original plan had already chosen a transport or that the broader capability register is implemented.

94.1.1 1. Purpose and authority

This plan organizes the technical and procedural capabilities needed to record, examine, exchange, contest, and revise generativity-related accounts. It translates the programme's epistemic and practical purpose into candidate development work. It neither adopts requirements nor certifies factual truth.

The governing development pattern remains the one in ADR-0002: a standards-track Working Draft identifies a requirement and conformance boundary; an identified infrastructure need triggers a Specification; pilots feed back into both. Formal project initiation follows the governance gate in the comprehensive programme plan.

Here, **protocol** means a defined interaction among roles, with inputs, outputs, states, transitions, and handling of failure. A protocol is technical content described in a Specification or an adopted Standard, not a fourth publication authority class. An institutional procedure allocates responsibilities, review, and decisions; a network binding defines messages and technical behavior. The latter cannot supply the former's authority.

The proposed allocation uses the existing publication taxonomy and family numbers. Capability labels below are planning labels, not publication identifiers. No new publication numbers, record ontology classes, transport, storage backend, or cryptographic dependency are assigned.

94.1.2 2. Allocation across existing work items

Structural role: identify which proposed requirements motivate which reusable technical details; resolve overlapping placeholders before substantive drafting.

Existing family	Proposed standards-track responsibility	Candidate specification destination
GR-100	Vocabulary and boundaries used by the capabilities below	Terms referenced by all three existing specification work items
GR-110	Minimum capture, attribution, trajectory, and completeness expectations	GR-SPEC-120 record structure; GR-SPEC-200 attribution and epistemic representation
GR-120	Implementation-neutral model constraints, identity, time, relationships, and versions	GR-SPEC-120 precise representation and mapping rules
GR-130	Information that survives exchange; permitted loss and incompatibility reporting	GR-SPEC-130 packaging, serialization, import/export; network binding only when needed
GR-140	Faithful presentation, visible mediation, epistemic status, and disclosure limits	Existing specifications carry required presentation metadata; rendering guidance belongs in manuals

Existing family	Proposed standards-track responsibility	Candidate specification destination
GR-150	Conformance targets, claim boundaries, and evaluation criteria	Test fixtures and executable checks alongside the applicable specification
GR-160	Preservation, access, restriction, retention, disposal, and interpretability outcomes	GR-SPEC-120 lifecycle representation; GR-SPEC-130 transfer/restriction behavior
GR-200	Distinguishing attributed observations, claims, interpretations, and judgments	GR-SPEC-200 epistemic representation and capture behavior
GR-210	Evidence assessment, competing interpretations, contestation, and revision outcomes	GR-SPEC-200 evidence and review interaction details
GR-300	Explicit interface for jurisdiction, legal assertions, and procedural context	Optional metadata profile after legal review; no universal legal-status field
GR-310	Scoped access, correction, objection, notice, and review procedure profiles	Procedural behavior in an existing specification where reusable precision is needed
GR-400	Accountable operators, decision authority, oversight, and organizational use	Role and policy references in existing specifications; organizational implementation guidance in manuals

GR-120 and GR-130 currently have both standards-track placeholders and specification destinations. The proposed distinction is between required outcomes/model constraints and their implementable realization. If drafting produces no distinct normative responsibility for a placeholder, record whether to retain, narrow, or consolidate it; do not duplicate normative authority. Existing paths and numbers remain stable pending that decision.

Each specification proposal records the motivating draft clause or requirement issue, affected actor, unmet interoperability need, alternatives, maintenance burden, pilot, and acceptance evidence. A local implementation preference alone is insufficient reason to establish a shared specification.

94.1.3 3. Candidate capability register

Structural role: scope a small set of coherent capabilities before selecting formats or service architecture. Each row is a work proposal rather than a present conformance requirement.

Capability and priority	Requirement origin and specification trigger	Inputs and outputs	Candidate conformance actors and essential failure cases
Capture and attribution — first pilot	GR-110/200; different recorders need an exchangeable account of who asserted or recorded what, how, and when. GR-SPEC-120/200.	Input: submitted account, source references, method, attribution, perspective, time/uncertainty, access context. Output: versioned account and receipt with disclosed omissions.	Recorder and receiving repository. Cases: malformed submission, unknown attribution, duplicate delivery, conflicting identifier, insufficient permission. Unknown attribution remains explicit rather than fabricated.
Evidence linking and assessment — first pilot	GR-200/210; independent readers need to distinguish cited material from an assessor's interpretation of its bearing on a claim. GR-SPEC-200 plus GR-SPEC-120 references.	Input: identified account/version, evidence locator, assessor, method, rationale, limitations. Output: separately attributed assessment and links to its basis.	Assessor, recorder, repository. Cases: unavailable or changed source, ambiguous target, incompatible assessments, withheld evidence. Successful linking does not establish evidentiary sufficiency.

Capability and priority	Requirement origin and specification trigger	Inputs and outputs	Candidate conformance actors and essential failure cases
Publication and presentation — first pilot	GR-140/160; different consumers need to disclose selection, reconstruction, uncertainty, and restrictions consistently. GR-SPEC-120 metadata and GR-SPEC-130 export.	Input: authorized record view, selection/transformation description, version and profile. Output: bounded presentation or release with appropriate source/version references and disclosures.	Publisher, presenter, repository. Cases: incomplete reconstruction, stale view, omitted competing interpretation, prohibited disclosure, misleading validation label.
Contestation, review, and revision — first pilot	GR-210/310/400; challenges and dispositions need durable targets and attributable procedural history. GR-SPEC-200; policy-specific procedure profile when justified.	Input: objection, target version, grounds, supporting material, applicable procedure. Output: receipt, review activity, reasoned disposition, linked correction or recorded disagreement.	Challenger, receiving institution, reviewer, revising recorder. Cases: inaccessible target, wrong recipient, missing authority, delayed review, contested disposition, failed notice. Receipt does not mean agreement.
Version and history — first pilot	GR-110/120/160/210; consumers need to identify an earlier account and distinguish editing, correction, withdrawal, and reinterpretation. GR-SPEC-120; GR-SPEC-130 exchange rules.	Input: base version, proposed change, actor and reason, relevant time and access context. Output: identified successor/branch and change relation, or explicit conflict.	Recorder, repository, importer, presenter. Cases: stale base, divergent branches, unavailable predecessor, prohibited history disclosure. Concurrent or incompatible accounts are not silently merged.
Access, restriction, and disposal — first pilot minimum; expanded later	GR-160/310/400; software and institutions need consistent handling of scoped requests and resulting lifecycle changes. GR-SPEC-120/130; procedure semantics from approved profiles.	Input: request, subject/resource scope, applicable policy/authority, reason and review path. Output: bounded decision, authorized view or lifecycle action, receipt and permitted audit trace.	Requester, custodian, policy decision authority, repository. Cases: disputed authority, inconsistent retention instructions, partial propagation, leaked identifiers, irreversible disposal. A request and an executed action are distinct.
Exchange, synchronization, and migration — batch exchange first; synchronization later	GR-120/130/150/160; two implementations need to preserve meaning and disclose unsupported material. GR-SPEC-130 with GR-SPEC-120/200 mappings.	Input: versioned package, declared profile, referenced material/access conditions, destination capabilities. Output: import report, preserved identifiers/links, disclosed loss or rejection, migration provenance.	Exporter, importer, validator, custodian. Cases: unsupported version, partial package, duplicate transfer, identifier collision, denied references, lost extensions. Synchronization adds ordering and conflict behavior only after a pilot demonstrates need.

These capabilities support practical recognition and accountable action by preserving the basis and history of accounts. They do not require agreement among observers, a universal confidence scale, a single institutional adjudicator, or exhaustive capture of experience.

94.1.4 4. Behavior to specify for every approved capability

Structural role: provide a reusable authoring checklist for future Specifications.

1. **Scope and actor:** identify the operation, responsible roles, conformance target, profile, and what an implementation claims to implement.
2. **Inputs and preconditions:** specify identifiers and target versions, authorization context, supported representation, required metadata, and treatment of unknown or unavailable information.
3. **Output and effects:** distinguish a received request, successful validation, committed change, substantive assessment, and delivered notice. Identify observable receipts and permitted audit data.
4. **States and transitions:** identify actor, trigger, guard, action, and result for each transition; distinguish policy decisions from their execution.
5. **Failure and recovery:** distinguish invalid input, policy refusal, unresolved conflict, unsupported capability, unavailable dependency, partial completion, and transient failure. Specify whether retry is safe and how duplicate effects are prevented.
6. **Concurrency and history:** specify base versions, branch behavior, supersession, withdrawn assertions, and out-of-order inputs. Define any merge operation narrowly enough to preserve disagreement and attribution.
7. **Disclosure and correction:** specify audience, visibility of omissions, permitted notice content, stale presentations, and revision propagation. Include cases where exposing even the existence of a record would breach access rules.
8. **Security and abuse:** state actor assumptions, authorization boundaries, forgery/replay risks, malicious inputs, resource limits, and reporting behavior that avoids disclosing restricted content. Select mechanisms after the relevant threat analysis.
9. **Conformance evidence:** provide examples and counterexamples, state-transition traces, testable outcomes, and checks requiring human or institutional review.

An initial procedure model can use `submitted -> acknowledged -> under review -> disposition recorded`, with separate paths for inability to proceed and later reopening. This is an illustrative sequence, not a mandated state vocabulary. Record visibility, review progress, evidentiary assessment, and factual content remain separate dimensions; a review state called “accepted” would otherwise risk conflating several judgments.

For an eventual network binding, specify message correlation, delivery acknowledgment, retry/timeout handling, representation and capability negotiation, concurrency controls, and application errors. Reuse transport semantics where suitable. Keep the procedure implementable through documented human steps or file exchange before requiring a network service.

94.1.5 5. Minimum vertical pilot

Structural role: demonstrate one complete recording-to-revision trajectory across a deliberately small technical surface.

The proposed first pilot uses the programme’s shareable decision history and a synthetic contested institutional case, as described in the governance and pilot plan. A consented research or collaborative inquiry case can extend this work when suitable material and participation are available. One participant records an observation or attributed claim with a source and uncertain time; a second records a competing interpretation; a reviewer examines their stated bases; an author revises an account; a custodian restricts part of the evidence. Before claiming interchange maturity, a separate implementation imports the permitted export and presents both the current account and the accessible history.

The pilot includes one consequential decision, an alternative not pursued, and the stated basis for a later change of direction. Those records test whether the trajectory remains intelligible beyond the final artifact; they are attributed accounts, not measurements of an assumed universal generativity score.

Candidate scope:

- one bounded recording profile and explicit missing/unknown/restricted information;
- stable record/version references and independently attributed assessments;
- one review procedure and one restriction/correction procedure;
- a documented batch package and one human-readable presentation;
- structural validation plus semantic, disclosure, and procedural checks;
- two independently implemented producer/consumer paths before an interoperability claim.

The first prototype can use one implementation to find problems. The two-implementation demonstration is a later readiness gate for the pilot specification, not a claim that the current repository has implementations.

Acceptance scenario	Evidence sought
Round-trip attributed claim and evidence	Import preserves the specified identifiers, target versions, source/assessor distinction, uncertainty, and restriction status; any unsupported content appears in the report.
Competing interpretations	Both accounts remain attributable and discoverable in the authorized view; export/import does not turn disagreement into one proposition.
Corrected and retrospectively reinterpreted account	Reader can distinguish what was recorded at each time, the reason/actor of change, and the current accessible version.
Retried or duplicate submission	A repeat has the specified observable effect without silently creating a second claim or review action.
Stale revision and diverging branches	A conflict is reported or separately represented; existing work is not silently overwritten.
Source missing, restricted, or changed	The result distinguishes the cases at the authorized disclosure level; no fabricated source text or false completeness claim appears.
Rejected, delayed, or disputed challenge	The procedure records receipt, available explanation and review route, without treating silence or rejection as factual refutation.
Restricted export and disposal request	Export contains only the permitted view; receipt distinguishes request, decision, action, and unresolved downstream copies.
Presentation of validation result	Readers can distinguish structural conformance, provenance checks, an assessor's judgment, and institutional decisions. No "truth certified" claim follows from a validator result.
Practical burden and intelligibility	Participants document capture/review effort and whether an uninvolved reader can recover the decision, alternative, evidence limits, and revision. Failures inform smaller or clearer requirements.

Before piloting, agree measurable thresholds for semantic loss, unacceptable disclosure, review completeness, accessibility, and participant burden. Set thresholds from the case and risk context; do not invent programme-wide numerical targets without evidence.

94.1.6 6. History, privacy, and institutional authority

Structural role: preserve a design tension that technical immutability cannot settle.

Historical traceability does not imply indefinite retention or universal access. An append-only public history can preserve corrections while also perpetuating sensitive or harmful material. Deletion can protect people while reducing the evidence available for reconstruction. The programme needs an explicit profile decision about content, metadata, disclosure, retention, and authority in each context.

Evaluate restricted historical access, redacted derivatives, limited disposal metadata, and complete erasure as different operations. Even a tombstone, identifier, hash, or reason can reveal sensitive information; no universal public tombstone is proposed. A deletion receipt describes the actor's action and scope, with stated limits concerning copies beyond its control.

GR-160 owns preservation/access outcomes; GR-310 and GR-400 identify the relevant procedure and decision authority; GR-300 identifies any jurisdictional assertions. Specifications implement that recorded policy choice. They do not create legal rights, decide admissibility, or convert access policy into an epistemic verdict.

94.1.7 7. Sequencing and exit evidence

Step	Deliverable and exit evidence
Governance and scope	Coherent programme procedures; approved work-item scope and accountable maintainers; resolved responsibility for overlapping placeholders.
Requirement discovery	GR-110/200/210 draft requirements, early GR-140/150/160 constraints, and the minimum pilot scenario; explicit specification triggers and initial cross-domain review.
Minimum specification drafting	Bounded GR-SPEC-120/200 model and behavior; GR-SPEC-130 package; source-to-clause traceability, worked examples, and failure cases.
Pilot and independent exchange	Recorded execution of the acceptance scenarios, disclosure review, burden findings and issue dispositions; independent import/export evidence when claiming interchange maturity.
Broader review and revision	Renewed horizontal conceptual, ethical, institutional, accessibility, legal-interface, and security review, building on review during scope formation and before live pilots; traceable revisions to requirements and specifications.
Stabilization and maintenance	Declared edition/profile boundaries, backward-compatibility or migration behavior, conformance evidence, maintainers, and explicit promotion decisions where warranted.

DEFERRED pending demonstrated need: federation/discovery, continuous synchronization, universal identity registries, consensus networks, mandatory signatures, global trust scores, real-time streaming, and automated substantive adjudication. Optional tamper-evidence can be evaluated for a specific threat model without making cryptography the foundation of factual warrant.

External reuse candidates and their limits are documented in the external standards landscape. Evaluation of a source is distinct from adopting it as a normative dependency.

The cross-domain programme supplies substantive review questions; the standards-development comparison informs how proposals, consensus, review and appeals are organized.

94.1.8 8. Decisions still open

- **OPEN:** responsibility and publication class of overlapping GR-120/130 placeholders and the boundaries of the three initial specifications.
- **OPEN:** minimum attributable epistemic unit and its relation to record ontology, without prematurely adding an ontology class.
- **OPEN:** enough common procedural behavior for interoperability while preserving legitimate institutional differences and appeals.
- **OPEN:** which historical metadata survive correction, restriction, or erasure under a scoped profile, and which actors decide.
- **OPEN:** first serialization, validation technology, identifier rules, and offline packaging; decide through the pilot rather than this plan.
- **OPEN:** thresholds and evidence for practical usability and independent interoperability before public review.

Programme-level disposition belongs in open questions and an ADR where architecture changes. This document supplies proposed scope and acceptance evidence for those decisions.

95 standards development comparison

Original source: `docs/planning/standards_development_comparison.md`.
Original source SHA-256: `ba9ff2ef7042be004e253bd2c03dc67da47a67180e39373031ba6f20bdd2adfb`.

95.1 Standards-development approaches and programme tailoring

Document class: Informative comparative planning analysis
Status: PROVISIONAL — proposals for governance development, not adopted procedures
Version: 0.1
Sources checked: 2026-09-22
Related plans: Comprehensive development plan; governance and pilots

95.1.1 1. Purpose and limits

Role: Compare established standards-development mechanisms and identify what this programme has reason and capacity to adopt, adapt, or defer.

The programme's motivation is epistemic and practical: make the grounds of recognition, judgment, classification, contestation, and action inspectable while preserving consequential generative trajectories. Its procedures consequently matter as much as the eventual record model. An inaccessible or unchallengeable development process would undermine the practice the programme seeks to support.

ISO/IEC and IEEE SA provide established approaches to initiating work, preparing drafts, consulting affected interests, handling disagreement, approving publications, and maintaining them. Their organizational structures, constituencies, resources, and authority differ. This comparison does not identify one universal development procedure or propose copying either institution's committees into a small programme.

The labels **ADOPT**, **ADAPT**, and **DEFER** below describe proposed directions for future decisions. None establishes a rule in this document. ISO, IEC, IEEE, and WTO references indicate sources, not affiliation, recognition, accreditation, permission to use institutional marks, or a claim of formal compliance. This analysis does not determine legal obligations or provide legal advice.

95.1.2 2. Source editions and access record

Role: Distinguish verified source content from edition metadata, inaccessible material, and questions needing rechecking before a governance clause relies on them.

Source	Edition or status verified on the check date	Access and use in this comparison
ISO directives and policies index, with its Part 1 resource listing	The official listing includes Part 1:2026 and transition materials.	Listing read. The linked resource interface did not expose a retrievable 2026 PDF in this check; its clause text and transition rules are not represented as verified here.
ISO/IEC Directives Part 1, Consolidated ISO Supplement, accessible HTML	The text identifies itself as **2024, V01/2024**, despite the URL containing `current`.	Text consulted for identified procedural examples. It is an earlier-edition source in this analysis, not evidence of the latest 2026 wording. Current clause-level dependence needs the 2026 text and transition arrangements checked first.

Source	Edition or status verified on the check date	Access and use in this comparison
ISO Part 2 resource listing and directives index	Part 2, ninth edition, **2021**, plus Amendment 1; the directives index identifies a **2026 amendment** concerning management-system drafting.	Edition and amendment listings read; full Part 2/amendment text was not successfully retrieved. The comparison uses ISO's accessible house-style guidance and foreword explanation for the specific drafting principles discussed below.
ISO development overview, stages and resources, and stage codes	Current official webpages accessed; no fixed edition claimed.	Used for the general development approach and stage structure. Their detail is not a substitute for the operative directives during the edition transition.
IEEE SA Standards Board Operations Manual and Bylaws	PDF title pages: Operations Manual approved **January 2026**; Bylaws approved **February 2026**.	Both PDFs accessed. IEEE identifies the PDFs as definitive; linked HTML clauses are convenient reading references. Its policy index also identifies policy-change resources.
IEEE development overview and development quick reference	Official explanatory resources; no rule-edition status inferred from the quick reference.	Used for lifecycle and principles. The 2026 governance documents take precedence for IEEE procedural detail.
WTO TBT Committee's six principles	Official presentation of the Committee's **2000 decision**.	Public text read. Used as a process-design reference; this plan makes no determination of the programme's status under the TBT Agreement.

No external document is copied into the repository. These are selective paraphrases and programme-specific proposals. Public access, free availability, redistribution rights, implementability, and participation rights are separate questions. Full-text access gaps above remain explicit tasks before an adopted procedure cites the affected clauses as its basis.

95.1.3 3. Comparison and proposed tailoring

Role: Separate observed mechanisms from proposed GR programme choices. The right-hand column is new planning analysis, not a statement that the cited organizations prescribe it for this programme.

Topic	Observed mechanism and primary source	Proposed direction for this programme
Motivation and legitimacy of new work	ISO describes stakeholder need, expert contribution, and consultation as foundations of development. ISO development principles	**ADAPT.** A proposal explains the recognition or practice problem, affected people, expected public benefit, alternatives to standardization, and risks of giving a category institutional authority. Market demand is relevant evidence, not the sole motivation. Test the proposal against symbolic-crisis cases, recording burden, and effects on future capacities.

Topic	Observed mechanism and primary source	Proposed direction for this programme
Participation and representation	ISO operates through member-nominated expertise. IEEE distinguishes individual participation from entity representation and prohibits dominance. ISO overview; IEEE Bylaws, 5.2.1	**ADAPT.** Select an explicit participation model from section 5. Include affected people, custodians, implementers, and epistemic, archival, ethical, institutional, and jurisdiction-specific expertise. Record gaps instead of treating a mailing list or one expert as representative of a constituency. Financing and affiliations are visible within justified privacy limits.
Initiation and authorization	ISO uses a scoped new-work proposal; IEEE uses a Project Authorization Request. ISO proposal stage; IEEE initiation guidance	**ADOPT the function; ADAPT the form.** Expand the existing NWIP to include intended conformance subjects, source tensions, non-goals, impacted groups, alternatives, dependencies, review capacity, and maintenance ownership. An approved scope provides the reference against which later expansion is assessed. Formal initiation follows governance launch.
Working-group drafting and oversight	ISO separates expert working drafts from parent-committee progression. IEEE assigns project supervision to a Standards Committee. ISO preparatory stage; IEEE Operations Manual, 5.1	**ADAPT.** One coordinated group with named editors can initially perform several functions. Separate authorship, progression decisions, and conflict-sensitive review in the records. Activate additional working groups when the work and participants justify them; committee names alone provide neither expertise nor independent oversight.
Consensus and voting	The 2024 ISO text distinguishes consensus from unanimity. IEEE combines ballot criteria with comment consideration. ISO Part 1:2024, 2.5.6; IEEE Operations Manual, 5.4	**ADAPT.** Assess whose concerns were heard, which substantial objections remain, and why progression is justified. Record votes separately from grounds and dispositions. A numerical majority does not establish factual truth or remove a material objection. Eligibility, quorum, thresholds, abstention handling, and escalation remain OPEN until the participation model is selected.
Wider review and recirculation	ISO enquiry provides comments through national members. IEEE public review accepts non-balloter comments and requires responses. ISO enquiry stage; IEEE Operations Manual, 5.4.5	**ADAPT.** Offer a direct, accessible comment route suited to the programme's constituency, with versioned drafts, disposition reasons, and notice of material changes. Deliberate outreach complements an open webpage. Significant changes return to affected reviewers. Review duration and outreach adequacy are future governance choices; no ISO or IEEE deadline is imported.

Topic	Observed mechanism and primary source	Proposed direction for this programme
Appeals and independence	ISO's 2024 text provides hierarchical appeals. IEEE's board appeal panels exclude involved or materially affected reviewers and consider procedural matters. ISO Part 1:2024, clause 5; IEEE Operations Manual, 5.8	**ADAPT.** Define standing, grounds, notice, opportunity to reply, conflicts, reasoned remedies, and a neutral review route. Keep technical reconsideration, procedural appeal, misconduct complaint, and requests concerning represented persons distinguishable. A small programme needs available neutral people rather than multiple nominal appeal levels. Section 6 addresses bootstrap capacity.
Openness and transparency	WTO principles address accessible work information, participation opportunities, and consideration of comments. WTO transparency and openness	**ADOPT the aims; ADAPT implementation.** Publish work programmes, draft status, issue dispositions, decision authority, and maintenance notices. Support participation without mandatory travel or proprietary tooling where feasible. Publish sufficient grounds to inspect decisions while protecting confidential evidence, contributors, and complaint participants. Openness does not mean unrestricted release of every record.
Ethics, conflicts, and dominance	IEEE participation rules connect conduct, ethics, affiliations, and non-dominance. IEEE Bylaws, 5.2.1	**ADAPT.** Review funding influence, retaliation risk, exclusion, uncompensated recording work, and whose accounts become authoritative. Establish disclosure, recusal, protected reporting, and corrective actions. Process ethics and assessment of harms from the proposed standard are related but separate reviews; a technically coherent draft can still impose unacceptable burdens.
Intellectual property and contribution terms	ISO publishes a common patent-policy framework and declaration resources. IEEE addresses contributions, copyright, patents, and open-source artifacts separately. ISO patent resources; IEEE Operations Manual, clause 6	**ADAPT.** Decide terms separately for prose, schemas, code, datasets, examples, and foundation material; record third-party permissions and known essential-rights concerns. Compare open implementation, contributor interests, and maintenance needs before selecting licenses. An upstream patent declaration or permissive code license is not assumed to settle all implementation rights. Exact policies remain OPEN for qualified review.

Topic	Observed mechanism and primary source	Proposed direction for this programme
Drafting and testability	ISO's Part 2 explanatory resources distinguish requirement types and assessment neutrality; IEEE distinguishes normative and informative content. ISO house style; ISO foreword explanation; IEEE Operations Manual, 6.4	**ADOPT the distinctions; ADAPT structure.** Use short, identifiable requirements, explicit scope and conformance subjects, examples outside requirements, and versioned dependencies. Locate theory and unresolved mathematics in Technical Reports. For observational or procedural requirements, identify evidence and assessment method without pretending every quality of judgment is machine-testable. Verify Part 2's amendment before taking clause-specific dependencies.
Cross-domain coordination	IEEE includes mandatory coordination during review; ISO supplies drafting guidance beyond formatting. IEEE Operations Manual, 5.4.4; ISO drafting resources	**ADAPT and extend for this mission.** At proposal, pilot, and release review, explicitly examine epistemic warrant, ethics, accessibility, privacy/security, jurisprudential boundaries, governance, political economy, and technical feasibility. A review identifies competence, findings, scope limits, and disposition. This proposed multidisciplinary review is not claimed to be an ISO/IEEE-mandated committee structure.
Adoption versus conformity assessment	IEEE's approval review considers process evidence; its ICAP is a separate conformity-assessment activity. ISO explains assessment against specified requirements. IEEE Operations Manual, 4.2.3; IEEE ICAP; ISO explanation	**ADOPT the separation; DEFER a certification scheme.** Programme adoption establishes a publication's authority under its own procedure. Record or implementation assessment tests a declared subject and profile. Neither certifies truth, legitimacy, or legal validity. Begin with transparent assessment reports; a certification service needs a separately justified scheme, competence, independence, and resources.
Maintenance, revisions, and withdrawal	ISO stage codes distinguish review and withdrawal. IEEE provides revision and inactive-status mechanisms. ISO stage codes; IEEE Operations Manual, clause 9	**ADOPT lifecycle responsibility; ADAPT cadence.** Assign maintainers and review triggers; distinguish correction, substantive amendment, revised edition, supersession, and withdrawal. Coordinate prose, protocol behavior, schemas, and fixtures. Retain public publication history while applying justified protection/deletion to underlying sensitive development records. Review intervals depend on scope and capacity, not borrowed institutional calendars.

Topic	Observed mechanism and primary source	Proposed direction for this programme
Policy and external authority	ISO provides resources for policy use; IEEE controls who speaks for its institutions. ISO public-policy resources; IEEE Bylaws, 5.2.1.6	**ADAPT.** Separate technical conformance from proposals about institutional adoption, legal recognition, funding, or public administration. Name the intended institution, mandate, alternatives, affected interests, and unresolved jurisdictional issues. A liaison or contributor expresses only the authority actually assigned. Policy recommendations enter their own review and authorization route.

95.1.4 4. Development stages: useful correspondence, distinct authority

Role: Relate the programme's existing lifecycle to established practice without relabelling it as an ISO or IEEE process.

ISO's published stage scheme includes proposal, preparatory, committee, enquiry, approval, publication, review, and withdrawal stages. IEEE's explanatory lifecycle covers initiation, group formation, drafting, balloting, final approval, and maintenance. ISO stage codes; IEEE quick reference

Programme work	Useful comparison	Programme-specific consequence
M0/M1: orientation and governance	Institutional procedures precede an authoritative development decision.	Establish founding authority, participation, review, and appeal capacity before formal project approval.
Stages 00/10 and scoped NWIP	Preliminary study and explicit project initiation	Authorize a bounded normative problem; source analysis and exploratory examples remain distinguishable from approved work.
Stages 20/30; M2–M4	Expert drafting and wider technical consideration	Co-develop requirements and only the Specifications/protocols needed to test them; preserve unresolved theoretical differences.
Stages 40/50; M5	Wider review and a recorded approval decision	Public review, horizontal findings, objections, remedies, and maintenance evidence inform adoption. A completed schema does not bypass these steps.
Stage 60; M6 and stage 90	Publication and subsequent maintenance	Declare edition and scope; maintain issues, compatibility, correction, and withdrawal records.

The programme currently groups review/revision/withdrawal under stage 90. ISO's published scheme distinguishes stage 95 for withdrawal. This is an explicit tailoring difference, not a reason to renumber repository documents. Local stages and M0–M6 milestones describe different things: document status and programme work respectively.

95.1.5 5. Participation models to decide

Role: Identify institutional options and their political-economy consequences before selecting voting rules. The contrast between ISO's member-mediated participation and IEEE's individual/entity methods motivates comparison; the options below are programme proposals. ISO development overview; IEEE Bylaws, 5.2.1

Option	Potential fit	Risk and proposed safeguard
Individual contributors acting in their own capacity	Accessible launch; direct epistemic, practical, and affected-person input without needing institutional sponsorship	Professional networks and available unpaid time can dominate. Record affiliations and participation gaps; use asynchronous review, accessible materials, and declared eligibility for decision roles. One employer's several contributors do not automatically demonstrate stakeholder diversity.
Institutional membership and designated representatives	Clear institutional mandates, sustained contributions, and accountable organizational commitments	Large funders or implementers can crowd out affected people and smaller organizations. Distinguish representation from expertise, manage related entities and conflicts, and provide non-member comment and challenge routes. Capacity to administer membership is currently unproven.
Hybrid participation with explicit decision roles	Combines individuals, affected communities, and organizational mandates	Double counting and ambiguous authority are possible. State which capacity each person uses for each decision, separate consultation from formal decision rights, and justify balance arrangements. Avoid creating multiple chambers before participants and administration exist.

The **PROVISIONAL planning preference** is an open individual-contributor launch with affiliation disclosure, deliberate stakeholder outreach, bounded delegated decision roles, and neutral procedural review. Institutional representatives can contribute with their capacity clearly identified. Transition to institutional or hybrid membership remains a later charter decision. This preference does not grant membership or voting rights now.

A participant register records the role and basis of participation, relevant affiliation, declared conflicts, and review competence, with a protected route for information that cannot safely be public. Representation claims need evidence of a mandate or consultation; demographic or geographic breadth alone does not establish that a person speaks for others.

95.1.6 6. Neutral review during bootstrap

Role: Make challenge and remedy possible with a small team while preserving the distinction between procedural authority and substantive truth.

The proposed launch arrangement identifies an editor/coordinator, an authorized progression decision role, and at least an available route to a neutral reviewer outside the disputed decision. These are functions to staff, not assumed existing bodies. Neutrality is assessed through involvement, interests, conflicts, and acceptance of the review procedure rather than asserted by job title. IEEE's conflict-sensitive appeal mechanism provides a useful comparison; its institutional panel size and deadlines are not imported. IEEE Operations Manual, 5.8

Candidate capacity arrangements are an agreed roster of external volunteer reviewers or a later reciprocal review arrangement with another organization. Neither is presently staffed or agreed. A temporary founding steward can coordinate preliminary drafts, but that role alone cannot provide independent review of its own consequential contested decision. Where impartial consideration is unavailable, the proposed response is to retain draft status or defer the disputed progression decision while continuing unaffected research.

The governance package distinguishes:

- **Technical or conceptual objection:** consideration by the responsible drafting/review

group, with source evidence, alternatives, reasons, and recorded remaining disagreement.
- **Procedural appeal:** review of whether the operative process, participation rights, conflicts, and decision authority were respected; available remedies include reconsideration or repeating an affected stage.
- **Ethics or conduct complaint:** a protected route capable of addressing retaliation, harassment, misuse of sensitive records, or domination without making public disclosure a condition of being heard.
- **Record-specific correction or access request:** the route established for the relevant pilot or institution, with the applicable authority and retention conditions identified.
- **Claim requiring an external legal remedy:** identified as outside the programme's adjudicative authority; a contextual review determines the appropriate interface without implying that internal appeal replaces it.

These distinctions prevent one technical chair from becoming a general authority over truth, morality, participation complaints, and legal rights. The relationship between routes, limits on repeated abusive submissions, publication pauses, and available remedies remains governance drafting work.

95.1.7 7. Applying the WTO principles proportionately

Role: Use the six principles as a diagnostic of participation and relevance. The source is a TBT Committee decision about international standardization; the following operationalization is this programme's proposal. WTO six principles

Source principle	Proposed programme question and evidence
Transparency	Can a reader locate proposed work, its motivation, draft status, objections, decision reasons, and maintenance owner? Demonstrate the public decision trail and justified restrictions.
Openness	Can a relevant person learn of the work and contribute before decisions become fixed? Test contact routes, draft access, meeting alternatives, and the handling of unsolicited relevant comments.
Impartiality and consensus	Do funding, affiliation, technical fluency, or control of tools prevent a concern from receiving fair consideration? Review participation, conflicts, and sustained objections as well as votes.
Effectiveness and relevance	Does the practice improve inspectability and contestability at a feasible burden? Use the bounded pilots and report failures, exclusions, and circumstances in which standardization adds little value.
Coherence	Is an existing standard reusable, and where do semantic or authority boundaries differ? Record source editions, gaps, mappings, and tests before compatibility claims.
Development dimension	What resource, language, connectivity, or institutional barriers exclude potential participants? Assess asynchronous options, accessible summaries, translation needs, and support that actual resources can sustain.

Applying these questions does not establish international representativeness or WTO recognition. Limited participation remains a reported limitation of the evidence supporting adoption.

95.1.8 8. Concrete governance-development outputs

Role: Translate the comparison into work under the existing plan rather than adding another layer of nominal institutions.

1. **Source/edition verification note:** obtain and review Part 1:2026 and its transition arrangements, Part 2:2021 with Amendment 1:2026, and recheck IEEE policy updates before adopting source-dependent clauses. Preserve the present access limitation and earlier-edition references in the history.
2. **Charter options memorandum:** compare founding authority, individual/institutional/hybrid participation, decision-role appointment and removal, financial influence, and routes to neutral review. Record the selected option and rationale through the programme's governance process.
3. **Directives Part 1 draft:** define initiation, review, consensus assessment, ballots if selected, disposition, appeal and complaint routes, publication, maintenance, and exceptions. Choose periods and thresholds only after the participation and capacity decisions.
4. **Directives Part 2 draft:** operationalize publication classes, source authority, normative language, testability, cross-references, versioning, and conformance boundaries. Keep GR interpretations traceable to foundation sources and operational decisions.
5. **Horizontal-review record:** for each work item, identify the motivation, affected interests, epistemic assumptions, ethical impacts, legal/institutional boundary, public-policy alternatives, burden distribution, technical evidence, and reviewer competence or gaps.
6. **Contribution and publication policy options:** compare rights for documents, code, schemas, examples, and data; obtain qualified review for the actual organizational and jurisdictional context. No license, patent commitment, or third-party entitlement is established by this plan.
7. **Governance rehearsal:** exercise a contested proposal, minority objection, recusal, neutral appeal, material draft change, correction, and withdrawal using synthetic material or the programme's appropriately shareable history. Revise procedures before treating them as coherent launch infrastructure.

Formal ISO/IEC or IEEE participation, adoption through another standards body, external certification, and international-institution endorsement remain **DEFERRED options**. Each would require its own purpose, eligibility and resource assessment, institutional agreement where applicable, and explicit authorization. The present objective is a credible, usable programme process proportionate to its actual community and mission.

96 drafting models

Original source: `docs/references/drafting_models.md`.
Original source SHA-256: `a079a181ff666a76f19c9bb86fe353de607af7487352bcd483aea3babb850983`.

96.1 External drafting and institutional models

Class: Informative comparative editorial study
Status: PROVISIONAL; supports Working Draft package 0.2
Sources checked: 2026-09-22

The UN system does produce technical standards, but it does not supply one universal standard-writing format. ITU is a UN specialized agency whose ITU-T Recommendations address technical standardization. UN/CEFACT publishes technical specifications and other trade-facilitation instruments. A UN statistical quality manual serves a different purpose. The programme selects practices by function and retains its own publication classes, authority and terminology. ITU institutional description, ITU-T Recommendations, UN/CEFACT catalogue.

This study supplements the earlier development-process comparison. It does not replace the GR foundation corpus with an external ontology or establish compatibility with any external standard. The proposed local decisions are recorded in ADR-0005.

96.1.1 1. Verified sources and access limits

Source and edition	What was inspected	Use in this revision
ISO Model International Standard, third edition, 2023	Official metadata and the 27-page annotated model PDF through the browser; direct download was refused	Document architecture and differentiated normative/ informative material
ISO House Style, web page checked on the date above	Official HTML guidance	Consistent terminology, formal hierarchy, concise impersonal provisions and readable production
IEEE SA Operations Manual, Clause 6, current official HTML checked on the date above	Published provisions on draft status, standard structure, references and verbal forms	Explicit status, normative/ informative separation and reference discipline
ITU Author's Guide for drafting ITU-T Recommendations, June 2023	Official catalogue and 30-page guide PDF through the browser; direct download returned HTML	Technical-document structure, definitions, references, annex roles and editorial review
ITU-T A.1, September 2019	Official catalogue identifies this edition as in force; full operative text was not inspected in this revision	A verified working-methods reference for further institutional study; no detailed rule imported
UN/CEFACT Core Components Technical Specification, version 3.0, 29 September 2009	Official metadata; linked full PDF was inaccessible	Evidence of a UN-system technical Specification class; detailed comparison remains deferred
United Nations National Quality Assurance Frameworks Manual for Official Statistics, 2019	Official metadata and full PDF; a local copy was downloaded from the UN Statistics Division	Institutional, process and output quality as distinct review concerns
UNESCO Recommendation on the Ethics of Artificial Intelligence, adopted 23 November 2021	Official text and adoption metadata	Ethical impact, participation and oversight questions for AI-mediated programme work; not a universal GR technical standard

The machine-readable source register distinguishes browser inspection, catalogue-only verification and successful local retrieval. Only the UN NQAF PDF was successfully cached locally in this revision. The cache is in ignored `build/reference_sources/`; it is not a redistributed programme publication.

The official IEEE drafting page links its Style Manual, editorial checklist and 2026 Word template. Access to the manual/checklist was refused with HTTP 418; the template download was refused with HTTP 403. These files were not read or adopted. The accessible Operations

Manual is the IEEE source actually used. The ISO directives page identifies Part 2 resources, including an amendment; the complete current amended text was not obtained. The model and house-style guidance do not substitute for a claim of full Directives compliance.

96.1.2 2. Differences that matter

96.1.3 Technical structure

The ISO model illustrates a title page, contents, Foreword, Introduction, Scope, Normative references, Terms and definitions, technical clauses, labelled annexes and a bibliography. Its rice example is instructional; its commodity requirements have no relevance to GR conformance. Annotated model PDF.

The ITU guide also separates scope, references, definitions and technical material, but distinguishes integral annexes from supplementary appendices. It is itself author guidance, not an ITU-T Recommendation. The programme uses one alphabetic annex sequence with an explicit normative or informative label. This is a deliberate local choice, rather than an assertion that ISO and ITU structures are identical. ITU guide PDF.

IEEE's accessible rules distinguish normative from informative content, identify the role of references and distinguish mandatory requirements, recommendations, permissions and capabilities. Its own copyright, distribution, committee and approval rules belong to IEEE. The GR programme does not copy those institutional authorities or assert compliance with them. Operations Manual, 6.4.

96.1.4 Institutional quality

The UN NQAF manual addresses official statistics through recommendations, a framework and implementation guidance. Its treatment of institutional environment, statistical processes and outputs makes it useful for asking whether competent responsibility, reliable methods and usable results are all present. It does not define truth for arbitrary factual claims, adjudicate legal disputes or supply a general-purpose provenance schema. UN Statistics Division PDF.

The local adaptation is to assess records and the practices that produce, review and maintain them separately. A well-formed package does not prove that a review was independent, that a notification reached its audience or that a remedy worked. Those are programme design conclusions, grounded also in the GR sources and programme objectives; they are not presented as clauses copied from the statistical manual.

96.1.5 Institutional mandate and policy

UNESCO's AI ethics Recommendation is also relevant to the governance discussion. It treats ethical assessment across an AI system's life cycle and connects values, impacts and institutional action. Its domain and recommendatory form differ from a technical interchange specification. The programme uses it as an informative comparator where AI mediation is involved; the broader GR project includes many processes outside that domain. Official Recommendation.

The existence of UN-system instruments does not identify the appropriate partner for this programme. An ITU technical activity, a UN/CEFACT interoperability activity and a statistical capacity-building initiative have different audiences and mandates. No organization is proposed as sponsor or adopter merely because its publications provided useful examples.

Any later international policy proposal needs a separate mandate analysis, options for voluntary participation and stewardship, participation and resource estimates, risks, safeguards and an evaluation design. It could cite an adopted GR Standard, propose a bounded pilot, or recommend deferral. It would not gain technical conformance authority by adopting the appearance of a UN publication.

96.1.6 3. Local publication model implemented in version 0.2

These are independent programme proposals, implemented in the shared TeX presentation and Directives Part 2:

1. **Front matter:** publication identity, maturity, version and date; contents; Foreword for responsibility and status; Introduction for motivation and relationships.
2. **Numbered clauses:** 1 Scope, 2 Normative references, 3 Terms and definitions, followed by the document's substantive clauses. Parent clauses with subclauses avoid unnumbered hanging text.
3. **Requirements:** stable identifiers retained across rearrangement; the responsible subject, triggering condition, action and evidence expectation are explicit. Editorial numbering and requirement identity remain separate.
4. **Normative schedules:** application conditions and assessment records belong in explicitly normative annexes. Every requirement has an assessment route; an annex's status does not silently turn its examples into obligations.
5. **Informative material:** worked examples, conceptual source maps, external comparisons and unresolved issues remain distinguishable from conformance criteria.
6. **References:** precise draft dependencies are separated from an informative bibliography. A new dependency edition requires reassessment of affected obligations.
7. **Production:** A4, readable serif body text, decimal clauses, restrained monochrome headings, captions, Roman front matter and Arabic main pagination. Annex boundaries have page breaks; ordinary clauses flow continuously. Fonts, code layout and margins are local production choices.
8. **Revision evidence:** the 0.1 source package is preserved; a requirement change register and build hashes identify the revision. Existing IDs are not renumbered to simulate a new origin.

The revision expands procedure and semantic content, rather than imposing a target page count. A useful standard can be short. Here the earlier compression omitted much of the application detail, assessment evidence and failure handling needed to evaluate the proposals. Length is reported as a production result, not as evidence of maturity.

96.1.7 4. Remaining review

The full current ISO directives, IEEE style resources and UN/CEFACT technical text need separate access and edition review before more detailed reliance. Language, accessibility and institutional burden need testing with intended users. Governance adoption, rights terms, actual appointments and independent review remain unresolved. No external source model resolves those local decisions.

97 academia application reference

Original source: `docs/reviews/academia_application_reference.md`.
Original source SHA-256: `269b4c3bc76263d90f44c97e22a350109877ee544bf64ac5fdb40d3baf2c0a01`.

97.1 Academia application reference review

Document class: Informative implementation comparison
Status: Source inspection; proposals are provisional
Reviewed: 2026-09-22
Reference repository: `research/projects/Generative-Relational-Academia-Application`

This review supports the generalized application's graph, recording protocol and record-module design. It compares the academia project's source with its own design documents. It does not establish conformance to the Generativity Standards Program or run the academia application's test suite. No files in that repository were modified and no software source was copied.

> Historical scope: the review below describes the pre-import inspection. ADR-0009 subsequently authorized consolidation; the application is now retained under `application_infrastructure/gr_academia_application/`. Links below resolve to the imported source. Exact original source is recoverable from its verified history bundle; see the migration guide. Earlier statements about work not yet copied or tested describe that original review, not the completed relocation.

97.1.1 1. Reuse the architectural distinction, preserve the different models

The academia application has a useful separation between protocol, host and presentation. Its TypeScript protocol package implements canonical encoding, content identifiers and signatures; its Fastify host stores accounts and a derived SQLite index; its React client presents records. The host delegates substantive record writes to the Python `grrp` command. Plain record files remain available without the host database.

Its semantic kernel is narrower than the programme's six operational record classes. GRRP records changes in understanding as eight acts: `question`, `claim`, `challenge`, `transformation`, `decision`, `connection`, `verification` and `release`. A question starts a trajectory inside a project. Projects are containers; they are not trajectories. A state is content reached through a transition rather than a separate selectable graph subject.

The graph-model draft explicitly refuses person and project nodes and treats occasions as readings of shared cited materials. These are substantive academia-profile choices. They cannot serve as universal restrictions on Entity, State, Event, Process, Relation and Property records in the generalized application.

A shared future kernel can provide stable references, record revisions, explicit relations, attachment digests, protocol versions, transaction integrity and portable storage. Academia can supply its own acts, trajectories, views and policy constraints through a separately declared profile. Mapping GRRP states or transitions directly to generalized State or Event records would require a recorded semantic argument.

97.1.2 2. Actual stored envelope and history

The Python store implementation constructs transition records with:

Group	Fields and treatment
Identity and structure	`id`, `protocol`, `kind`, `trajectory`, `parents`, `prior_state`, `posterior_state`
Factored description	`act`, `target`, `relation`, `trigger`, `disposition`
Attribution and grounds	`performer`, `performed`, `contributions`, `absorption`, `artefacts`
Registration	`registrar`, registration `time`, `attested`, optional `signature` inside `registration`
Administrative operations	`kind: operation`, `operation`, `subject`, `payload`; the common envelope supports these separately from substantive transitions

The three dispositions are `accepted`, `contested` and `unresolved`. Relations include sixteen CiTO bindings and three explicitly local terms. Contributor-role bindings use CRediT. The source preserves the distinction between performing an act and a later party registering it. A distinct registrar's signature is not represented as approval of the substantive content.

State identifiers are SHA-256 digests of stored content bytes. Content is normalized once before initial writing; later readers verify the actual bytes. Transition identifiers cover an explicit, versioned field list, including semantic parents. Registration and disclosure are excluded from that identifier. Registrar signatures cover `{id, registrar, time}`. A cross-language test-vector suite checks Python/TypeScript agreement; it previously exposed different whitespace handling.

Transitions live in append-only `trajectories/<id>/transitions/<hash>.yaml`; state content lives separately in `states/<hash>.md`. Disclosure is a separate sidecar, so its lawful change does not alter the transition identifier. Group-tier proposals live outside the registered-transition directory until registration. Corrections are later transitions. The store topologically orders parent records before descendants; timestamps break ties rather than determine the semantic graph.

The Git adapter stages and commits exactly the paths an operation supplies. It returns a success flag; record files can exist without a successful Git commit. Git history is therefore a substrate, not a one-to-one definition of a semantic transition. This is a useful conceptual distinction, but a generalized application promising Git-backed atomic writes needs stronger failure, locking, rollback and concurrency behavior than this optional adapter supplies.

97.1.3 3. Graph and module patterns worth adapting

The graph canvas already supports selection, neighbor highlighting, dragging, panning, zooming, fit and local layout persistence. Connection transitions with multiple parents appear as selectable capsules on connecting lines. The same connection is thus an edge-like presentation and an inspectable record with its own content.

The subject panel separates Record, Disclosure, Workspace and conditional Calendar tabs. Selecting a graph subject opens relevant components and actions in one place. This is a useful interaction pattern for generalized records: selecting a Relation should expose the same provenance, revision and attachment capabilities as selecting another record class.

The host projection builds graph edges from semantic parents and artifact citations. It distinguishes `follows`, cross-trajectory `crosses`, and `cites`. Repeated references to an artifact become one material node. Structural links and substantive connection records have different authority and affordances; a displayed line need not itself be a record.

The graph-model draft classifies modules by storage and authority:

Module	Intended boundary	Generalized design implication
Record	Protocol-authored semantic content	Persist substantive changes through the recording transaction path.
Disclosure	Protocol operation and sidecar history	Keep permissions and disclosure changes explicit; do not infer them from canvas visibility.
Workspace	Mutable project-shared working material	Distinguish a convenient file collection from a cited, immutable evidence snapshot.
Calendar/layout	Local presentation or planning state	Moving a node or changing a local view need not assert a change in the represented situation.

A workspace upload does not itself become evidence in GRRP. A substantive act deliberately cites a digest. The generalized application can adapt this distinction while offering a clearer attachment workflow: immutable bytes and manifest metadata when attached to a record, with a separately named scratch workspace if later needed.

97.1.4 4. Observed implementation gaps and migration traps

These findings are based on the inspected source, not executed exploit or integration tests.

1. **Disclosure is a placeholder in the node panel.** Its own text says the sidecar is not wired. An attractive tab is not evidence of working access or disclosure controls.
2. **Calendar storage differs from the design.** The draft proposes `.gra/calendar/`; the client stores entries in browser `localStorage`, keyed by project slug. This is not account-scoped persistence or a shared calendar.
3. **The universal workspace is narrower in the UI.** The draft gives every material subject a workspace; the panel enables it for transitions and held `state:` materials, excluding external works. Upload/delete routes allow the project creator, whereas the draft describes project-party sharing.
4. **Visual connection creation is incomplete.** The canvas supports layout interaction, but connections are created with a form containing a typed target identifier. It does not yet implement drawing a connection between selected endpoints. Ordinary act forms also omit the proposed artifact picker and contributor controls.
5. **Missing parents disappear from the graph.** `projectGraph()` skips parent identifiers absent from the current node map. The draft instead calls for explicit "not held here" stubs. The generalized application should preserve restricted, absent or unresolved endpoint information without inventing endpoint content.
6. **Operations need an explicit projection rule.** The trajectory reader maps every YAML file under `transitions/`; the graph builder does not filter `kind: operation` before producing transition-shaped nodes. This differs from the design instruction to keep administrative operations in panels rather than substantive graph nodes.
7. **Authentication and recorded performer are not visibly bound in the web adapter.** The host checks the session party for project access, but calls `runGrrp()` with inherited process environment and no request-specific acting identity. Initializing a project creates a GRRP key in its record directory. The account party and recorded performer therefore need an explicit end-to-end identity check before shared authorship claims. Existing account-database tests alone do not test this binding.
8. **Mutable files are not immutable evidence snapshots.** `writeProjectFile()` can overwrite a path and `removeProjectFile()` deletes it without looking for citations. They do not themselves commit those file changes. The draft's "in Git" and cited-material guarantees should not be inferred from those helpers. Content-addressed storage and a record attachment manifest avoid meaning changing behind a stable record reference.
9. **Bundle import needs separate hardening before reuse.** `bundle.apply()` skips existing target paths without comparing bytes; the draft expects conflicting bytes for an identifier to be refused. It also joins archive names to the target after only a `trajectories/` prefix check. It does not establish safe, atomic, validated import by itself. No importer should be transplanted without path, size, schema, hash, identity-collision and partial-failure validation.
10. **Documentation and types have drift.** The TypeScript grounds list uses `exploratory` where Python uses `vulnerability`; its contribution type is a mapping while Python creates a list. README milestone/test statements are inconsistent. The source and behavior need to govern migration evidence, not a single README status paragraph.

97.1.5 5. Recommended compatibility boundary

Develop the generalized recording kernel and application first, as the user requested. Keep the academia entry point and domain workflow independent. A future adapter can map supported common fields and preserve the original GRRP bytes, identifiers, signatures, profile version and unmapped fields. It should report incomplete mappings explicitly; it should not rewrite signed historical records to make the two models appear identical.

Candidate shared conformance cases include stable record identity across revisions; distinction between Git commit parentage and semantic relations; relation records carrying their own modules; immutable attachment digests; atomic record-plus-relation creation; conflict rejection without losing either submitted revision; explicit missing-reference handling; portable export; and recovery from failed writes. Cross-application compatibility remains unclaimed until such fixtures have been implemented and independently read by both applications.

The reference project's licensing file identifies software as AGPL-3.0-or-later and specifications/documentation as CC BY 4.0 unless separately stated. Its `grrp/README.md` still says MIT. This review transfers design observations only; a later decision to copy software would need to account for the applicable source notices rather than rely on that stale README line.

98 expanded working draft review

Original source: `docs/reviews/expanded_working_draft_review.md`.
Original source SHA-256: `6a26c2ad635d71f5a908fad720815eca344ce3339b27b80ee07ebac5de4f3c3f`.

98.1 Expanded Working Draft 0.2 review

Class: Informative editorial and artifact review record
Status: PREPARATORY; 2026-09-22
Package: Archived nine Working Drafts, version 0.2
Review relationship: AI-assisted drafting and cross-review in the same development session. This is not independent stakeholder review, a formal ballot or a finding of institutional conformance.

98.1.1 1. Scope and source basis

The revision responds to the need for substantive application detail and formal publication structure. It develops all five existing governance drafts and the four initial technical drafts. It does not open additional work items or adopt the instruments. The 0.1 archive preserves original sources and tools with hashes.

The external-source study distinguishes editorial models from quality frameworks and policy instruments. ISO's annotated model, accessible IEEE rules and ITU authoring guidance support publication design; UN NQAF and UNESCO AI ethics materials provide bounded institutional comparisons. Actual access and failed retrievals are recorded. The theoretical basis remains the GR manuscript corpus, with passage-level locators in each technical document.

Particular source attention was given to FM-005's generative attribution, trajectories, evidence survival, reconstruction, uncertainty, epistemic justice, machine mediation and revisability; FM-003's praxis and limits of a fixed intervention sequence; and FM-007's operational roles and conceptual evolution. These readings do not resolve the Property/Attribute question, chronology of Chapter 3 variants or stronger emergence claims beyond the formal assumptions.

98.1.2 2. Substantive changes

Document	Added depth and review purpose
Programme Charter	Actual authority and resources, delegation and reserved decisions, participation barriers, accountability, transitions, readiness and evidence
Directives Part 1	Work-item and stage dossiers, review preparation and disposition, ballots and clocks, independent appeal capacity, emergency action, maintenance and release controls
Directives Part 2	Formal architecture, definition and requirement construction, dependency precision, semantic/protocol boundaries, normative assessment records and editorial completion checks
TC Charter	Assignment, source and decision registers, multidisciplinary review, pilot preparation, failure reporting, handover and maintenance
Ethics/IP Policy	Intake, protection, investigation, response, reasoned findings, proportionate remedies, reconsideration, conflicts, impacts, contribution rights and assessment
GR-100	Numbered terminology, six operational roles with identity and temporal conditions, scale, continuity, mappings, missingness and vocabulary assessment

Document	Added depth and review purpose
GR-110	Purpose and collection planning, generative accounts and evidence, conditions/contributions/alternatives, maintenance and loss, practical effects, custody and assessment
GR-200	Claim decomposition, methods, source dependence, material survival, interpretation, uncertainty, revision, machine mediation, protection and normative semantic schedules
GR-210	Case intake and state transitions, responsible review, competing accounts, response and disposition, corrections and practical effects, review limits and assessment schedules

The requirement change register reports text-level changes against the archived edition. It preserves old and new texts and their normalized hashes. Stable IDs identify provisions independently of their new clause locations. No ID was intentionally removed or reassigned.

98.1.3 3. Cross-review findings and dispositions

Finding	Correction and remaining limit
Sole requirements appeared in Scope while D2 required a declarative scope	Relocated the relevant Charter, D1, TC and EIP provisions into application or authority clauses, preserving their identifiers
Some D2 provisions were under unrelated headings after restructuring	Moved epistemic distinctions, conformance limits, automated checks, bindings and artifact-execution rules to their corresponding clauses
Ethics acknowledgement and determination periods were described collectively as extendible targets	Revised EIP-014 to distinguish mandatory seven-day acknowledgement from the extendible determination target; this is an explicit revision of a 0.1 obligation
Temporary participation restrictions had unclear review/expiry linkage	EIP-067 expressly applies the emergency review and expiry controls, without creating additional institutional authority
Internal conduct threshold and merits reconsideration needed limits and a usable route	EIP-069 states a reasoned criterion, contrary evidence and fairness prerequisites; EIP-099–104 specify scoped reconsideration and assessment. The threshold remains a local proposal under Q-29
Some definition entries blended definitions with examples and implications	Separated explanations into notes in the core vocabulary and epistemic drafts
One result per ID could conceal failure of a component within a grouped requirement	Added component-result rules in the core assessment schedules; every applicable component needs evidence for overall fulfillment
Unknown/restricted values could be read as a waiver of essential record structure	Distinguished required identifiers, content and scope from contextual facts that can be explicitly unknown or protected; an allowed declaration does not prove the fact was examined
A timestamp example overstated proof of recording time	Qualified it by source attribution and clock/integrity/context limits
Repeated long-table headers repeated their caption labels and produced compiler warnings	Separated first-page captions from continuing column headers; checked the revised cross-references and renderings

No review finding establishes beneficial generativity, truth of a claim, legal authority or an operating institution. Shared-session AI cross-review is not the independent human review required by the proposed governance.

98.1.4 4. Artifact verification

The full build report records compiler outcomes, source/preamble/PDF hashes, warnings and tool versions. The check report records structural checks, archive integrity, retained IDs, local

reference resolution, freshness and PDF text coverage. These historical reports were copied before revision to 0.3; current results are recorded in the substantive validation cycle.

All nine documents compiled successfully through WSL/LuaLaTeX. The checker passed with **753 requirement identifiers across 225 PDF pages**, compared with 318 identifiers and 84 pages in 0.1. There were no duplicate or unresolved identifiers, missing requirement text, stale artifact hashes, changed archive hashes, removed historical IDs, overfull boxes, missing glyphs or detected LaTeX/package warnings.

Document	0.1 pages	0.2 pages	0.1 requirements	0.2 requirements
GSP-Charter	9	19	41	85
GSP-Directives-1	13	27	58	95
GSP-Directives-2	8	26	45	95
GR-TC1-Charter	7	17	30	83
GSP-Ethics-IP	8	22	40	104
GR-100	13	30	12	26
GR-110	8	28	34	111
GR-200	11	32	26	49
GR-210	7	24	32	105

All 318 historical IDs remain: 315 requirement texts are unchanged after whitespace normalization, two advance the GR-200 dependency edition, and EIP-014 explicitly corrects the acknowledgement/target distinction. There are 435 new IDs. Clause relocation and non-requirement prose changes are not classified as requirement text changes by the CSV tool.

Formal-structure checks cover opening clauses, front matter, annex status, table captions and local references. The archive and PDF hashes were verified. Local Markdown targets resolved, and `PROJECT_INDEX.txt` lists 108 source/corpus files. These checks are artifact evidence, not fulfillment of all D2 technical and institutional assessment duties.

Visual review sampled each document's cover, opening Scope page and first normative annex, plus D2's assessment schedule, GR-100's record-role and source tables, and GR-200's assessment schedule. The 31-page selection is recorded in `build/review/v02/render-plan.json`; rendered pages and contact sheets are stored beside it. The inspected samples showed readable headings, intact tables and no observed clipping or overlap. One nonblocking underfull-line spacing advisory remains in GR-100's source-map introduction; its rendered page was inspected. No tagged-PDF, screen-reader or affected-user comprehension assessment was performed.

The final toolchain is recorded in the build report: Python 3.12.3, latexmk 4.83 and LuaHBTeX 1.17.0 (TeX Live 2023/Debian) under Ubuntu-24.04/WSL. Builds use shell escape disabled and fetch no external dependencies. Text extraction checks use the Windows Python review environment with pypdf. Source-word counts in the machine report include TeX markup and repeated table headers, and are not represented as prose word counts.

98.1.5 5. Remaining assessment and institutional work

P0 and P1 remain historical 0.1 fixtures. Their arithmetic and authored examples do not assess newly added obligations or demonstrate performance of an actual committee, recording practice, review service or remedy. The initial templates likewise do not substitute for the 0.2 normative schedules.

Before adoption, work remains on actual founding authority, accepted appointments, representation, independent-review capacity, rights terms and a governed rehearsal. Before live operational claims, work remains on contextual legal/ethical review, burden and resource measurement, observed procedure tests, affected-user understanding, accessibility and justified profiles. Current TeX/PDF production does not certify tagged-PDF or screen-reader accessibility.

More detailed drafts expose decisions that can now be reviewed; they do not settle those decisions by their length or typography. ADR-0005 and Q-27–30 retain the proposed choices and alternatives.

99 git layers 2026 09 22

Original source: `docs/reviews/git_layers_2026-09-22.md`.
Original source SHA-256: `b4c7c3260b531bf0a46031c2f627f0a39243a4e0ebf55ffe33f299e591b507bd`.

99.1 Git repository layering verification

Class: Implementation and preservation review
Date: 2026-09-22
Status: Local repositories committed; recursive clone and independent audit passed

99.1.1 Scope

The user's requested structure is implemented by four source repositories: programme, infrastructure, generalized application and academia application. Infrastructure is the programme's submodule; both applications are infrastructure submodules. Common packages remain ordinary infrastructure files. ADR-0010 records authority, alternatives and the selected boundary.

The repositories are local. The user will create hosted repositories after these commits. No remote push, outer-repository commit, application-record mutation or account migration is part of this operation.

99.1.2 Preflight evidence

- The outer repository tracked no programme paths. Its index digest and references were captured privately for an unchanged-state comparison.
- Academia's original source repository was clean at `b98730b46eca5fdf441937aef0180f5b3d4f94dd`, and its preserved bundle matched the recorded SHA-256.
- An independent bounded scan examined 329 reachable academia blob versions for private-key, common token and obvious runtime-path patterns. It found no matches. This is not a comprehensive secret or security certification.
- Source inventories contained no symlinks or junctions requiring an out-of-workspace traversal. The intentionally retained original source-history bundle was identified separately from private runtime history.

99.1.3 Construction and attribution

Boundary-local ignores exclude private runtime, account databases, key files, backups, environments, dependencies and generated builds. Git attributes preserve source bytes, with explicit LF handling for shell scripts and existing academia web sources. Local `core.longpaths` supports the nested Git metadata paths on Windows; no global configuration was changed.

Academia's original main history is imported from the local bundle. Its prior tree is loaded into the new index without checking it out over the relocated working files. The new commit therefore records relocation and current documentation/licensing changes as a continuation of the original history.

All four repository roots have comprehensive READMEs, an MIT licence, scope notes, contributor attribution and contribution guidance. Python packages carry their own copies of the MIT/contributor notices for distribution. Earlier academia notices are retained as dated history. The original bundle, foundation manuscripts and research PDF bytes are preserved; current additional permission for project-controlled material is documented separately from their historical embedded notices.

Historical migration manifests remain evidence of the earlier captured state. They are not refreshed to claim that these later licensing, README or Git-boundary changes occurred during the earlier relocation.

99.1.4 Verification record

Repository	Initial committed revision	Entries in its own index
Programme	`992284aad1798109362edfb784475875103a29d8`	166, including one infrastructure gitlink
Infrastructure	`34878d4149b02a3e4a2672147478e60b2452ffc2`	37, including two application gitlinks
Generalized application	`4df26e7297f4f917bcb879a5ebd9648051cbcf2a`	29
Academia application	`1edbabab28486eeb9994e7298773bb6e7d67bccc`	142

The programme receives a subsequent documentation commit recording this verification; child revisions remain as shown. The initial recursive clone was made from the listed programme commit.

Check	Observed result
Four repository identities and clean trees	Passed in source and fresh recursive clone
Parent `160000` entries and checked-out child revisions	Exact matches for all three submodules
Fresh recursive local clone	Both levels initialized and checked out successfully
Source-to-clone byte comparison	All 371 tracked files identical
Historical publication snapshots	All 30 recorded file digests match in the clone
Private runtime in clone	Absent; ignore probes and bounded tracked-path checks pass
Git object integrity	All four source repositories pass `git fsck`; one harmless unreachable former `.gitmodules` blob in infrastructure
Academia ancestry and original checkout	Original source commit is an ancestor; external checkout remains clean and unchanged
Enclosing repository	HEAD, complete references, index SHA-256 and programme tracked-path inventory unchanged
Python distribution licensing	All three wheels built offline and contain MIT metadata, licence text and contributor files
npm licensing metadata	Four local packages and matching lockfile entries identify MIT; third-party entries unchanged
Retained notices and documents	Earlier licence snapshots, four academia PDFs and source bundle digests preserved
Active Markdown links	All checked current guide targets resolve; historical source snapshots excluded
Hosted remotes	None configured; no push performed

An independent reviewer repeated repository identity, gitlink, clean-tree, object-integrity, ancestry, ownership, privacy and enclosing-repository checks. The recursive clone and byte comparisons were performed separately by the implementing agent. Detailed operator outputs remain in ignored `build/git-layers/`.

Windows initially assigned the newly created repository directories to the sandbox identity. Only the owner field on the new repository/Git directory roots was assigned to the user's Windows account; access-control rules and global trust settings were not changed. Absorption ran under that account. Independent inspection confirmed that repository roots, absorbed Git directory roots and `.git` pointer files belong to the user, and ordinary user Git commands succeed.

Reproduce the structural check with `python tools/check_repository_layers.py` after all four repositories are committed. The check is read-only and does not initialize missing modules or read user records. The previous application regression results remain the dated migration baseline; this task's new verification concerns repository structure, preservation and packaging metadata.

99.1.5 Remaining boundary

Hosted URLs and remote publication remain deferred by the user. Local submodule URLs describe this local nested source layout; they must be updated to actual hosted repositories

before publication. The workflow guide gives the commands and dependency order. Application protocol alignment, existing dependency advisories and operational deployment work remain as previously recorded.

100 initial working draft review

Original source: `docs/reviews/initial_working_draft_review.md`.
Original source SHA-256: `3c56ce2f896a2156e78c8dcaa068ce2bc56376d5178ed7d95979e295bc90976f`.

100.1 Initial working-draft review

Document class: Informative editorial and artifact review record
Status: PREPARATORY; version 0.1; 2026-09-22
Package: Archived nine Working Drafts, draft version 0.1
Review relationship: AI-assisted authoring and cross-review within the same development session. This is not independent stakeholder review, a formal public review, or a competent legal/ethical determination.

100.1.1 1. Scope and evidence

The review examines conceptual distinctions, cross-document requirements, explicit authority, source traceability, synthetic counterexamples, and generated artifacts. It draws on the Programme Brief, repository instructions, seven indexed foundation manuscripts and the prior standards-development comparison. TeX sources contain passage-level source rationale; the manuscript map preserves unresolved differences. External procedures inform comparison, not a claim of ISO/IEEE affiliation or procedural conformity.

Different drafting agents reviewed the governance documents and the recording/epistemic documents; the primary author integrated findings. The P1 example received a separate cross-review. These are useful editorial checks within one AI-assisted process and do not supply the expertise, constituency independence or participation evidence required for actual programme adoption.

100.1.2 2. Findings and dispositions

ID	Finding	Implemented disposition	Evidence
RV-01	Draft R110-012 and some vocabulary metadata mixed occurrence/modality with observational/inferential basis.	Separate them. A realized past event can be inferred retrospectively.	GR-100 Event/Process; E200-005; R110-012; P1-C.
RV-02	“Loss shall be recordable” tested capability but allowed known material loss to be omitted.	Require actual recording or an explicit collection/protection limitation.	R110-017; P1-I.
RV-03	Claim-level GR-200 references could hide its package-scope and assessment obligations.	Identify a bounded material-claim package and require the corresponding dependency results.	R110-005; C210-030.
RV-04	Package/case review and practice/procedure assessment had ambiguous applicability.	Treat documentary-only assessment as partial in this edition; unobserved performance remains not assessed. Condition multi-case rehearsals on procedure assessment.	GR-110 conformance section; C210-030–032; Q-24.
RV-05	D2 amendment language would constrain ordinary draft editing as though every edition were adopted.	Apply formal amendment/revision to adopted normative editions, draft-stage rules to drafts and declared maintenance to released Specifications.	D2-045.

ID	Finding	Implemented disposition	Evidence
RV-06	D1 referenced separate participation/records policies that did not exist.	Cite the Charter, named ethics/rights policy and exact records clauses.	D1-001/008/048 and associated prose.
RV-07	Specification and policy release routes were referenced but underspecified.	Require class-specific review plans, release authority, evidence, objections and appeals; preserve explicit promotion and mandate-specific policy decisions.	D1-056–058; CH-013; TC-022.
RV-08	Charter wording implied every maintenance decision required a substantive ballot.	Refer to applicable ballot/review rules and distinguish substantive changes, corrections and confirmation.	CH-038; D1-029/045/047.
RV-09	Returned-ballot quorum alone could allow one approval plus abstentions.	Require at least three substantive votes in addition to quorum and the two-thirds substantive approval threshold.	D1-031; P0 arithmetic cases. This threshold remains a proposal.
RV-10	Some documents lacked editor/source metadata and governance titles introduced unnecessary codes.	Mark responsibility UNASSIGNED and canonical source; use descriptive governance identifiers and existing GR/TC 1 designation.	Source front matter; manifest build IDs.
RV-11	P1 risked deriving absence from a partial packet, implying an unavailable log had been inspected, overstating adjustment evidence as calibration quality, and treating scheduling as completed reassessment.	Preserve source availability, narrower source content, conditional conclusions and pending actions; include pre-submission antecedents in temporal scope.	P1 inventory, evidence table, procedure and summary.
RV-12	Source prose implied a chronological relationship between two Chapter 3 files.	Describe separately supplied variants and retain unresolved chronology.	GR-110 source rationale; Q-08.
RV-13	The initial GR-110 PDF had a long-path overflow.	Use a breakable source path and recompile the revised package.	Build report and PDF inspection.

No finding resolves the Property/Attribute relationship, full metamodel interpretation, universal generativity measurement, legal jurisdiction, rights licence selection or institutional legitimacy.

100.1.3 3. Artifact checks and reproducibility

The machine-generated build report is the authoritative record of compiler outcomes, source/preamble/PDF hashes and detected warnings for the historical 0.1 full build. The check report records source metadata, unique/resolved requirement identifiers, build freshness and extraction of all source requirement IDs from the PDFs. These historical reports were copied before the 0.2 revision. Current build results belong to the expanded review; they do not replace this record.

The archived build guide explains reproduction of this edition. Compilation uses LuaLaTeX through `latexmk` under WSL with shell escape disabled. No external source material or package dependencies are fetched by these scripts.

The checks discriminate lost identifiers, stale PDFs and unresolved references. They do not

prove that every rendered sentence is correct or assess the substantive warrant of a claim. Visual inspection samples title pages, body text and tables; it is not a full accessibility audit.

Completed artifact results (historical 0.1): all nine documents compiled; all 318 requirement identifiers were found in the historical 84-page PDF package; source, preamble and PDF hashes matched; no duplicate/unresolved requirement identifiers, overfull boxes, missing glyphs or detected unresolved LaTeX references remained. Local Markdown links resolved and the project index matched all 87 source/corpus files. These are artifact checks, not a D2-wide conformance determination.

Draft build identifier	Requirements	PDF pages
GSP-Charter	41	9
GSP-Directives-1	58	13
GSP-Directives-2	45	8
GR-TC1-Charter	30	7
GSP-Ethics-IP	40	8
GR-100	12	13
GR-110	34	8
GR-200	26	11
GR-210	32	7

Toolchain recorded by the final build: Python 3.12.3, latexmk 4.83 and LuaHBTeX 1.17.0 (TeX Live 2023/Debian), running in Ubuntu-24.04 under WSL. The machine report supplies exact versions and hashes.

Visual review covered all nine title pages, PDF page 4 of each document, and assessment/source tables on PDF pages 8 (GR-110), 9 (GR-200) and 7 (GR-210). Additional inspection covered GR-100 role definitions on PDF page 8 and the D1 defaults table on PDF page 11. The samples showed readable layout without observed clipping or overlap. Title-word hyphenation and description-list warnings were corrected in the shared preamble; narrow table columns were changed to ragged-right alignment. The affected samples were inspected again after recompilation. One nonblocking underfull-line spacing advisory remains in the Charter; the build report records it separately from errors and LaTeX/package warnings. Final render samples and contact sheets are in `build/review/`; page numbers here count the title page as PDF page 1. No screen-reader, tagged-PDF or affected-user comprehension assessment was performed.

100.1.4 4. Synthetic evidence and remaining work

P0 checks explicit ballot arithmetic and illustrates comment/disposition logic. It does not perform a real public review, election, recusal, appeal or founding agreement. P1 supplies attributed claims and discriminating defects for review; it does not establish that procedural actions occurred, controls worked, users understood the presentation or harm was repaired.

Use the assessment template to record per-requirement evidence in actual rehearsals. No unqualified conformance claim is made for P0, P1, the programme or an institution. Documentary inspection and arithmetic are only parts of a future assessment.

Before governance adoption and technical initiation, remaining work includes actual founding authority, accepted appointments, neutral-review capacity, participation/representation review, selected rights terms and a real governance rehearsal. Before live institutional claims, work includes contextual legal and ethical review, affected-user participation, disclosure/retention authority, resource and burden measurement, observed procedure tests, accessibility/comprehension evaluation, and a decision on bounded conformance profiles.

M1 and later milestones remain open. Compiled drafts are the first reviewable development output, not evidence that the programme's institutional infrastructure is already operating.

101 remote publication 2026 09 22

Original source: `docs/reviews/remote_publication_2026-09-22.md`.
Original source SHA-256: `c9e6ecc3f59c927c9996e764042455a6287f2395c3b797e4e4e31175297de02c`.

101.1 Hosted source publication

Class: Repository operation and verification record
Date: 2026-09-22
Status: All four repositories published; hosted recursive clone and source comparison passed

101.1.1 Authorization and destinations

The user supplied four GitHub SSH destinations and explicitly requested setup and publication of the local commits. Each repository uses its own `origin` and `main` branch. Both `.gitmodules` files now contain hosted SSH URLs. The repository guide gives clone, identity-selection and maintenance commands.

Repository	Destination
Programme	Generativity-Epistemic-Infrastructure
Infrastructure	Generativity-Relational-Epistemic-Applicative-Infrastructure
Generalized application	Generalized-Generativity-Relational-Social-Science-Application
Academia application	Generative-Relational-Academia-Application

101.1.2 Authentication and publication boundary

Windows OpenSSH authenticated as `huangwanhong-maker` using the user-selected `serendip_id_ed25519` identity. The executable and identity selection are configured locally in each repository. Strict host-key verification remains enabled; noninteractive checks use a temporary batch-mode setting. No global Git or SSH settings were changed, and the private key contents were neither displayed nor added to source.

This operation publishes source repositories. Private account databases, native signing keys, project-record repositories, uploaded material, local backups and environments remain outside source control. An independent bounded preflight checked the repository structure, ignored paths and 638 text blob versions for high-confidence credential patterns without finding a match. This is a limited source audit, not a comprehensive secret or security certification.

101.1.3 Existing remote history

The programme, infrastructure and generalized remotes were empty when inspected. Academia already contained `08590a2e73fd92578e5e75639c09b5815002d7b9`, a README-only commit changing its copyright attribution to all contributors. It and the migrated local branch had diverged from the retained earlier source commit.

The remote commit was fetched and merged with both parents preserved. The README conflict was resolved by retaining the current comprehensive MIT guide and explicitly crediting all contributors listed in `CONTRIBUTORS.md`. The historical README snapshot, import manifest and original source-history bundle retained their earlier bytes. No force push or history replacement was used.

Published application revisions are generalized `19341ae30c6a4f69cb97c424a6a34617a6e8e478` and academia `4e577f2b3f38a3b3c3dcd009804b06182ea4b70b`. Infrastructure `a363e39f51f18734badaabb52eb3740f3063714b` pins those exact commits. Each child was published before its parent pointer.

101.1.4 Verification

The initial hosted programme commit is `d2e5b2398005b2434130c9fc3db00592ae24a175`. A subsequent programme documentation commit records these completed checks; application and infrastructure revisions remain as listed above.

Check	Result
Four remote `main` references	Match the corresponding published local commits
Upstream configuration	Each local `main` tracks its own `origin/main`
Parent/child commit pointers	Programme pins infrastructure; infrastructure pins both published applications
Hosted recursive clone	GitHub supplied all four repositories and all three submodule checkouts
Source comparison	All 372 tracked files in the hosted clone matched the local source bytes
Private runtime	Absent from the hosted clone
Structural checker	Passed in the source workspace and the fresh hosted clone
Academia remote ancestry	Existing remote commit retained through an ordinary merge and non-force push
Frozen academia source evidence	Historical README snapshot, import manifest and original bundle unchanged
Active documentation links	Current local guide targets resolve

The byte comparison used Windows extended file paths for the longest PDF filenames under the disposable clone directory; no machine-wide long-path setting was changed. Detailed command results remain in ignored `build/git-publication/`. The verification clone contains source only and is not a backup of application accounts or user records.

This publication does not adopt a Standard, change application record semantics, resolve the existing dependency advisories or complete cross-application protocol alignment.

102 spacetime projection 2026 09 22

Original source: `docs/reviews/spacetime_projection_2026-09-22.md`.
Original source SHA-256: `55dbe8f5fab113db645daa7ae08a63cc8927351c2cf7b8394f58b2b420a3381c`.

102.1 Event-defined spacetime implementation review

Class: Informative implementation verification record
Status: EXPERIMENTAL; implementation checks on 2026-09-22; preview verification completed 2026-09-27

102.1.1 Scope

This review concerns the additive GR-SPEC-121 implementation selected in ADR-0011: the common Python protocol package, generalized HTTP binding and interface, and the native file chooser styling. It does not adopt a Standard, certify factual warrant, or establish cross-application interoperability. Academia source and native GRRP semantics are unchanged.

The package distribution advances to `gsp-record-protocol` 0.3.0. Its base protocol, schema and profile identifiers remain at 0.2; supported temporal modules and the projection have their own version identifiers. Earlier clients preserve these required modules and refuse unsupported mutations.

102.1.2 Observed automated checks

Check	Observed result and boundary
Combined common protocol, real-Git storage and application API suite	178 passed; five browser tests present at that point were skipped because the browser flag was unset. Isolated runtime; 182.42 seconds.
Shared protocol suite	100 passed, including 47 temporal cases. Covers reverse recording order, incomparable events, predecessor closure, self/multiple cycles, withdrawal, qualifications, unknown/unbounded/unscoped extents, invalid bounds, subject grouping, partial incidence and unsupported module versions.
Bounded scale and cycle review	A 1,000-record, 500-event chain verifies iterative traversal and complete predecessor closure. An independent reachability oracle agreed with cycle component detection for 500 deterministic generated graphs. This is a bounded check, not a throughput benchmark.
New authenticated API tests	Six passed against real isolated Git repositories. Covers cut purity, historical labels/order, retained contradictions and withdrawal, uncertainty, ownership, CSRF, unreachable revisions, ambiguous/excessive JSON and legacy reads without migration. Included in the combined total.
Browser checks	Seven browser tests passed across focused runs: three temporal workflows, three existing application/graph workflows and one topology-layout regression. The temporal workflow run passed in 95.08 seconds. An existing graph journey exceeded its five-second assertion while other browser tests ran; a bounded 20-second assertion allowance and isolated rerun passed in 28.82 seconds. On 2026-09-27 the layout regression and affected temporal workflow passed together in 52.71 seconds. No application assertion was removed.

Check	Observed result and boundary
Script/dependency checks	`node --check` passed for app.js, graph.js and spacetime.js; `pip check` found no broken requirements after the editable package upgrade.
Existing publication dossier	`tools/check_validation_package.py` passed its fixed-baseline identifier/status checks and all 18 arithmetic cases. Historical TeX editions were not changed.

The existing application/API tests retain their scope; passing these cases is not a general security audit. Browser checks use authored accounts and isolated temporary Git repositories. They do not exercise the user's research records.

Together, the completed checks account for **185 passing tests**: 178 non-browser tests and seven browser tests. These were separate runs, not one combined command. The selected-file draft and topology-layout regressions were added after the non-browser run.

102.1.3 Findings addressed during review

- The ordinary unstyled native file button now uses the application palette, a visible focus state and a bounded responsive control. Selection remains a native file input.
- Temporal order is carried by explicit Relation modules. Descriptive dates, Git timestamps, UUID sorting and display columns do not add precedence. An event saved later can occupy an earlier asserted position.
- Contradictory orders remain retained and inspectable. Unsupported ordering versions also prevent a purported complete cut, while unsupported extents keep affected presence indeterminate.
- Active Relation accounts retain their identity when some participants lack active scope. The topology omits those incidences and exposes a partial-relation diagnostic.
- Browser integration exposed a save/refresh race: a closed module dialog could allow a second edit against the previous head. Dialog completion now waits for the accepted snapshot refresh.
- Review required an explicit modality choice for ordering claims, preservation of unseen relation qualifications on revision/rebase, retention of a failed cut selection on retry, and file-aware unsaved-form comparison.
- Final visual review confirmed node overlap in disconnected and mixed-component topology layouts. Edgeless views now use a deterministic grid; connected views retain the force layout when its node boxes are separate and fall back to the grid when needed. All edges are retained. Browser assertions check desktop/mobile separation and a connected pair alongside an isolated node.

102.1.4 Evidence and remaining limits

Ignored local screenshots are under `build/webapp-review/`, including the file picker and desktop/mobile spacetime views. They document the authored test scenario, not a deployed institutional workflow. Tests and reproduction commands are in application TESTING.md and common verification.

On 2026-09-27 the local generalized preview was started on port 8000. Its public capability endpoint returned `gsp.spacetime/1` and both temporal module versions; its page included the temporal interface script. The two existing generalized project heads matched the private pre-refresh capture. No demonstration records or automatic migration were added to those projects. This verification preceded the separately authorized source publication; its findings concern implementation behavior, independently of the later source commits.

The view evaluates retained applicability assertions. It does not execute events to infer later target states, decide between competing chronologies, model extended-event overlap, or prove that two accounts describe the same continuing entity. Unscoped records stay separate from active topology. Event ranks and consistent cuts do not establish physical simultaneity or elapsed duration. These limits and further assessment needs remain in Q-45–48.

Assistive-technology evaluation, measured participant comprehension, scenario-specific interpretation selection and independent implementation interoperability remain OPEN. The

successful bounded tests supply implementation evidence only.

103 README

Original source: `docs/reviews/validation_0.2/README.md`.
Original source SHA-256: `e8d72f9e2bdb9e1b5608b45612bd411d7977813ee81b730c20cf3aab85def9c7`.

103.1 Substantive validation of Working Draft 0.2

Class: Informative review, fixture-assessment and revision record
Status: PREPARATORY; 2026-09-22
Fixed baseline: Archived Working Draft package 0.2
Resulting publication: Coordinated Working Draft 0.3

103.1.1 1. Result and limits

The cycle examined all **753 baseline requirement identifiers through 116 topical review groups**, produced new P0/v2 and P1/v2 fixtures, and identified five supported drafting corrections or clarifications. The current edition advances to 0.3 with **754 identifiers**, including one new conditional requirement concerning recirculation accounts. No publication, governance instrument or institution was adopted or certified by this work.

Editorial review, component assessment, arithmetic execution and institutional readiness are separate evidence categories. The review groups document what was read and compared; they do not mean 753 independent conformance tests passed. The source review is AI-assisted interpretation, not author approval of every operational narrowing or independent stakeholder validation.

The requirement review matrix gives each baseline ID its exact archived source, hash, requirement text, review groups, findings and available P1 results. The 0.2 to 0.3 change register records actual requirement text changes. The matrix continues to describe 0.2; it is not silently relabelled as an assessment of 0.3.

103.1.2 2. Review streams

Stream	Baseline coverage	Evidence and review record
Governance	462 requirements; 58 groups	Review, group register, P0/v2
Conceptual fidelity and generativity recording	137 requirements; 35 groups	Review, group register, actual manuscript passages and source-to-operational distinctions
Epistemic recording and contestation	154 requirements; 23 groups	Review, group register, P1/v2 and assessment register

The conceptual review covers recognition, mediated evidence, metamodel/record distinctions, identity, generative attribution, alternatives, possibility fields, maintenance/loss, recirculation and revision. It preserves the unresolved Property/Attribute relationship, manuscript precedence, formal emergence limits and the broader interpretation of generativity return. Exact manuscript passages and operational narrowings are recorded in that review.

103.1.3 3. Findings and revision dispositions

Finding	Disposition in 0.3	Verification and remaining limit
GOV-F01: invalid/unresolved attempted ballots disappear into nonresponse	D1-032/074 and the ballot dossier distinguish valid returns, attributable unsuccessful attempts and no attributable submission; separate unattributable/ineligible messages	Count partition and replacement cases preserve the original thresholds. Actual identity, validity review and participation remain untested

Finding	Disposition in 0.3	Verification and remaining limit
CF-01: absence of a mapping can incorrectly exempt a general safeguard	GR-100 Annex A separates the general V100-011 distinction from its conditional mapping component	A no-mapping example still receives the general check
CF-02: disputed attribution is mixed into occurrence/modality	R110-012 explicitly separates occurrence/modality, epistemic basis and assessment/dispute disposition	Realized effect, retrospective inference and disputed attribution can coexist without forced selection of one status
CF-03: generic return recording can conceal uncertainty in recirculation links	New R110-112 and the semantic/assessment schedules distinguish initial generation, conversion/transfer, return path and later-condition effect	Applies only when recirculation is asserted. Unknown links remain unresolved; no universal measure, entitlement or complete theoretical definition is introduced
EP-01: GR-210 can accidentally import blanket GR-100 conformity	Clause 2 identifies the incorporated terms, role meanings and result meanings, preserving the complete applicable GR-200 package obligation	No claim-only shortcut and no unstated vocabulary-certification requirement

The revision regression cases make the corrected distinctions inspectable. Their outcomes are authored-text comparisons; they are not live process tests. ADR-0006 records the alternatives, rationale and scope of the new operational requirement.

Of the 753 old requirement texts, 748 remain unchanged after whitespace normalization, three are revised, and two change only the GR-200 dependency edition. One new identifier is added. The GR-100 assessment-row and GR-210 dependency-prose corrections are substantive clarifications outside the requirement macros and therefore appear in this disposition table rather than as changed requirement text in the CSV.

103.1.4 4. What the rehearsals establish

103.1.5 P0: numerical results and procedure design

The checker executed **18 authored count cases: 13 valid-count states and five malformed inputs**. All matched the independently authored expected results. Cases include quorum failure, insufficient substantive participation, approval boundaries, all abstentions, zero/small rosters, hypothetical recusal and invalid count types/totals. An invalid input is distinguished from a valid numerical defeat. These results do not prove participant eligibility, consensus, proper notice, fair review or an adoption decision.

The expanded narrative includes founding readiness, comment/reply/re-review, ballot replacement, recusal, unavailable appeal capacity, ethics reconsideration, source rights, release and maintenance. Its timelines are synthetic. The cycle did not conduct public review, appoint reviewers or wait through institutional deadlines.

103.1.6 P1: documentary results and unperformed practice

The register contains **208 assessment rows**, explicitly divided into 54 selected components and 154 whole-requirement coverage results:

Assessment level	Fulfilled	Not fulfilled	Not assessed	Not applicable
Selected documentary components	53	0	1	0
Whole GR-200/210 requirements in the declared fixture scope	0	0	152	2

QA-01 corrected an initial failure classification under C210-094. P1 contains a proposed retention arrangement, not an identified operative retention/disposal decision; the assessor had inferred the trigger and incorrectly required a fixed period where an event-based timing rule can suffice. Both the component and whole-requirement results are now not assessed with unresolved applicability. The original classification and rationale for correction remain traceable in EP-03 and the fixture. The two inapplicability results concern absent comparison/reproducibility claim triggers under E200-035/041. The fulfilled components establish that identified information or distinctions are present in supplied text, not that fictional events occurred.

P1 now gives explicit scope, source dependence, claim and issue tracks, service periods, attributed grounds, a notice specimen, view limits, action ownership and failure branches. The original application, original log, instrument identity, notification receipts, actual review, funding outcome and effective repair remain unavailable or unperformed. The unresolved retention arrangement remains visible; no operative decision, authority or fixed period is invented to manufacture either a failure or a pass.

No entire GR-200 or GR-210 requirement receives a fulfilled result in this register. GR-100/110 source interpretation is covered separately; the P1 register does not assert full assessment of those documents. The new 0.3 recirculation requirement has a discriminating example and source review, but is not retroactively inserted into the 0.2 assessment totals.

103.1.7 5. Reproducibility and artifact checks

Run from the repository root:

```
python tools/check_validation_package.py
python tools/compare_publication_requirements.py --baseline 0.2
python tools/build_publications.py --wsl Ubuntu-24.04
python tools/check_publications.py
```

The validation checker verifies baseline hashes, coverage membership, identifiers, assessment levels/results, fixture locators and numerical expectations. It writes a generated report and the requirement matrix. The report records the Python version and SHA-256 hashes of the checker, requirement extractor, registers, fixtures and baseline manifest. It does not automatically judge source fidelity, factual warrant or institutional performance. The authored reviews and assessments remain the evidence for those bounded judgments.

Publication builds and source/PDF checks are recorded in the build report and publication check report. Generated files are ignored and need reproduction in a fresh checkout. Historical 0.2 results are preserved separately under `build/archive/0.2/`.

All nine 0.3 PDFs compiled successfully: **226 pages and 754 requirement identifiers**. The publication checker passed with current source, preamble and PDF hashes, retained historical identifiers and intact archives. There were no reported review warnings; GR-100 retains one nonblocking underfull-line spacing advisory. Visual inspection covered 24 rendered pages: the nine covers, nine foreword pages, the revised ballot clause, the GR-100 assessment schedule, three GR-110 return/semantic-schedule pages and the GR-210 dependency clause. No clipping or overlap was observed in those samples. The render plan and images are local generated artifacts under `build/review/v03/`; this sampling does not establish complete rendering or accessibility conformance.

103.1.8 6. Readiness and the next evidence

The readiness and burden record distinguishes available preparation evidence from the actual authority, accepted responsibilities, independent competence, representation, rights and observed practice still needed. No elapsed participant effort, cost, fairness or accessibility measurements are invented.

Reply/ballot overlap and calendar-day boundary conventions remain governance choices requiring explicit treatment before use. Practical burden and proportionate profiles need observed tasks. A future GR-150 draft can use these findings to separate package, practice and procedure claims and state trigger rules, inherited obligations, permitted exclusions and evidence requirements. There is no reduced profile or automatic launch approval in this cycle.

104 conceptual review

Original source: `docs/reviews/validation_0.2/conceptual_review.md`.
Original source SHA-256: `d6087aaaf653718dcb33232dedff6a4bece6b5541609aac254dc0b433d2cb336`.

104.1 Conceptual-fidelity review of GR-100 and GR-110, Working Draft 0.2

Document class: Informative review record
Status: PROVISIONAL; editorial source comparison, not programme adoption or a conformance assessment
Review date: 2026-09-22
Reviewer: AI-assisted documentary review; no independent manuscript-author confirmation obtained
Baseline: Archived GR-100 0.2 and archived GR-110 0.2

104.1.1 1. Review question and result

This review asks whether the operational proposals preserve the distinctions they draw from the foundation manuscripts, where they deliberately narrow the theory, and where their drafting or assessment instructions can lose those distinctions. It examined all **26 GR-100 requirement identifiers and 111 GR-110 identifiers**, their surrounding definitions, and their normative assessment schedules. The machine-readable group register assigns every identifier to exactly one review group. A group's `reviewed` status means that its text was examined; it does not mean that an implementation fulfilled the requirement, that a historical claim is true, or that the author endorses the interpretation.

The central architecture is consistent with the inspected passages: record existence is distinct from factual warrant; relational reality can precede recognition; representations can change later relations; contribution is more demanding than association; historical continuity differs from a chain of contributions; and descriptive generation has no automatic favorable normative sign. The text preserves these distinctions substantially better than a provenance-only or output-only account would.

Three local improvements are proposed. **CF-01** repairs an assessment instruction that can exempt a general safeguard. **CF-02** separates an ambiguous modality example from a claim's assessment disposition. **CF-03** makes the conditional interpretation of a recirculation claim explicit in the return requirements. CF-03 is a precision improvement rather than evidence that version 0.2 contradicts the theory: its general linkage requirements already supply part of the needed discipline. No finding licenses a universal measure of generativity, a compulsory causal method, or a complete ontology.

Source fidelity remains only one part of validation. The number of required declarations, actual recording effort, review competence, comprehension, protected access, and operational correction still need case evidence. Their presence in a well-written clause does not demonstrate a working institution.

104.1.2 2. Sources and limits of examination

Page references below are **one-based PDF pages in the supplied files**, not newly assigned edition dates. Titles, filenames, and source status are indexed in the foundation manifest. The review read the passages themselves through PDF text extraction. Mathematical symbols affected by extraction were not used to certify a proof. The review does not independently verify the external works cited inside those manuscripts.

Source	Passages directly examined for this review	Purpose
FM-001, `GRE_Chapter_01.pdf`	§1.14, pp. 78–83	Symbolic abundance, referential instability, classification effects, provenance and practical trust.

Source	Passages directly examined for this review	Purpose
FM-003, `GRE_Chapter_03.pdf`	§3.12, pp. 129–141; the opening of §3.13, p. 141	Iterative praxis, allocation, downstream effects, feedback, withdrawal, reversal and repair; descriptive/evaluative separation.
FM-004, `GRE_Chapter_04.pdf`	§4.2, pp. 11–19	Reality registers, pre-recognition reality, manifestation, recursive effects, non-necessary comparability.
FM-005, `GRE_Chapter_05_Complete_First_Draft.pdf`	§5.4, pp. 28–29, 32, 34; §§5.13–5.14, pp. 105–122; §5.17, pp. 145–150; §§5.19–5.20, pp. 168, 170, 173–174	Claim-relative evidence, generative attribution, carriers, trajectories, possibilities, uncertainty, return pathways, and revision.
FM-006, Part I metamodel	§§3–4, pp. 5–6; §§6–8, pp. 10–11	Weak formal state/mechanism notions, fixed-carrier limits, and limits on normative readings of collapse.
FM-007, Part II metamodel	p. 2; §§7–8, pp. 26–27, 32–33; §9, pp. 39–41, 43; §10, pp. 43–50; §11, pp. 52–54; §12, pp. 56–57, 60; §§16–17, pp. 76–80	Overlapping roles, identity, incidence, event multiplicity, attributes, state sufficiency, history, classification uptake, and regime change.

These selections support the comparisons below. They are not a fresh complete collation of all seven manuscripts. In particular, FM-002 and FM-003 have not been assigned an editorial precedence, and their full differences have not been resolved by this review.

104.1.3 3. Source-to-operational-requirement matrix

The **source position** column reports the inspected manuscript. The **operational translation** column identifies the programme's drafting choice. Normative metadata duties are new programme proposals, even where their rationale is strongly source-grounded.

Topic and source position	Operational translation in 0.2	What is narrowed, qualified, or left open	Review result and discriminating case
Symbolic crisis. FM-001 §1.14.2–5, pp. 79–83 distinguishes fabricated representations from sincere but outdated categories; authentication, trust, and substantive adequacy differ; correction can arrive after consequential action.	V100-002–004/012/017; R110-003/019/029–030/074/081 distinguish record, warrant, institutional uptake, and later repair.	The draft standardizes inspectability and recording duties. It does not standardize trust, certify a referent, or imply a universal collapse of representation.	Reviewed. An authentic AI-assisted summary can contain an unwarranted inference and still cause a real funding decision. Correcting the summary does not prove restoration of funding or capacity.
Reality and recognition. FM-004 §4.2.2–5, pp. 13–19 allows relational efficacy before recognition and allows a later manifestation to alter the system. Registers are different questions, not stages or exclusive bins.	V100-002/007/012; R110-016/019/050/067–068/074 retain target, access, description, and practical effect separately.	GR-100's operational Manifestation definition selects recording-relevant availability. No philosophical-register field is mandatory; a record role does not confer reality.	Reviewed. A category can reveal an older relation and separately change its future treatment. Record both claims and their distinct grounds.

Topic and source position	Operational translation in 0.2	What is narrowed, qualified, or left open	Review result and discriminating case
Trace and evidence. FM-005 §5.4, pp. 28–29, defines evidence through its inferential role relative to a target; a transcript can support an utterance more strongly than a durable intention.	V100-003/004/017; R110-042–047/051 preserve origin, transformation, claim-relative grounds, and the bounded GR-200 dependency.	The operational Trace definition admits a proposed trace connection whose warrant remains disputed. This broadens recordability relative to a reading requiring the source connection already to be established. It does not redefine every record as evidence.	Reviewed. One log can evidence that a value was entered while remaining insufficient evidence that the represented calibration occurred. Multiple copied reports are not independent corroboration.
Generative attribution. FM-005 §5.13, pp. 105–113, especially Definition 5.93 and Proposition 5.103, treats attribution as a warranted, target-relative claim with plural methods and graded support.	R110-010–014/051–056 records proposed contributions, mechanisms, alternatives, configuration and uncertainty. V100-008 separates attribution from evaluation.	`Generative account` is deliberately more permissive than manuscript `Generative attribution`: a contested or weak account can be recorded without becoming warranted attribution. Completion of a record is distinct from evidential adequacy.	Reviewed, with CF-02 for the status wording. A strongly supported occurrence and weak contributor linkage remain two differently supported claims.
Carriers and delayed contribution. FM-005 §5.13.6–7, pp. 110–112, distinguishes temporal distance, a persisting/transformed carrier, branch opening, selection, and stabilization.	R110-057–059/061 requires carrier accounts, link-specific support and limits of useful attribution. R110-013/062 preserves distributed contribution without compulsory credit allocation.	No new carrier ontology class or mandatory percentage allocation is introduced. A long chain can retain conjectural links rather than receiving one uniform confidence value.	Reviewed. Maintenance can sustain capacity later used by a different contributor; the earlier maintenance does not acquire the whole discovery's attribution.
Relational versus generative trajectory. FM-005 §5.14.1–2, pp. 114–116, distinguishes continuity of a relation under a criterion from a chain in which earlier contributions change later conditions.	V100-005/006/022; R110-006–009/048–050/057–060 distinguish identity, lineage, ordering, carriers, and path dependence.	The broad operational `Trajectory` term is an umbrella for bounded accounts. It is not asserted to be synonymous with either manuscript-defined trajectory. No total temporal order is mandatory.	Reviewed. A training relation can end while an acquired skill contributes later; a continuous filename cannot establish a continuous social relation.
Alternatives and possibility field. FM-005 §5.13.7 and §5.14.4/6, pp. 111–112, 117–118, 120, distinguishes a path becoming feasible, realization, and historically grounded alternatives from retrospective imagination.	R110-015/061/063–066 records whose options, conditions, horizon, practical access, comparative meaning and non-exhaustiveness.	`Possibility-field account` is a bounded representation, not the complete theoretical possibility field. No enumerated tree, probability distribution, or forced common metric is required.	Reviewed. A proposed option that was unavailable under historical resources stays distinct from an available but unchosen option; permission alone does not establish practical access.
Revision and re-epistemization. FM-005 §5.14.7, pp. 121–122, and §5.20.2/5–6, pp. 170, 173–174, distinguishes new evidence, category change, target change, and reflexive observation.	V100-007/015/018; R110-016/020–022/050/067–068/079/082–083/105 retains versions, semantic mapping and propagation limits.	The three-history organization is operational scaffolding; several kinds of change can coincide. It does not claim that changing a label produces a new past object or that every later reading is equally plausible.	Reviewed. New evidence can correct a past assertion while a new eligibility rule changes future access. Reflexive-observation temporal segmentation remains a useful additional pilot question.

Topic and source position	Operational translation in 0.2	What is narrowed, qualified, or left open	Review result and discriminating case
Praxis and consequences. FM-003 §3.12, especially pp. 130–133 and 137–141, treats diagnosis/intervention/feedback as iterative, distinguishes implementation from effects, and separates withdrawal, reversal and repair.	R110-019/074–081 identifies reliance, authority, intended transformation, follow-up, feedback, actual action and residual consequences.	Recording obligations apply when the account or practice includes the relevant activity. An archive does not acquire authority to operate a programme, and the heuristic praxis sequence is not made a universal protocol.	Reviewed. A delivered correction notice, a changed administrative decision, and restored practical opportunity require separate evidence. Unobserved follow-up receives an explicit limitation.
Maintenance, loss and value. FM-003 pp. 130, 133–134, 140–141 and FM-007 §16.7, pp. 77–78, distinguish maintained capacity, descriptive generation and appraisal. FM-005 p. 116 allows a short-run capacity to become long-run dependence.	V100-008/012; R110-017/069–072 records sustaining work, several forms of loss, affected positions, horizon, values and disagreement.	No value ranking is inferred from novelty or formal preservation. Record loss is not identical to destroyed real-world capacity; capacity expansion for one party can coincide with another party's foreclosure.	Reviewed. A quiet year of maintenance can be generatively relevant, and aggregate expansion can coexist with reduced access for an excluded participant.
Generativity return and recirculation. FM-005 §5.17.3, p. 145, distinguishes initial generation, conversion/transfer, return path, and effects of returned value on future generative conditions. Each contributes uncertainty.	GR-100's provisional `Generativity return` topic; R110-018/073 separates asserted concept, recipients, evaluation, quantity, transfer, response and entitlement. R110-058 separately protects link-specific uncertainty.	The programme term is not yet established as equivalent to manuscript `recirculation`. Its presence does not establish a universal return measure or distribution entitlement.	CF-03: clarify the four links conditionally when recirculation or return to future generative conditions is claimed. A promised grant, an observed payment, and an evidenced sustained capacity are different claims.
Metamodel versus record roles. FM-006 pp. 5–6 defines weak states and mechanisms; pp. 10–11 limits the fixed carrier. FM-007 p. 2 makes the six roles selected and overlapping; §§7–12 add identity, incidence, occurrence and history.	V100-009–011/018/021/025; R110-009/048 retains semantic roles, referenceable Relations, criteria, and information losses.	No one-to-one mapping from the carrier to record State, mechanism to Process, or formal action to Event is presumed. Property/Attribute remains unresolved.	CF-01 concerns the assessment row, not the body safeguard. An agreement can be a Relation and an Entity while its negotiation is a Process; these do not create six substances.
Definedness, scale, and sufficiency. FM-007 §§10.4–10, pp. 45–50, and §11, pp. 52–54, separates unknown/inapplicable, numerical codes/meaningful arithmetic, current-report accuracy/predictive sufficiency/history.	V100-019–021/025; R110-026/043/066/070/086/088/090/108 retains missingness reasons, domain/scale, scope and migration loss.	Semantic safeguards are adopted as recording proposals without importing a complete partial-map or quotient construction. `Unknown` remains an epistemic declaration, not an imposed third truth value.	Reviewed. Converting unknown, zero and withheld to one empty cell loses meaning. A correct current flag can still omit a history needed by a later query.

104.1.4 4. Findings and proposed dispositions

104.1.5 CF-01 — Assessment instruction can waive part of V100-011

Location: GR-100 V100-011; normative Annex A, Table A.1, V100-011 row.
Type: Assessment applicability ambiguity; priority: fix before relying on a complete vocabulary assessment.

The body first requires the application to distinguish operational record roles from metamodel concepts. Its second sentence conditions particular identifications on an explicit scoped mapping and argument. The assessment row says that absence of a mapping makes the conditional check not applicable. A reader can interpret that as making the whole requirement inapplicable, even when an application describes record roles and implicitly confuses them with formal primitives.

Proposed disposition: Retain V100-011. Rewrite the assessment row to check the general separation safeguard in the declared application, then assess the mapping-and-argument component only where a mapping or identification is made. A declared absence of mappings can support non-applicability of that component, but cannot exempt an implicit identification found elsewhere. This follows the component-result rule V100-026.

Alternative: Make V100-011 itself entirely conditional. That would weaken the general architectural safeguard and is not recommended.

Discriminating check: An application labels a semigroup mechanism as Process without a mapping document. The assessor finds an implicit identification requiring an argument; absence of the document is not an absent trigger. An application that makes no formal identification still receives review of the general separation component, with only the mapping-specific component excluded.

104.1.6 CF-02 — R110-012 mixes a dispute label into modality examples

Location: GR-110 R110-012; compare GR-100 V100-016 and R110-051.
Type: Terminological ambiguity; priority: local clarification.

R110-012 lists `disputed` alongside realized, intended, possible and unrealized effects. A dispute can concern whether an effect occurred, who contributed, or whether it was beneficial. Its location in the modality list can encourage one status value to carry actuality, knowledge mode and assessment disposition. GR-100 V100-016 expressly separates these three dimensions. FM-005 §5.17.3 p. 145 additionally distinguishes warrant for the relation, target change and connecting attribution.

Proposed disposition: Retain the identifier and its existing purpose. Name actuality/modality, epistemic mode, and assessment disposition separately. Use `unresolved actuality` where the occurrence question itself is unresolved, or qualify the dispute's target. Keep the example that an actual past effect can be retrospectively inferred. Do not make a disputed attribution change a supported occurrence to hypothetical.

Alternative: Retain `disputed` but add an explanatory note that identifies exactly which claim is contested. This is weaker because the normative clause would continue to place an assessment expression among modality examples.

Discriminating check: A maintenance activity is documented; whether it materially enabled a later discovery is contested. The record preserves an actual activity, a retrospectively inferred contribution, and an unresolved attribution assessment without forcing them into one status.

104.1.7 CF-03 — Make recirculation links explicit only when that return claim is made

Location: GR-100 provisional Generativity return definition and source note; GR-110 R110-018/058/073, semantic and assessment schedules.
Type: Conditional recording precision; priority: develop in the next draft without settling the broader return concept.

R110-018/073 correctly avoids inventing a quantity or entitlement. It does not explicitly tell the reader how to distinguish a transfer from its contribution to regenerated conditions. The broader linkage clauses can cover that problem, but their application to a return account is indirect. FM-005 §5.17.3 p. 145 identifies the separate uncertainty in generation, conversion/transfer, return and subsequent effects. An improvement should expose this structure while preserving the open relationship between `generativity return` and `recirculation`.

Proposed disposition: Add a conditional requirement or extend R110-073: where a return account claims recirculation or alteration of future generative conditions, identify those asserted links, relevant subjects/recipients, boundary, horizon, grounds, and link-specific uncertainty, or state that a link is proposed, unobserved, unavailable or unassessed. Cross-reference R110-058. State that completed transfer alone does not establish restored or ex-

panded generative capacity. Add the same discriminating check to the return assessment row and semantic schedule.

Alternatives: Keep only the general linkage clauses and clarify their application informatively; or impose a universal return formula. The first remains possible if pilots show the direct clause unnecessary. The second is unsupported by the reviewed sources and would close an unresolved theoretical and normative question.

Discriminating check: An institution proposes training support following a disputed decision. This is a proposal, not an observed transfer, a legally established entitlement, or evidence of changed future capacity. A later receipt can establish only the transfer claim unless further evidence supports the remaining links.

104.1.8 5. Tensions deliberately preserved

1. **Property and Attribute — OPEN.** FM-007 §10 treats Attribute through a declared domain, interpretation, scale and definedness. GR-100 retains Property as a provisional operational role and expressly denies an established equivalence. Its minimum metadata, numerical-scale rule and missingness rule preserve many relevant distinctions; they do not settle whether the concepts coincide. A future ADR needs comparative examples for a qualitative classification, a partial value, disputed assignment, and a value whose subject changes across descriptive levels.

2. **Fixed carrier, declared regimes, and emergence — OPEN.** FM-006 pp. 10–11 acknowledges that its fixed carrier and congruence do not generate new states or distinctions. FM-007 §17.1–2, pp. 78–80, models transitions within declared regimes and expressly leaves genuinely unrepresented vocabulary development to further work. R110-066 can record changing distinctions without claiming that these formalisms exhaust emergence. Category counts, graph size, and formal collapse are consequently not universal measures of generativity.

3. **Preservation and normativity — OPEN.** FM-006 pp. 10–11 places normative weight on the chosen congruence while acknowledging that not every collapse is wrong. FM-007 §16.7, pp. 77–78, separates formal preservation from reasons to value a distinction. The standards retain explicit evaluations, access limits and justified loss; they do not silently rewrite the earlier formulation or claim that mathematical preservation proves justice.

4. **The two Chapter 3 files — OPEN.** The manifest records a verified eight/nine problem-family difference and unresolved chronology. This review uses FM-003's specified praxis passages. It does not declare FM-003 final, replace FM-002, or claim that the two files have been fully collated.

5. **Return terminology and distribution — OPEN.** The recording topic can hold proposals and disputed accounts. Its relationship to manuscript recirculation, any assessment of beneficial return, recipients' claims, and legally effective allocation remain separate decisions. CF-03 does not resolve those matters.

6. **Proportionality and practical value — OPEN.** Source support for a distinction does not prove that every proposed declaration is necessary at every scale. R110-035–037 allows bounded purposes and acknowledges unmet work; it does not yet establish a lighter conformance profile. Measure actual authoring/review effort and losses before selecting GR-150 profiles.

104.1.9 6. Implications for the P0/P1 exercises

These are review tasks, not reports that institutional actions occurred. Their actual execution and component results belong in the separate pilot assessment records.

The P1 version 2 fixture now supplies stable documentary locators: claims, claim-relative evidence, and revision/action records. `GEN/v2` distinguishes practical access and the retrospectively imagined alternative; `AC6` and the following return statement preserve the absence of an established return chain. These passages were inspected as authored case representations, not as independently established events.

Task	Requirements principally tested	Observable discriminator	Limit to retain
Read the original and revised claim with its evidence	V100-002–004/016/017; R110-005/012/046/047/051	Reader distinguishes a recorded statement, an occurrence claim, a contribution claim, and their different grounds/statuses.	Reading authored fiction cannot authenticate a missing original log or establish a real occurrence.
Reconstruct a historical alternative	R110-015/063–066	Actor-period evidence distinguishes a contemporaneously available option from a later analyst's imagined option; practical access remains separate.	No evidence of an option is not proof that every alternative was absent.
Follow correction into consequences	R110-019/074/077–083	Receipt, reliance, revised judgment, implemented action, and repair have distinct locators or explicit unassessed status.	A pending funding outcome and unverified external spreadsheet correction remain pending/unverified.
Examine a return proposal	R110-018/058/073; proposed CF-03	Proposed support, completed transfer and altered future capacity remain distinct; each asserted link has grounds or its own uncertainty.	The current P1 has no verified return pathway. Recording that limitation does not assess substantive return.
Apply a role and assess its criteria	V100-009–011/025/026; R110-009	Stable structural references remain supplied, uncertain contextual values remain typed, and unmet criteria do not receive fulfillment.	A usable role description is not proof of subject identity; review of the V100-011 general safeguard is not waived.
Re-read after classification change	V100-007/015/018; R110-016/050/067/068/105	Old categories and grounds remain inspectable; correction, new knowledge and rule change are separately located.	A revised account does not give earlier actors later knowledge or establish that practical harm was repaired.

The immediate revision can address CF-01–03 without resolving the open theoretical questions. Subsequent pilots need cases beyond P1: maintenance with delayed effects; conflicting identity criteria after organizational succession; and historical reconstruction with severe preservation gaps. Those cases test whether the present distinctions survive use and whether the required recording effort is proportionate.

105 epistemic review

Original source: `docs/reviews/validation_0.2/epistemic_review.md`.
Original source SHA-256: `4d7f6f4753f6ece719fcb78629b77d575593f7d434f0ff05a5f7a2e97afb06d8`.

105.1 GR-200/210: substantive review and P1 documentary validation

Publication class: Informative review report
Status: PROVISIONAL; author review, 2026-09-22
Baseline: GR-200 WD 0.2 and GR-210 WD 0.2.
Reviewer: Codex assistant performing the repository task; author of the revised P1 fixture, not an independent assessor.
Artifacts: Exact-ID review groups, P1/v2 dossier, P1 component results.

105.1.1 1. Scope and method

This review examines all **49 GR-200 requirements and 105 GR-210 requirements** by bounded topical groups. Every requirement ID occurs in exactly one review group. Group status `reviewed` means its text was compared with the declared conceptual basis and related clauses; it does not mean the requirement was fulfilled by a practice or validated across domains. `finding` identifies a concrete drafting or fixture issue, and `open` identifies a question needing further evidence or a decision.

The work comprised direct reading of both drafts, their normative annexes, the original P1 example, GR-100/110 scope and dated-dependency clauses, and relevant actual foundation PDF passages. P1/v2 was authored to make the existing case's distinctions inspectable, then compared manually with selected components of the requirements. Whole-package and whole-procedure fulfillment was not assessed. There was no actual institutional reviewer, participant, exchange, hearing, signature test, access-control test, timing exercise or outcome observation. No public-policy or legal compatibility determination was made.

The supplied foundation passages were read from FM-005, one-based PDF pp. 28–29, 145, 150–151, 161–162, 169–170 and 172–173. This is focused source review of the relevant distinctions, not a new complete manuscript collation or verification of the manuscript's external citations. The foundation manifest preserves version uncertainty and source differences.

105.1.2 2. Conceptual fidelity

Source distinction actually consulted	Draft treatment and bounded conclusion	P1 discriminator
FM-005 §5.4, Definitions 5.25/ 5.26 and Claim 5.27, pp. 28–29: a trace is not evidence independent of a target and an articulated inferential role.	E200-010/011/012/032/033 and C210-013/014/059/060/061 preserve material, assignment, assessor and grounds. The recording obligations are operational proposals; the source supplies no universal numerical reliability test.	M1 has an extract-content role but cannot establish complete application contents or non-calibration. L1's adjustment report differs from proof of adequate calibration.
FM-005 §5.17.3, Proposition 5.132, p. 145: support for a relation and outcome does not establish the generative linkage; recirculation inherits uncertainty at successive links.	E200-014/028/031/035/039 and C210-063/064 support separate contribution questions. GR-110's fuller return-path scope is reviewed by the companion conceptual review; P1 supplies no completed return chain.	C7a report, C7b causal attribution and C7c prospective risk remain separately examinable. AC6 is proposed support, not observed transfer or return.
FM-005 §5.17, Proposition 5.138, p. 150: confidence is proposition-relative and qualified across several dimensions.	E200-014/035/036 and C210-016/062/067 do not require probability or collapse incompatible judgments. This supports qualitative cases without denying valid domain metrics.	Identity, method, dependence, time, causal linkage, boundary and authority stay distinct in U/ v2.

Source distinction actually consulted	Draft treatment and bounded conclusion	P1 discriminator
FM-005 §5.18, Definition 5.139, pp. 150–151: access, visibility, testimony and contestability matter without replacing evidential warrant.	C210-004/011/012/036/043/053/054/055/057/091/099 address opportunity and barriers. Their practical adequacy needs participant evidence, not merely an authored inclusive declaration.	A technician's testimony is considered in relation to access and scope. Neither low institutional status nor an invitation to speak determines warrant or demonstrates uptake.
FM-005 §5.19, Definitions 5.149/5.150 and Proposition 5.151, pp. 161–162: mediation includes acquisition, selection, classification, transformations and institutional effects, not only generative AI.	E200-022/033/040/041 and C210-018/061/067 retain operations and limits. No inaccessible internal explanation is fabricated.	M1→S1→C1 has shared derivation; S1 output is not an independent observation. No actual execution or reproducibility claim is supplied.
FM-005 §5.20, Definitions 5.159/5.162/5.166/5.167 and Proposition 5.165, pp. 169–170, 172–173: evidential revision, target change, intervention and category revision have different histories.	E200-017/018/019/037/038/039 and C210-023/066/075/076/077/086/087 preserve prior grounds and consequences. The clauses do not mandate one metaphysical account of change.	C1 revision changes current assessment of the past; K2 changes the rule; D2 schedules action; none establishes completed practical repair.

The review found no need to redefine the GR-200 epistemic modes or turn an evidence assignment into a new ultimate ontology class. E200-005 already distinguishes asserted actuality/modality from epistemic basis. P1 labels retrospective inference as a mode concerning an alleged actual occurrence, while dispute and warrant remain assessment matters. The correction proposed for R110-012 in the companion review does not require a corresponding change to E200-005.

105.1.3 3. Findings and dispositions proposed for the next edition

105.1.4 EP-01 — Ambiguous GR-100 incorporation in GR-210

Type: Draft clarification; normative dependency scope. **Priority:** Resolve before publishing the coordinated next edition.

GR-210 Clause 2 says GR-100 supplies operational terms, then says the referenced drafts' relevant requirements remain applicable to the bounded claim package. That sentence can be read to import a separate GR-100 vocabulary-application assessment. GR-200 and GR-110 instead precisely incorporate Clause 3 terms, Clause 5 record-role meanings when used, and result-category meanings in 8.3, while explicitly excluding a separate GR-100 conformity claim. C210-030 invokes the complete applicable GR-200 package obligations, not an independently specified V100 result set.

Alternatives: (a) import every applicable V100 requirement and specify the additional subject/results; (b) adopt the precise terminology incorporation already used by GR-200/110. **Proposed direction:** (b), preserving all GR-200 package-level obligations. It avoids a hidden conformance expansion without weakening the epistemic package. **Affected material:** GR-210 Clause 2 and C210-030's interpretation; dependency declarations in updated fixtures. No new requirement ID is needed solely to clarify this reference.

105.1.5 EP-02 — P1/v1 lacks documentary and performance evidence needed by the expanded procedure

Type: Fixture gap, not a newly discovered event or universal draft defect. **Priority:** Address documentary structure now; rehearse performance later.

P1/v1 has a useful narrative but only two response targets, incomplete issue/action separation and no performed grounds/reply, notice or practical-response evidence. Against C210-035/052/069/071/073/102/104, an overall successful-case label would obscure those differences. P1/v2 adds an explicitly authored service schedule, I1–I6, AC1–AC6, a grounds-notice specimen and component results. All actual performance remains not assessed. The current values are local hypotheses whose feasibility needs resource and participant evidence.

Proposed disposition: retain the v0.1 fixture historically; use the new one as an experimental rehearsal input. Do not manufacture receipts, assignments or completed funding outcomes. Full C210 procedure conformance remains unclaimed.

105.1.6 EP-03 — Protected-source and retention claims remain bounded

Type: Evidential limitation and OPEN contextual design question; corrected author assessment. **Priority:** Resolve contextual policy before a real pilot.

P1's protected original is not supplied, and B's scenario authorization concerns the excerpt only. A statement that B inspected or authenticated the original would contradict E200-023/042 and C210-059/068/095. P1/v2 distinguishes that unavailable source from the actual invented excerpt and preserves the examination limit. Its retention text supplies a proposed arrangement and future Custodian review, not an identified operative retention or disposal decision. C210-094's decision trigger is therefore unresolved for this design, and its result is **not assessed**. Contextual authority, timing and verification remain questions for the proposed arrangement; no fixed retention period is imposed by this review. Actual retention/disposal/enforcement is also **not assessed**.

Review correction QA-01: The initial author assessment marked a C210-094 component and its requirement not fulfilled because contextual authority and a specified retention period were absent. That classification inferred a decision trigger not supplied by P1 and treated a fixed period as necessary when a stated event can define timing. The finding was withdrawn after critique. The register preserves this rationale and now records not assessed with applicability unresolved; no baseline decision or artificial failure case was added.

Proposed disposition: keep the limitation visible and prepare a contextual retention arrangement before collection of real data. No blanket retention period or legal basis is invented. Restriction does not turn an unexamined obligation into fulfillment or make an actual activity inapplicable.

105.1.7 EP-04 — Conformance claim inflation through component results

Type: Assessment design hazard; existing normative safeguards sufficient for this case. **Priority:** Enforce in result tooling and summaries.

E200-049 explicitly requires materially different component results to remain visible. C210-097 similarly distinguishes documentary adequacy from performance. A row showing that C1/v2 states an uncertainty is insufficient to pass E200-014 for every included claim, and a notice specimen cannot pass C210-022's actual notification duty. The P1 register labels each subject, method and coverage; whole-requirement rows remain unassessed unless their whole scope was examined. No new permission to downgrade applicable practice obligations is proposed.

Proposed disposition: retain these clauses; make their aggregation rule explicit in assessment artifacts and later GR-150 work. A fulfilled component never overrides a failed or unassessed applicable component. Even a row with no known failure is not an overall pass when coverage is incomplete.

105.1.8 EP-05 — Proportionality and actual access remain open pilot questions

Type: OPEN empirical/profile question. **Priority:** Measure before fixing reduced profiles or routine service commitments.

The expanded drafts can express a careful case, but this review does not establish a practicable workload for a small project. The number of requirements is not a burden measure: one shared record can support several checks, while a single participation duty can demand significant resources. Independent capacity, user comprehension, protected participation, actual notice recovery and follow-up are still untested. A future proportionate profile needs an explicit decision about its claim and retained protections; describing a small operator does not silently remove current duties.

Proposed disposition: collect preparation time, per-case time, handoffs, support requests, inaccessible material, disputed judgments, comprehension failures and unresolved practical outcomes in a bounded rehearsal. Retain shared-context references where useful, without treating their mere existence as actual performance. No normative burden threshold is selected here.

105.1.9 4. P1 reassessment design and results interpretation

The machine-readable review groups cover every E200/C210 requirement exactly once. The component result register is a different artifact: it records whole-requirement coverage limits and selected inspected components against the fixed 0.2 baseline. Whole-requirement rows are deliberately not promoted from a selected component pass. Conditional absence can produce `not applicable` only with an actual missing trigger; this edition uses that result narrowly for E200-041's absent reproducibility/independent-reviewability claim and E200-035's absent comparison or transfer of confidence grades. Unperformed notification, competent review or user comprehension remains `not assessed`.

Actual review evidence consists of the cited fixture portions and the assessment reasoning recorded in the register. In-world representations are identified as authored synthetic material. Documentary checks locate content/version distinctions, source derivation, reasons, qualifications, action status and view limitations. The failure branches are manually compared variants: no live operator was observed making the expected response.

P1 now exposes the complete intended path from capture through practical response without declaring every step performed: A1→M1→S1→C1→D1→CH1→AS1→C1/v2→K2→D2→pending action. C7 and AC5 preserve unresolved effects rather than ending the inquiry at record correction. A proposed acknowledgment or policy change remains different from replenished monitoring capacity, funding or trust.

105.1.10 5. Next evidence and publication handling

The immediate drafting correction is EP-01. The principal remaining validation work is a participant rehearsal of the documented procedure, followed by independent assessment of the recording and procedural evidence. It needs an ordinary case and the conflict, unavailable-source, missed-target, failed-notice, restricted-view, rule-challenge, propagation and reopening conditions in GR-210 Annex C. The current authored variants prepare those cases but do not discharge their performance tests.

A later edition can reuse an unchanged documentary result only after recording why changed text, dependencies, scope or evidence do not invalidate it. This report remains fixed to archived Working Draft 0.2. Any next-edition fixes belong in a separate disposition record; they do not retroactively change the reviewed baseline or transform an unperformed scenario into empirical pilot evidence.

106 governance review

Original source: `docs/reviews/validation_0.2/governance_review.md`.
Original source SHA-256: `fabd1af9e3c2001b548db8cfd9ddbea63a193f80ec58c22d6beada18a5658941`.

106.1 Governance review of Working Draft 0.2

Class: Informative substantive review record.
Status: PROVISIONAL; authored inspection and synthetic design analysis, 2026-09-22.
Reviewer: AI-assisted repository review; no appointed governance assessor or independent human reviewer is represented.
Baseline: The five governance sources preserved in the 0.2 archive.
Assessment claim: Inspection of all 462 requirement bodies, their document structure and relevant normative schedules. This is a review of proposed rules, not a conformance assessment of an operating institution.

106.1.1 1. Conclusion and boundary

The coordinated governance texts preserve the programme's central distinction between an inspectable account and warranted institutional authority. They provide explicit founding conditions, versioned decisions, review and reply, minority consideration, protected handling, rights clearance and independent challenge. These mechanisms are coherent enough to support continued preparatory drafting and a more demanding rehearsal. They do not establish governance launch readiness.

One concrete ballot-accounting omission needs correction: invalid or unresolved attempted submissions have no explicit place in the required summary partition. Two timing choices need explicit interpretation before a live procedure. Actual personnel, commitments, permissions, protected routes, independent competence, and resource capacity remain unavailable as assessment evidence. Their absence is not a textual defect to be cured by adding fictional names.

This review does not independently establish foundation-manuscript fidelity, applicable law, a rights clearance, accessibility conformance, societal trust, representative legitimacy, or external standards compliance. The root programme review addresses manuscript interpretation separately. No external source has been newly incorporated through this review.

The method was to read the requirement bodies in source order, examine the controlling definitions and schedules, compare cross-document authority and dependencies, and apply normal, failure and boundary scenarios. The grouped register is governance_review_groups.json. Every identifier is listed exactly once. A group marked `reviewed` means its authored text was examined against the stated question; it is not a group pass or individual fulfillment result. `finding` identifies a demonstrated drafting omission; `open` identifies a policy choice or unavailable evidence needed before an institutional conclusion. Requirement-level conformance results would need the component evidence required by D2-054/086/091–095.

106.1.2 2. Findings, alternatives and proposed dispositions

106.1.3 GOV-F01 — Invalid attempted ballots disappear from the tally partition

Classification: Drafting defect; correct before relying on the tally procedure.
Exact baseline: Directives Part 1 0.2, D1-029–032, D1-074, D1-076 and Annex B's Ballots row. Historical P0 0.1 defines nonresponses as `N − R`.

D1-031 correctly defines `R` as valid returns. D1-074 requires clarification of ambiguous or unverifiable submissions and prohibits silently converting them into approval or abstention. D1-032 nevertheless lists valid returns, approvals, disapprovals, abstentions and nonresponses without requiring a separate count for an otherwise eligible participant whose attempted return remains invalid or unresolved. The older P0 formula consequently treats every such attempt as nonresponse. That hides an access, authentication or clarity problem as silence.

The discriminating example is five eligible persons: two approvals, one disapproval, one abstention and one timely but unresolved ambiguous submission. `R=4`; the three numerical

conditions pass. There are zero actual nonrespondents, not one. The unresolved attempt still needs its own validity decision, reasons, challenge route and materiality assessment; a mathematical pass cannot remove that issue.

Alternatives are: (a) classify every excluded attempt as nonresponse, losing a procedurally important distinction; (b) count every attempt as a return, changing the valid-return quorum; or (c) retain valid-return quorum and add explicit submission-state accounting. **Proposed direction: (c).** Record `N=R+I+U`, where `I` counts eligible persons with an attributable excluded or unresolved attempted submission and no counted valid ballot, and `U` counts eligible persons without an attributable submission. Replacement and duplicate handling precede this partition. An individual with a valid replacement contributes to `R`, not also to `I`; the attempt history remains in the protected audit. Count records describe persons, while the audit may contain multiple submissions. Unattributable or ineligible submissions have a separate inventory; their identity is not invented to complete the person partition. An invalid attempted replacement does not by itself erase a preceding valid ballot; withdrawal or invalidation needs an applicable rule and recorded decision.

Affected text: D1-032, D1-074 and the Annex B Ballots row; supporting P0 and tally checks. D1-031's quorum, minimum substantive participation and approval formula remain unchanged. A procedural finding about an excluded attempt can still block progression under D1-028/076 even where the arithmetic passes. Closure requires inspection of the revised clauses and a fixture distinguishing valid replacement, excluded attempt and genuine nonresponse.

106.1.4 GOV-O01 — Reply-window and ballot sequencing

Classification: OPEN implementation choice, not a proved contradiction.
Exact baseline: D1-023, D1-024, D1-027–029, D1-033, D1-073/075 and Annex A stage 50.

The text requires disposition replies before final approval and a completed review dossier at the final-approval stage. It does not state explicitly whether a ballot can open during a final reply window if the package remains frozen. One reading serializes reply, assessment, ballot and appeal. Another allows reply and ballot to overlap but withdraws the ballot if a reply requires substantive change. The latter can save calendar time, while placing greater demands on notification and explaining what the ballot actually considers.

Provisional rehearsal choice: use sequential windows. This is a conservative scenario assumption, not a newly adopted rule. Before a live process, either make sequencing explicit or specify the permitted overlap, reply handling, updated objection record and withdrawal triggers. The effect is calendar time and informed consideration; shortening the 30-day minimum is not proposed.

106.1.5 GOV-O02 — Calendar-day boundary conventions

Classification: OPEN implementation detail.
Exact baseline: D1's calendar-day definition, D1-019/020/023/025/029/034–036/050/059/092; EIP-014/067/100.

Notices must identify exact timestamps and time zones, which makes a chosen deadline observable. The drafts do not fix whether the initiating calendar date is day zero, how an inclusive last date is interpreted, or how a local daylight-saving transition affects the minimum opportunity. A shared convention would prevent two administrators calculating different deadlines from the same receipt.

Alternatives are elapsed hours, local calendar-date arithmetic at the same local time, or a specified close-of-day convention. **Provisional rehearsal choice:** UTC timestamps and addition of 7, 30 or 60 date intervals, with the start as day zero. That avoids daylight-saving assumptions in the fixture. Choose and document the operational convention before live notices; do not retroactively shorten an already announced window.

106.1.6 GOV-O03 — Minimum institutional capacity and independent review

Classification: OPEN launch gate; no evidence of fulfillment.
Exact baseline: CH-021–025/028/029/036–041/055/060/065/078–085; D1-003–005/008/016/035–038/041/051/060/076; TC-011–014/040/054/062/071; EIP-001/010/020/042–046/101.

The documents correctly refuse to let role labels constitute appointments and permit combined functions only with disclosed limits. The minimum three substantive ballots are arithmetic conditions, not evidence of reviewer independence or a sufficient range of perspectives. A single person and several AI assistants cannot supply the independent human functions required for founding, disputed decisions, tally verification or source/render release review.

Options are to obtain accepted bounded roles and competent external review, reduce the formal work scope to actual capacity, or continue preliminary development. **Current direction:** preliminary development, while preparing an appointment and capacity dossier for actual people to consider. No names, commitments, contacts, review independence or rights competence have been invented. Availability needs actual acceptance and an exercised route. An unfilled mandatory function is not `not applicable` merely because the programme is small.

106.1.7 GOV-O04 — Burden, accessibility and concentrated influence

Classification: OPEN empirical question.
Exact baseline: CH-015–020/031/043–045/049–052/064–068/073; D1-007/019/021/060/072/090; D2-060/079/080; TC-040/054/067; EIP-012/045/055/076–081/094.

The texts make unpaid labor, funding, infrastructure control and access barriers visible. They permit shared registers and reuse of still-applicable evidence, which can reduce duplication. The actual cost of administering the full package is unmeasured. A small, cooperative synthetic example cannot establish affordability for a volunteer committee, language accessibility, protected reporting usability or meaningful affected-person participation.

Options are separate forms for each obligation, shared records with explicit views, or reduced scope with bounded claims. **Proposed next experiment:** one shared dossier, with recorded operator time, assistance, failed tasks and reviewer effort; no weakening of requirements is inferred. Test public and protected routes with consenting participants after responsible roles and permissions exist. Numerical targets for acceptable burden remain unset pending those observations.

106.1.8 GOV-O05 — Rights and organizational context

Classification: OPEN adoption and distribution gate.
Exact baseline: CH-034/064/071; D1-033/040/082; EIP-026–038/066/082–090/098.

The policy accurately separates permission to examine material from permission to redistribute or sublicense it, and distinguishes prose, code, schemas, examples, datasets and manuscripts. It does not select contribution terms, establish legal personality or appoint a competent rights reviewer. Those unresolved facts cannot be closed by adding a generic open-source license to the entire repository.

Alternatives are artifact-specific permissions, suitably reviewed common terms with documented scope, replacement of restricted material, or narrower distribution. **Current direction:** preserve source terms and record actual intended uses; prepare a rights register and obtain competent contextual review before the affected public distribution or operative agreement. This report supplies no legal opinion or clearance.

106.1.9 3. Cross-document results

Topic	Inspected provisions	Textual result and consequence
Founding authority	CH-001/002/036–038/058–060; D1-003/004	Express commitments and founding review precede operation; a repository revision cannot adopt the package. Actual founding evidence remains absent.
Formal project activation	CH-014/028; D1-009–014/060; TC-001/032/033	Standards-first drafting can continue preliminarily; launch, mandate and accepted resources still gate formal projects.

Topic	Inspected provisions	Textual result and consequence
Review and minority objection	D1-019–028/068–072; CH-027; EIP-058	A vote does not dispose of an objection, and conduct handling does not suppress a technical concern. Replies and material changes retain separate records.
Ballot and recusal	D1-029–032/073–076; CH-039/040/053; EIP-053/054	Numerical thresholds are internally consistent; a material roster change requires a new ballot. GOV-F01 concerns submission-state accounting.
Procedural appeal	D1-034–039/078–081; CH-029	Independent review, stay where specified, reasons and remedy verification are explicit. Absence of capacity prevents contested progression.
Conduct and merits reconsideration	EIP-014/016–020/064/067/069/099–104	The internal evidence criterion is explicit and separate from fair response; scoped substantive reconsideration is distinct from procedural appeal. Contextual acceptability still needs human review.
Emergency protection	D1-049–051/088; EIP-067/068/103	Seven-day independent review and 30-day expiry apply to temporary participation restrictions as well as publication safeguards. A late remedy does not erase an earlier failure.
Release and maintenance	D1-040–048/082–087; D2-042–045/082–084; TC-072–075	Exact source, authorization and substantive change control remain distinct. An editorial correction cannot alter an outcome merely because it is a small edit.
Protection and public reasons	CH-069/070; D1-021/052/053/080/095; EIP-039/091/092	Safe public accounts can expose limitations without exposing protected existence or identity. Restricted access does not establish evidential adequacy.
Assessment and publication classes	D2-001–005/026–032/068–071/085–095; TC-026/051/052	Per-subject and per-component evidence is required. This grouped authoring review does not satisfy full conformance or institutional performance claims.

The JSON register supplies the complete 462-identifier matrix rather than treating the selected identifiers in this table as exhaustive.

106.1.10 4. Updated P0 and completion conditions

P0 for Working Draft 0.2 expands arithmetic boundary cases, malformed-input cases and synthetic procedural traces. The old P0 remains historical. An executable fixture's mathematical result has a different evidence status from a fictional notice, appointment, appeal, or behavior.

The next institutional rehearsal needs an actual mandate limited to rehearsal, willing participants, declared interests, safe synthetic input, tested public/protected routes, assigned custody, accessible assistance, a non-conflicted reviewer and an agreed record of observed effort. It can test mechanisms over compressed time only if it says so; compressed time cannot fulfill elapsed 7/30/60-day obligations.

Before governance launch, the dossier still needs actual founding review and dispositions, accepted appointments and commitments, independent assessment, rights and contribution arrangements, records/recovery capacity, release authority and a neutral procedural review

route. Completed prose and successful arithmetic do not discharge these conditions. The recommended drafting repair can advance to 0.3 while these institutional gates remain pending.

106.1.11 5. Complete grouped inspection matrix

Each row is an authored-text review group. Exact identifiers and immutable source locators are in the JSON register; the counts are coverage counts, not passed conformance obligations. Open findings can affect only part of a group.

Group	Document and topic	Requirements	Review state	Inspection basis
GOV-R001	GSP-Charter: Normative references	1	reviewed	Exact adopted editions are fixed explicitly; later drafts cannot acquire authority by replacement.
GOV-R002	GSP-Charter: Mission and programme commitments	10	reviewed	Mission evaluation distinguishes intended benefit, measured practice and broader trust claims; layers and operational narrowing stay separate.
GOV-R003	GSP-Charter: Publication authority	8	reviewed	Reserved decisions, editorial custody and publication class are distinguished; pre-adoption drafting does not authorize work items.
GOV-R004	GSP-Charter: Participation and consideration	13	open	Contribution, representation, endorsement and eligibility are separated; alternative access and anti-dominance duties require observed capacity.
GOV-R005	GSP-Charter: Organization and accountable appointments	10	open	Accepted bounded appointments, recusal, vacancy and handover control authority; combined roles cannot supply neutral self-review.
GOV-R006	GSP-Charter: Founding and decision accountability	16	open	Founding review and express commitments avoid self-authorizing drafts; independent capacity and effective conditions remain launch gates.

Group	Document and topic	Requirements	Review state	Inspection basis
GOV-R007	GSP-Charter: Resources and infrastructure	7	open	Support conditions, essential-resource control, staffing and exercised recovery are identified; actual resources are not yet evidenced.
GOV-R008	GSP-Charter: Records and external relations	6	open	Public decision history is bounded by protection; external agreements and representation require actual mandate and assent.
GOV-R009	GSP-Charter: Oversight, transition, and closure	6	reviewed	Annual review, prospective amendments, transition and custody preserve earlier decisions without pretending external uses disappear.
GOV-R010	GSP-Charter: Assessment	3	reviewed	The subject, period, relationships and evidence are declared; blank forms and unobserved routes do not establish performance.
GOV-R011	GSP-Charter: Annex A: Minimum governance evidence records	5	reviewed	Authority, decision and continuity records retain evidence and limits; sampling cannot imply observation of inaccessible routes.
GOV-R012	GSP-Directives-1: Founding, responsibilities, and participation	8	open	Founding basis, appointments, access and recusals precede consequential operation; unassigned mandatory functions defer progression.
GOV-R013	GSP-Directives-1: Project initiation and scope control	8	open	NWIP scope, normative problem, Specification need and resource acceptance are explicit; proposal receipt is not project approval.

Group	Document and topic	Requirements	Review state	Inspection basis
GOV-R014	GSP-Directives-1: Stages and progression evidence	10	reviewed	Stage labels require actual evidence; source decisions, missing expertise, synthetic tests and shared dependencies remain visible.
GOV-R015	GSP-Directives-1: Public review and comment disposition	14	open	60-day intake, 7-day acknowledgement, 30-day disposition target/reply and substantive re-review are distinct; access failures affect progression.
GOV-R016	GSP-Directives-1: Consensus, ballots, and final approval	12	finding	Valid-return quorum and substantive thresholds are consistent; invalid attempts lack a required separate tally category, while recusal can require restart.
GOV-R017	GSP-Directives-1: Procedural appeals and separate complaint routes	10	open	Accessible notice, independent assignment, replies, scoped stay, reasons and implemented remedy differ from substantive disagreement.
GOV-R018	GSP-Directives-1: Publication and release integrity	5	open	Authorization, rights, exact artifacts and non-editor source/render review are prerequisites; successful compilation does not authorize release.
GOV-R019	GSP-Directives-1: Maintenance, review, and withdrawal	10	reviewed	Correction, amendment, confirmation and withdrawal have different effects; prior editions and existing users are not retroactively relabelled.

Group	Document and topic	Requirements	Review state	Inspection basis
GOV-R020	GSP-Directives-1: Emergency safeguards and continuity	4	reviewed	7-day independent review and 30-day expiry constrain temporary safeguards; emergency action cannot make permanent normative changes.
GOV-R021	GSP-Directives-1: Records, transparency, and external liaison	9	open	Records, review cycles and external liaison are bounded; Specification technical requirements retain the full technical review route.
GOV-R022	GSP-Directives-1: Annex A: Stage evidence and procedural schedule	3	open	Stage records reuse evidence only when still applicable; clocks need explicit start, zone, deadline and failure effects.
GOV-R023	GSP-Directives-1: Annex B: Registers and minimum decision records	2	finding	Shared registers preserve specific record content; ballot accounting needs a distinct attempted-but-not-valid category.
GOV-R024	GSP-Directives-2: Normative references	1	reviewed	Bounded internal dependencies identify invoked subjects and edition; incompatible or unavailable material blocks the affected result.
GOV-R025	GSP-Directives-2: Publication identity and document architecture	15	reviewed	Class, status, title, front matter, scope, annex role and leaf hierarchy distinguish publication functions and controlling requirements.
GOV-R026	GSP-Directives-2: Formulation of provisions	16	open	Actor, trigger, criterion, modality, component results and exceptions are specified; unknown declarations do not resolve underlying facts.

Group	Document and topic	Requirements	Review state	Inspection basis
GOV-R027	GSP-Directives-2: Terminology and conceptual sources	9	reviewed	Operational definitions and manuscript interpretation retain scope and source differences; no formal-to-archival equivalence is presumed.
GOV-R028	GSP-Directives-2: References and dependency management	7	reviewed	Verified primary provisions, precise dependencies and access gaps are distinguished from informative bibliographic motivation.
GOV-R029	GSP-Directives-2: Conformance and assessment provisions	11	reviewed	Record structure, practice, interoperability, warrant and authority have separate subjects and evidence; partial claims stay bounded.
GOV-R030	GSP-Directives-2: Information models, protocols and technical artifacts	10	reviewed	Semantic need precedes encoding; protocol delivery, acceptance, retry and institutional outcome differ; artifact conflicts need disposition.
GOV-R031	GSP-Directives-2: Presentation, accessibility and contextual statements	9	open	Accessible structure, formulas, synthetic examples and contextual claims require evidence beyond successful rendering.
GOV-R032	GSP-Directives-2: Versioning and publication production	7	reviewed	Canonical sources, hashes, build tools and archived editions support traceability; semantic changes trigger the appropriate review.
GOV-R033	GSP-Directives-2: Assessment of a publication package	4	reviewed	Declared competence and per-requirement evidence precede overall results; correction closure needs a revised artifact and recheck.

Group	Document and topic	Requirements	Review state	Inspection basis
GOV-R034	GSP-Directives-2: Annex A: Structural schedule for programme publications	2	reviewed	Structural presence is not substantive completeness; unresolved topics need exclusion, development or a blocking status.
GOV-R035	GSP-Directives-2: Annex B: Requirement assessment record	3	reviewed	Requirement records retain applicability, method, component results, assessor and limits; missing evidence cannot become fulfillment.
GOV-R036	GSP-Directives-2: Annex C: Publication self-assessment schedule	1	reviewed	Discriminating checks are meaningful prompts; grouped schedule rows explicitly do not authorize undifferentiated passes.
GOV-R037	GR-TC1-Charter: Normative references	1	reviewed	Exact coordinated governance editions are recorded before committee reliance; external text cannot amend obligations by implication.
GOV-R038	GR-TC1-Charter: Mandate and work programme	17	reviewed	Mandate, work authorization, dependencies and protocol scope remain distinguishable from preliminary technical authoring.
GOV-R039	GR-TC1-Charter: Organization and conduct of work	11	open	Editors and reviewers accept bounded roles; asynchronous work, disclosed self-review, capacity shortfall and handover retain separate records.
GOV-R040	GR-TC1-Charter: Source interpretation and requirements	14	reviewed	Foundation interpretation, alternatives, edge cases and assessed requirements are traced; independent exchange evidence is required for interoperability.

Group	Document and topic	Requirements	Review state	Inspection basis
GOV-R041	GR-TC1-Charter: Multidisciplinary review	11	open	Domain competence, affected perspectives, conflicts and reasons are retained; technical agreement does not create a legal mandate.
GOV-R042	GR-TC1-Charter: Pilot preparation and authorization	8	open	Baseline, questions, permissions, protection and stop/restart conditions precede real pilots; authored scenarios remain synthetic.
GOV-R043	GR-TC1-Charter: Pilot evaluation and implementation evidence	6	open	Failure, assistance, burden, excluded perspectives and later unobserved effects qualify outcomes; independence is a scoped evidenced relationship.
GOV-R044	GR-TC1-Charter: Progression, maintenance, and publication	7	reviewed	Progression includes rights, findings, source/render agreement and maintenance; an informal implementation update cannot amend requirements.
GOV-R045	GR-TC1-Charter: Committee assessment	3	reviewed	Committee performance is assessed for a declared activity, edition and period; a problem-to-decision trace reveals missing evidence.
GOV-R046	GR-TC1-Charter: Annex A: Committee dossier and record content	5	reviewed	Dossier records link baseline, sources, findings, pilot limits and progression; reuse can avoid duplication without erasing distinctions.
GOV-R047	GSP-Ethics-IP: Normative references	1	reviewed	Material cross-policy timing, authority or protection conflicts are resolved before consequential dependent determination.

Group	Document and topic	Requirements	Review state	Inspection basis
GOV-R048	GSP-Ethics-IP: Responsibilities and readiness	7	open	Contacts, alternates, protected custody and independent review require actual acceptance and tested routes before operation.
GOV-R049	GSP-Ethics-IP: Conduct and evidential integrity	9	reviewed	Disagreement is not misconduct; claims, errors and AI assistance retain sources and accountable review without exposing protected material.
GOV-R050	GSP-Ethics-IP: Interests and influence	10	open	Disclosure alone does not manage conflicts; recusal preserves relevant evidence and retrospective discovery can require renewed procedure.
GOV-R051	GSP-Ethics-IP: Report intake and triage	8	open	Intake, triage and determinations differ; acknowledgement remains due in 7 days even if the 30-day determination target is extended.
GOV-R052	GSP-Ethics-IP: Inquiry and fair response	7	open	Adverse findings need safe grounds and reply; missing evidence and limited participation do not prove conduct or non-occurrence.
GOV-R053	GSP-Ethics-IP: Protective measures and determinations	18	open	Protection is time-limited; more-likely-than-not criterion does not override fair review; scoped merits reconsideration has independent assignment.
GOV-R054	GSP-Ethics-IP: Ethical impact assessment	11	open	Impacts distinguish observed effects, predictions and values; operational mitigation and practical repair require evidence.

Group	Document and topic	Requirements	Review state	Inspection basis
GOV-R055	GSP-Ethics-IP: Contribution intake and permission	12	open	Rights to examine, incorporate, modify and distribute are separate, versioned and use-specific; source custody is not relicensing.
GOV-R056	GSP-Ethics-IP: Terms, implementation rights, and publication	10	open	Artifact-specific terms need contextual competent review and actual assent; known implementation-rights issues cannot be cleared by an empty register.
GOV-R057	GSP-Ethics-IP: Records, oversight, and assessment	6	open	Safe public summaries and retention duties avoid exposure; assessment and recurring-failure review do not assume effective remedies.
GOV-R058	GSP-Ethics-IP: Annex A: Handling records and state transitions	5	open	Case states, conflicts, rights and timing records preserve unfinished performance; specimen completeness is distinct from observed handling.

107 readiness and burden

Original source: `docs/reviews/validation_0.2/readiness_and_burden.md`.
Original source SHA-256: `b786fa68f47ee6c7c2b6829a54fb12bff41d0552b3e55860d20da31b86ba3bdf`.

107.1 Readiness and burden assessment

Class: Informative assessment design and evidence-gap record
Status: PROVISIONAL; Working Draft 0.2 validation cycle
Boundary: Repository evidence and synthetic exercises; no external institution assessed

107.1.1 1. What the available evidence establishes

The programme has authored governance and technical drafts, preserved their earlier editions, compiled review artifacts and performed bounded editorial and arithmetic checks. These are preparation activities. They do not establish accepted appointments, stakeholder representation, legal authority, rights clearance, independent review, operational accessibility or successful repair of a real consequence.

The following are evidence gaps in this dossier, not assertions that the relevant people or capacities cannot exist.

Readiness question	Evidence in this cycle	Present conclusion	Next evidence needed
Can a founding authority adopt and resource the programme?	Proposed Charter and unsigned founding template	Not established by the dossier	Identified authority, applicable mandate, accepted responsibilities and resource commitments
Can separate and competent review actually be supplied?	D1, TC and ethics requirements; fictional reviewer reassignment	Not assessed	Accepted reviewers, conflicts record, availability and an observed handling exercise
Are affected interests able to participate?	Participation requirements and synthetic access barriers	Not assessed	Recruitment and access evidence, actual contributions, missing perspectives and response records
Are contribution and publication rights usable?	Proposed rights-clearance procedures	Not established by a procedural draft	Artifact-specific terms, authority to grant them and resolved source restrictions
Can a practice capture a meaningful history at reasonable cost?	Authored P1 record inventory and selected component assessment	Expressibility examined; operational burden not measured	Repeated capture/review tasks with time, assistance, omission and interruption records
Can the challenge and correction routes work?	Declared synthetic routes and failure branches	Real procedure not assessed	Observed receipt, assignment, response, decision, notification and downstream correction
Can intended users understand the result?	Editorial PDF inspection and authored public view	User understanding not assessed	Task-based sessions with intended users and suitable access arrangements
Does the infrastructure improve outcomes?	Proposed causal accounts and unresolved practical repair in P1	No observed effectiveness finding	A bounded outcome question, comparison, time horizon, alternate explanations and follow-up evidence

107.1.2 2. Burden dimensions to measure

Counting clauses, records or fields does not measure minutes of work, cognitive effort or institutional cost. The 753 baseline identifiers are a review inventory; they are not 753 mandatory

independent entries in every record. Conditional obligations, reusable package-level declarations and overlapping evidence need explicit treatment.

A future observed rehearsal can record the following without inventing a universal acceptable threshold:

Dimension	Observation record	Interpretation limit
Initial setup	Roles involved, declaration work, configuration and review time	Separate reusable setup from each subsequent claim or case
Capture	Active task time, material available, fields requiring judgment, assistance and interruptions	Missing historical evidence is not necessarily a usability failure
Assessment	Time to locate grounds, understand source dependence, identify an uncertainty and apply a criterion	Fast assessment can still be wrong or superficial
Contestation	Steps and effort to submit, clarify, respond and obtain a reasoned disposition	Successful submission is not successful remedy
Protection	Work to prepare permitted views, inspect access, manage retention and document limitations	Reduced effort does not justify exposing protected content
Revision	Dependent records located, transformations checked, notifications attempted and verified	An uncontrolled external copy can remain uncorrected
Participation	Language/access assistance, preparation burden, unavailable perspectives and withdrawal	Attendance alone does not establish effective influence
Maintenance	Recurring custody, review, migration, incident and training effort	One initial build does not establish sustainable capacity

Each observation identifies the task, actual participant role, experience level, scenario/version, start/end convention, excluded idle time, interruptions, assistance, result and limitation. Thresholds or comparison criteria are selected before interpreting measurements and remain purpose-specific. This cycle has no such participant measurements and reports none.

107.1.3 3. Profile decisions informed by the cycle

Three assessment subjects need separate consideration in GR-150 development: a retained documentary package, the practice that creates and maintains it, and a procedure handling challenges and practical responses. Version 0.2 permits partial documentary assessment but supplies no reduced profile that turns it into complete practice or procedure conformity.

Candidate simplifications include reusing an unchanged package declaration, referencing controlled material rather than duplicating it, providing explicitly permitted unknown historical context, and omitting a conditionally required feature when its trigger is absent. They do not permit dropping known material loss, concealing an unassessed component, or calling an unperformed action inapplicable.

A profile proposal records parent obligations, intended users, trigger rules, retained safeguards, additional obligations, exclusions, evidence methods and its exact claim. Alternatives are assessed against the same scenario. There is no adopted profile in this cycle and no requirement to use a particular database or schema.

107.1.4 4. Readiness consequence

The current evidence supports a traced drafting revision and more precise rehearsal materials. Formal governance adoption and claims about institutional performance remain pending the evidence above. Preparatory drafting can continue, with its status and assumptions explicit, while those capacities are developed.

108 README

Original source: `examples/README.md`.

Original source SHA-256: `7dba5b56c2fba85eab8e3696550702e76a752ca44b8fab9b2a5d1f9afe04fefb`.

108.1 Examples

Current informative fixtures: P0 governance arithmetic and design rehearsal and P1 contested decision. These are synthetic authoring/review material, not live pilot results or conformance certification.

Planned example datasets:

1. Individual research idea development
2. Human–AI assisted manuscript development
3. Collaborative research project
4. Institutional decision process
5. Historical reconstruction from incomplete records

Examples are informative unless explicitly incorporated into a conformance test suite.

109 p0 governance rehearsal

Original source: `examples/p0-governance-rehearsal.md`.
Original source SHA-256: `156d8faeb7d54e489379faa3ecca7de0f11a939ea5435c999eb68119dfdba3f2`.

109.1 P0 — Governance arithmetic and procedure design rehearsal

Document class: Informative synthetic example and evaluated arithmetic fixture
Status: EXPERIMENTAL; version 0.1; 2026-09-22
Related drafts: Directives Part 1, Programme Charter, and Ethics, Conflict-of-Interest, and Contribution Rights Policy, Governance Working Drafts 0.1
Assessment boundary: Five finite numerical states were evaluated in PowerShell. The comment, disposition, recusal, and later procedure examples are synthetic design exercises. No actual ballot, review notice, appointment, complaint, appeal, adoption, or elapsed review period is represented.

109.1.1 1. What was exercised

The arithmetic evaluation checks the three simultaneous conditions in proposed D1-031:

- Returned-ballot quorum: `R >= ceiling(2 × N / 3)`.
- Minimum substantive participation: `Y + D >= 3`.
- Approval: `Y >= ceiling(2 × (Y + D) / 3)`.

`N` is the number of eligible non-recused participants; `Y` approvals; `D` disapprovals; `A` abstentions; `R = Y + D + A`. Nonresponses are `N − R`. These are synthetic counts, not participant identities or representation claims. A numerical pass checks only D1-031 arithmetic. Consensus assessment, legitimate appointments, notices, timing, conflict management, comment disposition, and independent appeal capacity require other evidence.

The formula above records the precise rule used in this exercise even if a later revision of draft 0.1 changes D1-031. The values are local proposed defaults, not ISO or IEEE thresholds.

109.1.2 2. Evaluated results

The following results were produced by an executed PowerShell calculation on 2026-09-22. The execution also checked that the five numerical outcomes, in order, were `true, false, false, false, true`; the check completed without an error.

Case	N	Y	D	A	R	Required R	Y + D	Required Y	Numerical result
P0-B01	5	2	1	1	4	4	3	2	Pass all three conditions
P0-B02	6	3	0	0	3	4	3	2	Fail returned-ballot quorum
P0-B03	3	1	0	2	3	2	1	1	Fail three-substantive-vote minimum
P0-B04-before	5	2	2	1	5	4	4	3	Fail approval threshold
P0-B04-after-hypothetical	4	2	1	1	4	3	3	2	Arithmetic passes; an actual decision still requires a new ballot

P0-B01 exercises the proposed two-approval, one-disapproval, one-abstention case with one nonresponse. Its two approvals meet the ceiling of two-thirds of three substantive votes. It does not establish that the objection has been considered or that three voters adequately represent affected interests.

P0-B02 shows that unanimous approval among three respondents does not overcome the missing fourth return required for a six-person roster. P0-B03 shows that two abstentions cannot supply the minimum substantive participation needed alongside one approval.

P0-B04 models a later discovery requiring recusal of one disapproving participant. Removing that person's eligibility and ballot changes the arithmetic from fail to pass. Under **D1-030**, the material electorate and result change requires a new ballot; the hypothetical recalculation cannot turn the original failed ballot into adoption. The original roster and result remain in

the record, with the recusal assessment and a new ballot identifier. Actual recusal, notice, and reballoting have **not** been performed here.

109.1.3 Reproducing the numerical evaluation

The following PowerShell code reproduces the evaluated formula and inputs. It creates no appointment, ballot, or decision record beyond the displayed calculation.

```
$p0Cases = @(
    @{ Case='P0-B01'; N=5; Y=2; D=1; A=1 },
    @{ Case='P0-B02'; N=6; Y=3; D=0; A=0 },
    @{ Case='P0-B03'; N=3; Y=1; D=0; A=2 },
    @{ Case='P0-B04-before'; N=5; Y=2; D=2; A=1 },
    @{ Case='P0-B04-after-hypothetical'; N=4; Y=2; D=1; A=1 }
)
$p0Results = foreach ($p0Case in $p0Cases) {
    $p0Returns = $p0Case.Y + $p0Case.D + $p0Case.A
    $p0Substantive = $p0Case.Y + $p0Case.D
    $p0Quorum = [math]::Ceiling(2 * $p0Case.N / 3)
    $p0Approval = [math]::Ceiling(2 * $p0Substantive / 3)
    [pscustomobject]@{
        Case = $p0Case.Case
        N = $p0Case.N; Y = $p0Case.Y; D = $p0Case.D; A = $p0Case.A
        R = $p0Returns
        QuorumRequired = $p0Quorum
        QuorumMet = ($p0Returns -ge $p0Quorum)
        Substantive = $p0Substantive
        MinimumMet = ($p0Substantive -ge 3)
        YesRequired = $p0Approval
        ApprovalMet = ($p0Case.Y -ge $p0Approval)
        NumericPass = (($p0Returns -ge $p0Quorum) -and
            ($p0Substantive -ge 3) -and ($p0Case.Y -ge $p0Approval))
    }
}
$p0Results | ConvertTo-Json
if ($p0Results[0].NumericPass -ne $true -or
    $p0Results[1].NumericPass -ne $false -or
    $p0Results[2].NumericPass -ne $false -or
    $p0Results[3].NumericPass -ne $false -or
    $p0Results[4].NumericPass -ne $true) {
    throw 'P0 ballot arithmetic differs from the stated expected outcomes.'
}
```

This bounded calculation does not test malformed inputs, participant identity, duplicate ballots, eligibility evidence, record protection, notification delivery, or arbitrary roster sizes. It is not an implementation of a voting service.

109.1.4 3. Synthetic comment, disposition, and re-review

The invented example below concerns a draft challenge-submission Specification. It is not an actual GR publication, received comment, or decision. Scenario versions `FICT-P0/0.1` and `FICT-P0/0.2` are local fixture labels without programme publication authority.

Record	Synthetic content
Draft provision FICT-P0-007 in 0.1	A submission is accepted only if the sender supplies a proposed replacement clause.
Comment P0-C01	An affected person can identify a misleading classification without knowing how to draft a technical clause. Accept an explanation in ordinary language and provide formatting assistance.
Commenter and recipient	Fictional Commenter A and fictional Review Chair B; neither represents an actual appointment or submission.
Initial disposition P0-CD01	Accepted. Making drafting expertise a condition of intake defeats the intended affected-person challenge route. Preserve the substance of the concern and offer assistance with technical formatting.

Record	Synthetic content
Revised provision FICT-P0-007 in 0.2	The challenge route accepts a free-text explanation of the concern without requiring a replacement clause. The operator offers assistance when structure is needed for processing.
Change classification P0-CC01	Substantive: the accepted inputs and operator obligations change. The intended conformance subject and affected constituency remain the same in this scenario.
Proposed review consequence	Under D1-025/026, show the changed text, rationale, and effects in at least 30 calendar days of public re-review. Notify prior commenters and relevant affected interests; consider consequences for unchanged validation rules.
Alternative scope consequence	If the change instead expands the original purpose, affected constituency, or conformance subject substantially, D1-025 calls for renewed scope approval and a full 60-day review. A "minor edit" label cannot determine that question.
Reply and later disposition	No actual reply or later disposition exists. D1-023/024 require disposition notice, the reply opportunity, and assessment of continuing disagreement before final approval.

The design exercise identifies the expected transition: comment → reasoned disposition → changed provision → substantive-change classification → re-review → further disposition and reply → possible progression. It does not advance a real document through that sequence. No fictional dates stand in for elapsed mandatory periods.

A chair's answer to the comment would not itself establish consensus. The approval package would still need the participation and objection assessment in D1-027/028. A protected procedural complaint about exclusion would use the separate appeal or conduct route appropriate to its grounds, with an actual independent reviewer.

109.1.5 4. Procedure exercises still to perform

The following are uncompleted tasks. Actual function holders, contacts, and independent reviewers remain **UNASSIGNED**. The required evidence concerns observable actions and accepted responsibilities, not merely completed templates.

- ☐ **Founding basis and commitments:** Identify actual prospective signatories, their capacities, reviewed texts, scope of commitment, dissent, and succession route under CH-036–038. No adoption instrument has been executed by this fixture.
- ☐ **Notice and accessible intake:** Staff and test public and protected contact routes; deliver a real test notice and acknowledgement; check asynchronous and assisted submission. Record actual timestamps and access failures under D1-006/018–021.
- ☐ **Participant roster and conflicts:** Apply published selection criteria, obtain accepted roles, assess concentrated interests, and exercise a recusal with a legitimate substitute. Verify D1-008/030 and CH-039–041 using consenting participants.
- ☐ **Comment and reply:** Have someone other than the draft's author try the submission route, receive a reasoned disposition, reply, and locate the resulting change. Record barriers without treating a self-review as independent review.
- ☐ **Material re-review:** Publish an appropriately labelled rehearsal change and test notification and version access. A compressed demonstration can test mechanics; it cannot establish compliance with elapsed 30- or 60-day minimums.
- ☐ **Independent appeal:** Identify an available, non-conflicted reviewer; test a process objection, access to grounds, opportunity to reply, stay, remedy, and restoration. Repeat the unavailable-reviewer case and show that consequential progression remains pending under D1-034–038.
- ☐ **Protected conduct report:** Exercise the distinct ethics route using synthetic material; verify contact and alternate, confidentiality limits, response, fair consideration, and remedy monitoring under EIP-013–020.

- ☐ **Publication integrity:** Independently compare an exact approved rehearsal source with its render, detect an intentionally omitted requirement, and record release deferral. Check D1-040–042 without representing the draft as adopted.
- ☐ **Maintenance and exceptional procedure:** Distinguish editorial correction from a changed conformance outcome; exercise revision, withdrawal, emergency expiry, role vacancy, and protected-record disposition under D1-043–053.
- ☐ **Rehearsal assessment:** Record time, effort, failures, unfilled roles, remedies, remaining objections, and proposed clause changes in a D1 requirement/evidence register. Obtain independent assessment of the actual founding process before declaring governance ready.

109.1.6 5. Limits and programme status

The arithmetic evidence supports the stated results for five finite input states. The comment fixture makes one design consequence explicit. Neither supplies actual participation, represented consent, independent review, rights clearance, notice delivery, elapsed review time, or procedural adoption.

M1 — Governance launch remains pending. This file contributes a limited rehearsal artifact to the governance and pilot evidence plan; it does not complete that gate, approve GR/NWIP-001, activate a committee, or publish an adopted Standard.

110 p1 contested decision

Original source: `examples/p1-contested-decision.md`.
Original source SHA-256: `447987aaa52b9ce73f28b4a442aeea66abbc30a5fbc8658e4595d4c052072eef`.

110.1 P1 — Contested funding decision and generative trajectory

Document class: Informative synthetic example and design fixture
Status: EXPERIMENTAL; version 0.1; 2026-09-22
Related drafts: GR-100/110/200/210 Working Draft 0.1
Assessment boundary: A fictional dossier and expected review behavior. No real people, institution, law, hearing, submission or remedy is represented.

110.1.1 1. Purpose and boundary

Package `P1/v1` examines how a fictional research fund classified a community water-monitoring application, how contrary material changed its assessment, and what changed for future monitoring capacity. Intended readers are participants, reviewers, custodians and designers of the recording procedure. The decision and response horizon is synthetic days 0–40, with relevant antecedent activity before day 0 included where identified. Dates below are ordered scenario labels, not claims about actual elapsed work.

The retained inventory comprises the following attributed records. It is not a complete history. Raw measurements, personal identities, vendor internals and subsequent environmental outcomes are outside the supplied material. A fictional Secretariat records receipt and custody; an initial Panel makes the funding decision; Reviewer B handles the later evidence review; a distinct Review Contact handles procedural reconsideration. These are scenario roles, not programme appointments. No actor has an asserted mandate beyond this fictional fund's internal procedure.

The purpose-based collection rule selects claims relied on for eligibility, evidence assessment, contribution and practical response. The material-claim set is C1–C7 and their assessments, with D1/D2 and rule versions K1/K2 as consequential dependencies. This is the bounded GR-200 package for R110-005 and C210-030. The fixture does not assert fulfillment of every applicable requirement.

110.1.2 2. Inventory and three distinguishable histories

Reference	Attributed content and role	Time and availability
A1	Community team application reports an operating sensor network. This is a report, not independent verification of every measurement.	Submitted day 0; only this content summary is supplied, not the full packet or an independently inspectable application extract.
M1	Intake extract omits the calibration attachment. It establishes the extract's contents, not whether calibration occurred.	Created day 2 from A1; intake scope excludes other channels.
S1	Fictional `SummaryTool/demo-v0` output: "The sensors were not calibrated." Input: M1 only; transformation: generated summary. Internal reasoning unavailable.	Day 3; taken up by Panel; output is generated, not independent evidence.
K1	Panel's rule category "documented calibration" requires an attachment in the application packet. Source of authority: fictional fund's internal rule only; no asserted legal effect.	Version 1 effective in scenario days 0–20.

Reference	Attributed content and role	Time and availability
C1/v1	Panel repeats S1 as a factual conclusion that calibration did not occur. Epistemic mode: inference from missing metadata; actuality claim: non-occurrence.	Recorded day 4; concerns equipment before submission; disputed.
D1	Panel excludes the application, relying on C1/v1 and K1. The exclusion and its factual warrant are different questions.	Day 5; institutional action in the story.
T1	Technician testimony reports calibration before submission. The technician also contributed maintenance labor omitted from A1's attribution.	Statement recorded day 7; retrospective report of pre-submission activity.
L1	Maintenance log records adjustments; fictional protected original includes contact details. Only the invented nonpersonal excerpt is supplied here: "Day −2: station S adjusted against reference instrument."	Original described as restricted; excerpt supplied day 8; no genuine protected data.
CH1	Team challenges C1/v1 and the suitability of K1, citing T1/L1 and requesting reconsideration and attribution review.	Received day 8; two distinct issues.
C1/v2	Reviewer B assesses that calibration activity has support from testimony, while L1 supports the narrower report of adjustment. Whether that adjustment met the intended calibration method, its quality and the chain of measurement remain unresolved.	Day 12; evidence/assessment revision, not a new calibration event.
K2	Panel changes its rule to permit assessed maintenance testimony and controlled log inspection as possible evidence. Adequacy remains case-relative.	Announced day 20; effective from day 21. A rule/category change.
D2	Panel schedules a renewed assessment under K2; it does not yet award funding.	Day 22; scheduling is recorded, while reassessment and its outcome remain pending.
C7	Team reports that the exclusion delayed equipment replacement and interrupted training; no independent outcome follow-up is supplied.	Day 30; reported practical effects and possible future constraint.

The first history concerns claimed calibration activity, maintenance, exclusion and possible effects on monitoring capacity, with their respective evidential qualifications. The second includes the creation, use and revision of claims about them. The third includes K1/K2 and changing evidential categories. The case does not identify a changed category with a changed past event. Historical use of K1 stays visible after K2 is introduced.

Record references identify representations and versions. They do not settle whether two sensor names denote the same physical instrument. An unresolved match stays unresolved. The maintenance relation can have its own participants, interval, contribution dispute and history; it need not disappear into an edge without attributes. Event, Process and Relation roles can describe different aspects of the same maintenance episode without asserting three different underlying episodes.

110.1.3 3. Claim-relative evidence and assessment

Claim	Grounds and method	Assessment and limits
C1/v1: no calibration occurred	Panel infers non-occurrence from M1. The method assumes all calibration would appear in that extract.	Unsupported inference in the fixture: expected recording coverage is unestablished. Preserve "attachment absent from M1." Do not automatically infer the opposite factual conclusion.
C1/v2: calibration activity occurred	Reviewer B considers T1's calibration testimony and L1's narrower adjustment report. The excerpt does not independently establish every part of the testimony.	Activity receives qualified support; instrument identity, method, reference quality and adequacy remain unresolved. Two sources do not establish independence if the testimony derives from the log.
C2: application met K1	Proposed rule comparison against complete packet contents; only M1's limited extract is represented here.	Compliance remains unresolved from the supplied material. Missing attachment can matter to K1's application, but its absence from M1 alone does not establish absence from the full packet. Even a correct rule application would not resolve the rule's legitimacy or procedural suitability.
C3: exclusion was unfair	Team applies stated values of accessible participation and recognition of maintenance labor, citing differing access to formal documentation.	Attributed ethical judgment. Panel's competing value of consistent evidence requirements remains identified. No universal value ordering is imposed.
C4: D1 violated a legal duty	Team's asserted legal objection.	Jurisdiction, legal source, competent authority and applicability are UNSPECIFIED in this fiction. The case records the allegation and routes it outside the reviewer's claimed competence. No legal finding follows.
C5: maintenance enabled continued monitoring	Technician's account connects adjustments and ongoing operation, compared with the earlier condition of drift.	Attributed generative account; causal sufficiency and longer-term effects unestablished. Maintenance can matter without a new output.
C6: granting the application would have preserved training	Proposed alternative raised during challenge, with team estimates of cost and availability.	Counterfactual, not observed outcome; feasibility is only partly examined. Other funding and scheduling constraints remain unknown.
C7: exclusion constrained later capacity	Team reports delayed replacement and interrupted training; reviewer identifies D1 as one possible contributing condition.	Reported realized effects and inferred contributions remain separate from predicted future loss. No complete causal attribution or remedy is established.

Reviewer B's method is qualitative comparison of claims, source scope, derivation and alternative explanations. No probability is invented. M1, S1 and C1/v1 share a derivation path; they do not constitute three independent observations. Authenticity of an excerpt and the strength of its support for calibration quality are separate assessments. This fixture has no actual signature or authenticity test.

Generativity return is not quantified. Attribution review can acknowledge maintenance contribution while leaving ownership, payment, entitlement and fair distribution unresolved. Any future assessment would need recipients, evaluative criteria, grounds and context. A funding award would not itself settle that inquiry.

110.1.4 4. Proposed procedural trace

The fictional operator declares the covered decisions, accessible text/oral submission routes, protected-contact option and a review contact distinct from the original Panel. Local fixture targets are acknowledgement within two scenario days and initial disposition within ten; extensions require notice before the target, reasons and a revised date. These values illustrate C210-003 and are not programme-wide service requirements. No actual contact channel has been created or tested.

1. **Receipt:** CH1 receives a distinguishable reference and day-8 receipt entry. An acknowledgement on day 9 identifies the two issues, review function and target. Receipt is not acceptance of the challenge's merits.
2. **Conflict:** Initial proposed Reviewer A authored S1's uptake note. The scenario identifies this conflict and reassigns to B; it does not label A independent. If no suitable reviewer is available, the record stays pending with notice and a declared alternative, rather than inventing independence.
3. **Participation:** Panel and team can respond to the grounds used. The technician can submit through protected contact. The short, nonpersonal L1 excerpt and B's assessment of that excerpt support response while the original remains restricted. B's described authorization covers the excerpt only; no examination or authentication of the unavailable original is represented. Missing perspectives and limits of that substitution remain visible.
4. **Assessment:** B separately considers factual calibration claims, K1 application, K1 adequacy, contribution attribution and the asserted legal objection. The legal matter is recorded outside B's competence. Silence by a party is not consent.
5. **Disposition:** On day 12, B replaces the unqualified C1 conclusion with C1/v2, preserves the earlier inference and its use, records remaining uncertainty, and refers reconsideration of D1 and K1 to the Panel. No funding award is represented as accomplished.
6. **Action:** D2 schedules reassessment. The action owner is the fictional Panel; completion evidence would be a dated assessment/decision record and notice. These are absent at the fixture boundary. Correction of C1 is complete within the supplied text; practical repair is pending.
7. **Notification and propagation:** A case notice is described as sent to the team and Panel. The public summary can be changed; a prior exported spreadsheet is a known dependent copy whose correction remains unverified. The fixture includes no delivery receipts, so sending and receipt are unverified procedural assertions.
8. **Further review:** The declared Review Contact can consider new evidence, an incorrect correction or a procedural failure. Reopening links CH1 and the prior disposition. The operator cannot promise external court review or exercise legal authority it lacks.

110.1.5 5. Restricted material and reduced presentation

The fictional custody rule authorizes B to examine the nonpersonal excerpt; public readers receive the excerpt and a scope statement, not personal contact details. Retention decisions separate claim history, testimony content, contact information and permitted audit evidence. Proposed contact-data disposal after closure needs a declared authority, executor and permitted confirmation; it does not require keeping the removed content to prove removal. No deletion is claimed to have been performed.

A suitable public summary reads:

> An earlier finding of no calibration relied on a missing attachment in a limited intake extract. Subsequent testimony supports calibration activity; a maintenance-log excerpt reports adjustment, with method, quality and identity limits remaining. The fund has scheduled reassessment under a revised internal rule. Funding, correction of external copies and reported losses remain unresolved. This summary omits personal contact information and does not provide full inspection of the described original log.

The summary preserves the difference among attributed assertion, assessment, institutional action and pending repair. Reader comprehension is an empirical question that has not been tested with users.

110.1.6 6. Discriminating cases and expected results

These are review expectations applied to authored variants, not passed live operational tests.

Case	Deliberately defective variant	Expected finding and relevant clauses
P1-A	Replace “no attachment in M1” with “no calibration occurred,” without a coverage argument.	Unsupported missingness inference; E200-013, C210-015.
P1-B	Count M1, S1 and C1 as three independent sources.	Shared derivation exposed; E200-012/022.
P1-C	Label calibration “unrealized” because its occurrence is retrospectively inferred.	Confuses modality with epistemic basis; E200-005, R110-012.
P1-D	Overwrite K1 with K2 and represent the earlier Panel as using K2.	Historical regime distinction lost; E200-017/018, R110-016/021.
P1-E	Mark D2 “funding restored” when only reassessment was scheduled.	Proposed action mistaken for completed remedy; C210-021/023, R110-022.
P1-F	Describe Reviewer A as independent without disclosing prior involvement.	Conflict and independence misrepresented; C210-009/024.
P1-G	Miss the stated review target with no notice; declare the case rejected by timeout.	Timing and disposition failures; C210-003/026.
P1-H	Publish contact details merely to make L1 inspectable.	Disclosure exceeds scenario authority; E200-023, R110-025/026, C210-027–029.
P1-I	Omit reported training loss from a supposedly complete account of capacity changes.	Material loss missing without collection/protection explanation; R110-002/017.
P1-J	Call the public summary conforming because its formatting validates.	Structural result overstated; E200-002/026, R110-030/034.
P1-K	Demand all history remain public forever, or claim an outside spreadsheet was deleted without evidence.	Retention and propagation limits ignored; R110-025/028, C210-028.

110.1.7 7. Assessment limits and next evidence

This fixture supplies concrete content and counterexamples for clause review. It does not provide a complete conformance dossier. Required operational evidence such as actual assignments, acknowledgements, delivery, reviewer performance, access enforcement, deletion results, comprehension and resource burden remains **not assessed**. Unavailable original material limits evidential examination; restriction alone does not convert an unassessed requirement into fulfillment.

Next, designated participants can rehearse the procedure with this fictional material, record what actually occurs, maintain a requirement-by-requirement result register, and revise the draft where burden or ambiguity appears. A live pilot would additionally need a real institutional mandate, contextual legal/ethical analysis, participation arrangements, protection decisions and a scoped profile. No jurisdiction or external partner is selected by this example.

111 p0 governance rehearsal

Original source: `examples/validation_0.2/p0-governance-rehearsal.md`.
Original source SHA-256: `9f5cc36dd050f84e2c4ea97618fff817d6198a8dd51a1cb027a544ab71a4260e`.

111.1 P0 — Governance rehearsal against Working Draft 0.2

Class: Informative synthetic rehearsal and finite arithmetic fixture.
Status: EXPERIMENTAL; authored 2026-09-22.
Baseline: The five Governance Working Drafts 0.2, preserved in the source archive.
Relationship: Extends historical P0 0.1, which remains unchanged.
Responsible exercise roles: UNASSIGNED. Scenario role names below are fictional functions, not actual appointments.

111.1.1 1. Purpose and evidence boundary

This rehearsal asks whether the proposed governance rules lead to distinguishable outcomes when a process succeeds, fails, receives an objection, or lacks capacity. It covers founding, proposal intake, review and reply, ballot arithmetic and submission handling, recusal, procedural appeal, conduct review, temporary protection, rights, publication and maintenance. It exercises rule interpretation on synthetic inputs; it does not constitute an operating governance service.

There are three distinct evidence kinds:

1. **Authored expected results:** The finite count inputs and their expected numerical results are in p0_ballot_cases.json. They are inspectable assertions awaiting or linked to a recorded execution; the JSON itself does not prove they were executed.
2. **Actual arithmetic execution:** A validator run can compare those expected values with recalculation, record its tool and fixture versions, and report disagreements. Its conclusion is limited to the selected finite count states and malformed-input handling. The execution record produced by the repository checker is the evidence of that run.
3. **Synthetic procedural traces:** Fictional notices, dates, persons, reports and actions below are authored scenarios. None is an observation of actual receipt, notice delivery, review, independence, elapsed institutional time or remedy. No procedural fulfillment is inferred from the prose.

The governance review records GOV-F01 and GOV-O01–05. The fixture uses the conservative timing choices described there. It does not create adopted timing rules, a reduced conformance profile or authority over anyone's rights.

Executed arithmetic result: The repository validator was run for this cycle; all 18 authored cases matched their expected results (13 valid-count states and five malformed inputs). The generated execution record records the run. This executes the numerical exercise only; the institutional sequences below remain synthetic.

111.1.2 2. Count domain and discriminating arithmetic cases

The four-count fixture accepts nonnegative integers `N`, `Y`, `D`, `A`, excluding Boolean values and requiring `Y+D+A <= N`. `N` counts eligible, non-recused persons; `Y`, `D` and `A` count their valid approval, disapproval and abstention ballots. `R=Y+D+A` is the valid-return count. The fixture assumes attempted submissions are valid; cases concerning invalid attempts have a separate record partition in section 5.

The three simultaneous conditions from D1-031 are:

```
returned-ballot quorum:   R >= ceil(2N/3)
substantive minimum:      Y+D >= 3
substantive approval:     Y >= ceil(2(Y+D)/3)
numeric_pass:             all three conditions hold
```

Integer recalculation can use `(2*N+2)//3` and `(2*(Y+D)+2)//3` on this nonnegative domain. A malformed input has no ballot result; it is not a procedurally valid defeated ballot. A zero-person input is mathematically valid for this finite fixture but fails the substantive minimum and says nothing about actual constitution of an electorate.

Case	N	Y	D	A	R	Required R	Y+D	Required Y	Authored expected result
P0-02-B01	5	2	1	1	4	4	3	2	Numerical pass; dissent remains to be addressed
P0-02-B02	6	3	0	0	3	4	3	2	Fail quorum
P0-02-B03	3	1	0	2	3	2	1	1	Fail substantive minimum
P0-02-B04-before	5	2	2	1	5	4	4	3	Fail approval threshold
P0-02-B04-after	4	2	1	1	4	3	3	2	Arithmetic passes; changed roster requires a new ballot
P0-02-B05	3	2	1	0	3	2	3	2	Numerical pass; breadth and independence unassessed
P0-02-B06	2	2	0	0	2	2	2	2	Fail substantive minimum
P0-02-B07	7	3	1	1	5	5	4	3	Numerical pass at both ceiling boundaries
P0-02-B08	7	2	2	1	5	5	4	3	Fail approval threshold
P0-02-B09	8	4	2	0	6	6	6	4	Numerical pass
P0-02-B10	8	3	2	1	6	6	5	4	Fail approval threshold
P0-02-B11	4	0	0	4	4	3	0	0	Fail substantive minimum; `Y>=0` alone proves nothing
P0-02-B12	0	0	0	0	0	0	0	0	Fail substantive minimum

Cases P0-02-I01–I05 respectively supply more valid returns than eligible persons, a negative count, a fractional count, a numeric string and a Boolean. All expect `valid_input=false` and `numeric_pass=null`. These validation choices are a bounded fixture convention; they do not specify an interchange format or a general voting-service contract.

The fixture does not authenticate persons, evaluate interests, receive ballots, observe a deadline, determine consensus, ensure accessibility, make a recusal or supply the independent tally verification required by D1-076.

111.1.3 3. Trace P0-02-G0 — Founding and proposal gate

Controlling provisions: CH-001/002/014/021/028/029/036–040/058–060; D1-003–005/009–014/059–061; TC-001/032/033; EIP-001/042/044.

Record	Synthetic input or operation	Expected state and discriminating consequence
P0-02-G0-01	An author has compiled all five governance documents and entered proposed role names in a form.	Prepared documents exist; appointments, acceptance, authority and adoption do not follow. Formal roles remain UNASSIGNED.
P0-02-G0-02	The form proposes a founding signatory who can control a repository but has no mandate to represent a university.	Only the actual resource commitment can be considered; the university representation assertion lacks a basis.
P0-02-G0-03	A fictional founding-review package identifies exact editions, prospective signatories, their capacities, proposed appointments, contribution terms and public/protected routes.	Ready for assessment of the proposed founding review; publishing this scenario does not open that review or start a clock.
P0-02-G0-04	No non-conflicted independent reviewer has accepted a bounded role.	Founding-process independence remains unavailable; formal initiation is pending. Preliminary drafting may continue.
P0-02-G0-05	A hypothetical proposal for a correction protocol supplies purpose, scope, affected interests, interfaces, assessment plan and resource estimate.	Register and acknowledge a proposal within seven days in an actual process; registration remains distinct from acceptance.

Record	Synthetic input or operation	Expected state and discriminating consequence
P0-02-G0-06	The proposal assumes a maintenance owner and protected-record custodian will be found later.	Essential accepted roles are missing. Revise scope or defer; do not describe assumed future capacity as present.

The real repository can supply source versions and this scenario. It cannot currently supply the synthetic signatory, notice, accepted roles or observations. The missing launch evidence is an institutional action list, not an invitation for an assistant to assign people.

111.1.4 4. Trace P0-02-G1 — Accessible comment, disposition, clocks and re-review

Controlling provisions: CH-015/017/018/049–052; D1-018–028/068–072/091–093; EIP-058.

A fictional protocol draft `FICT-P0/0.2-A` accepts a challenge only if the sender provides a replacement technical clause. An affected person submits an ordinary-language explanation that the entry identifies the wrong contributor and describes a practical consequence. A second part of the submission alleges that an administrator dismissed previous comments because of the person's affiliation.

The intake trace has separate but linked records: `P0-02-G1-C01` for the technical objection, `P0-02-G1-E01` for protected conduct handling, and `P0-02-G1-P01` for the access/protection decision. The technical record retains the person's actual concern; converting it into structured fields records any interpretive assistance. A safe summary omits identifying conduct details. An unsupported conduct allegation does not dispose of the technical objection.

The proposed technical disposition accepts ordinary-language challenge submissions and identifies assistance requirements. The record preserves the replacement-clause-only alternative, its exclusion risk and the resulting proposed change. The change affects accepted inputs and operator obligations, so it is substantive. Within the same purpose, constituency and conformance subject, it needs at least 30 days of re-review. If it changes those boundaries substantially, renewed scope approval and 60-day review apply. A label such as "minor wording" cannot select the shorter route.

The following is a separate **unchanged-text timing branch**, used only to make successive periods inspectable. It assumes UTC, start as day zero, effective notice at the stated timestamp, no delivery/access failures, no substantive replies and sequential reply/ballot windows. Those assumptions have not been observed.

Fictional event	Scenario timestamp	Meaning
Initial review opens	2026-10-01 09:00 UTC	Identified fixed draft and notice
Review closes	2026-11-30 09:00 UTC	60-day opportunity; intake closure is not disposition completion
Initial dispositions delivered	2026-12-30 09:00 UTC	30-day target after close; delivery assumed only in this scenario
Reply window closes	2027-01-29 09:00 UTC	30 days after disposition notice
Ballot opens after assessment	2027-01-30 09:00 UTC	Frozen package and completed review dossier assumed
Ballot closes	2027-03-01 09:00 UTC	30-day ballot
Decision notice accessible	2027-03-02 09:00 UTC	Starts ordinary appeal opportunity; not immediate release permission
Ordinary appeal period ends	2027-04-01 09:00 UTC	Release can be considered after the period only if remaining conditions are met

The substantive-change branch does **not** inherit this unchanged-text schedule. It inserts the applicable re-review, dispositions, reply and reassessment before a new frozen approval package. A later material reply cannot be ignored to preserve a planned publication date.

Failure injections make the obligations observable in a future live rehearsal:

Injection	Expected response	Evidence still needed
Comment arrives 2026-10-02 09:00 UTC; acknowledgement occurs 2026-10-10	Record a missed seven-day duty; explain effect and correction. A determination-target extension cannot make acknowledgement timely.	Actual received/sent logs, delivery limits and handling reason
Essential supporting material is inaccessible for affected reviewers	Assess material access failure and extend review sufficiently to restore opportunity.	Access incident, affected scope, extension reasons and revised notice
A disposition email is known to have failed	Offer a workable route or extend the affected reply window; do not count failed delivery as silence.	Delivery record, permitted alternative, effective opportunity and progression decision
A late reply identifies a material rights defect	Assess before adoption irrespective of receipt date.	Grounds, competent review, disposition and any blocking consequence
The 30-day disposition target cannot be met	Notify reasons, interim state and a new target before expiry. A missed target remains historical if already missed.	Actual notice and revised target; no deemed resolution

111.1.5 5. Trace P0-02-G2 — Ballot validity, replacement and recusal

Controlling provisions: D1-029–033/073–076; CH-039/040/053; EIP-053/054.
Related finding: GOV-F01. The explicit `I/U` summary partition below is a proposed repair to 0.2, not a claim that 0.2 already specifies that partition completely.

Five fictional eligible persons are designated A through E. Their proposed receipt ledger is:

Person	Submission history at closing	Final count state
A	Attributable approve	Y
B	Attributable approve, followed by an unverifiable purported replacement	Earlier valid approve remains the latest valid ballot unless an applicable withdrawal or validity decision changes that; unresolved attempt stays in audit
C	Attributable disapprove with a material procedural objection	D; grounds require disposition independently of the arithmetic
D	Attributable abstain	A
E	Attributable but ambiguous “possibly”; clarification not completed	Attempted but not counted valid; record clarification, exclusion/review grounds and challenge route

The candidate person partition is `N=5, R=4, I=1, U=0`, with `Y=2, D=1, A=1`. Here `I` counts otherwise eligible persons with an attributable excluded or unresolved attempt and no counted valid ballot; `U` counts eligible persons without an attributable submission. A naive `N–R` nonresponse formula would falsely count E as silent. Unattributable and ineligible submissions need a separate inventory; no identity is invented to force them into the roster partition. The numeric quorum passes; the actual effect of E’s handling and C’s objection still needs reasoned assessment. If exclusion reflects a material failure of participation or administration, D1-028/076 prevents progression even though the numerical rule passes.

If E supplies a valid approval before close, the candidate partition becomes `R=5, I=0, U=0`, with `Y=3, D=1, A=1`. E is not counted twice. The ambiguous earlier attempt remains in the protected audit. A duplicate transmission from A does not add a person or vote. No unknown message is silently converted to an abstention.

For recusal, use B04-before and B04-after from the count fixture. Removing one disapproving person’s eligibility after a material conflict discovery changes both the electorate and apparent result. Preserve the first frozen roster and failed tally, record the conflict decision, and start a new ballot if the matter proceeds. Recalculating the old tally is diagnostic; it cannot transform the old failed ballot into adoption.

The real exercise still needs identity and acceptance evidence, announced validity rules, conflict handling, protected audit controls, actual notice/receipt, an independent tally check and a reasoned consensus assessment. A script supplies none of these.

111.1.6 6. Trace P0-02-G3 — Procedural appeal and unavailable capacity

Controlling provisions: CH-023/029/061; D1-034–039/078–081/093; EIP-010/020.

Step	Synthetic case state	Expected action and failure boundary
P0-02-G3-01	A commenter alleges exclusion from a changed review package and supplies the earlier notice.	Log receipt and relevant decision; acknowledge within seven days; distinguish alleged failure from a finding.
P0-02-G3-02	The original chair offers to determine whether their own notice was adequate.	Do not treat that chair as independent; obtain a non-conflicted appointed reviewer or keep consequential disputed progression pending.
P0-02-G3-03	Review cannot proceed because no independent reviewer is available.	Record the capacity gap, action owner and review point; preserve appropriate protection and affected publication stay. Silence is not rejection.
P0-02-G3-04	In an alternative staffed branch, a reviewer accepts a bounded mandate, discloses interests, explains admissibility, access and timetable.	Provide meaningful reply to the appellant and decision maker. Record how protected grounds can be assessed fairly.
P0-02-G3-05	The reviewer establishes that a material delivery failure prevented reply and remits the decision for renewed opportunity.	Identify the affected stage, remedy, owner and evidence needed to lift the stay. The finding addresses procedure, not factual truth.
P0-02-G3-06	The appeal file is marked closed, but no corrected notice has been delivered.	Remedy implementation remains open; file closure does not establish restored participation.
P0-02-G3-07	A new notice is actually delivered and the required opportunity is restored in a future exercise.	Verify the actual evidence before renewed progression; cite the appeal and repeated stage in the new decision.

An ordinary appeal is filed within 30 days of accessible notice. Ineffective notice or newly discovered concealed failure can support a reasoned extension by the independent reviewer. That flexibility is not an excuse to omit notice or make the original decision maker determine their own appeal.

111.1.7 7. Trace P0-02-G4 — Conduct, temporary protection and reconsideration

Controlling provisions: EIP-013–020/056–075/095/096/099–104; D1-035/036/050.

The synthetic report concerns alleged retaliatory exclusion from a working discussion. It uses no actual person’s information. The handler logs the report and requested protection, checks conflict and immediate risk, and separates factual allegations from their assessment. Acknowledgement has a seven-day deadline; a complex inquiry may need a reasoned extension of its 30-day initial-determination target, notified before expiry. The extension affects that target only.

An authorized temporary access restriction, if justified, records evidence, scope, safer alternatives, impact, challenge route and notice limits. It needs independent review within seven days and expires within 30 days unless the authority records a justified extension, next review date and remedy plan. Relabelling it “temporary” every month cannot substitute for reasons and review. An immediate protective measure is not a concluded conduct finding.

Three outcome branches are deliberately distinct:

- **Unresolved evidential balance:** Two plausible accounts remain equally supported after fair examination. The allegation is not substantiated under EIP-069. This does not establish that the report was false or permit retaliation.
- **Unsafe grounds:** The information cannot be disclosed or tested sufficiently for a meaningful response. EIP-016/020/064 prevents an unsupported adverse finding even if the author feels confident. The record identifies limitations and feasible non-punitive improvements within authority.
- **Material assessment error identified later:** A reporter or reported person submits a scoped substantive reconsideration request. A competent, non-conflicted reviewer who did not determine the finding handles admissibility and any admitted grounds under EIP-099–102. Mere repetition without grounds can receive a reasoned refusal; an identified error cannot be treated as misconduct for being raised.

Ordinary reconsideration filing is within 30 days of accessible disposition notice, with the stated extension grounds. Acknowledgement is within seven days and an initial admissibility or substantive determination has a 30-day target. The existing remedy gets an explicit stay/modification/continuation decision under EIP-103; neither automatic continuation nor automatic suspension is inferred from the request alone. Temporary restrictions remain subject to EIP-067. A revised finding preserves the earlier decision and records changed practical effects.

These branches exercise the specified criterion and procedural distinctions. They establish neither actual fair treatment nor contextual acceptance of the programme's proposed internal evidence criterion.

111.1.8 8. Trace P0-02-G5 — Rights, publication integrity and maintenance

Controlling provisions: CH-047/048/071; D1-040–053/082–088; D2-042–045/075/076/082–084; EIP-026–038/082–090/098.

Synthetic condition	Expected distinction and disposition
A foundation manuscript can be read within the project, but public redistribution is unverified.	Preserve source terms; do not infer permission from the manifest or citation. Obtain a reviewed basis, remove the attachment, or restrict the affected distribution. New independent drafting within actual permission can continue.
A contributor assents to code terms, while a submitted example contains a third-party dataset.	Code assent does not clear the dataset. Separate artifacts, versions, intended uses and authority evidence.
Source is approved in a fictional record, but the rendered PDF omits a requirement.	Block release; resolve the source/render discrepancy and obtain review by someone other than the final editor. Compilation success alone is insufficient.
A proposed one-character edit changes `30` to `3` days.	Substantive change: it changes permitted outcomes and needs the relevant review route. Character count does not define editorial status.
A real error can be corrected without altering intended meaning or valid outcomes.	Use a documented corrigendum only after the required non-editor review; retain the original publication and effect interval.
An exchange dependency becomes unavailable or changes incompatibly.	Assess affected versions, implementation rights, users and migration losses; narrow scope, revise or defer rather than claim interoperability by citation.
A serious protection incident requires immediate warning or distribution suspension.	Use bounded emergency authority, review and expiry; permanent amendment or withdrawal retains the ordinary procedure.
The maintenance contact leaves and no alternate accepts custody.	Record the vacancy and loss of capacity. Reassign within mandate or defer dependent decisions; an unchanged email address is not an accepted duty.
A recovery test restores files but loses protected-access restrictions.	Record a failed material part of continuity; successful copying does not establish preserved custody or safe service restoration.

Synthetic condition	Expected distinction and disposition
A withdrawal is proposed.	Give at least 60 days' public notice, dispositions, reply and formal approval; preserve historical edition identity and avoid retroactive claims about earlier users.

111.1.9 9. Actual work remaining and measurement plan

The substantive review and authored fixtures are preparatory evidence. The following remains **NOT ASSESSED** as institutional performance:

Activity	Observable evidence needed	Responsible function
Founding process and commitments	Actual authority, reviewed texts, signatory assent, dispositions and independent assessment	Prospective founders; UNASSIGNED
Public/protected intake and assistance	Real test deliveries, failure logs, assistance requested and supplied, access controls	Secretariat and protected custodian; UNASSIGNED
Eligibility, interests and tally verification	Accepted roles, declared capacities, conflict decisions, per-person audit, separate verifier	Chair and non-conflicted verifier; UNASSIGNED
Reply, appeal and reconsideration	Observed notices, meaningful response, independent competence, reasons and actual remedy verification	Independent reviewers; UNASSIGNED
Rights and release	Competent use-specific review, identified permissions, exact source/render examination, authorization	Rights reviewer and release owner; UNASSIGNED
Recovery, maintenance and remedy	Exercised recovery including access restrictions, accepted handover and demonstrated correction	Custodian and maintenance owner; UNASSIGNED
Practical burden and accessibility	Operator/reviewer time, waiting time, repeated entry, failed tasks, assistance, missing perspectives and user findings	Pilot evaluator; UNASSIGNED

For a future staffed rehearsal, record time separately for preparation, interpretation, record entry, assistance, review, correction and waiting. Track one shared dossier instead of copying the same facts into every form, while retaining each required distinction and locator. Report actual measurements and population limits; do not fabricate person-hours or assume a compact scenario scales to a live institution.

The stop conditions are unavailable authority for the attempted action, unsafe disclosure, unresolved material conflict, failure of independent capacity, material exclusion, and an unhandled substantive change. A stop leads to a recorded limitation and response; it does not prohibit unrelated authorized drafting.

Governance launch remains pending. A successful arithmetic run establishes only the finite mathematical results it reports. This document does not approve a work item, create a committee, constitute public review, or adopt a Standard.

112 p1 contested decision

Original source: `examples/validation_0.2/p1-contested-decision.md`.
Original source SHA-256: `d614093324a7caecfe0b6fd2a56ad0064dc4a5406d2b44a0bd527366b1a9ec84`.

112.1 P1/v2 — Contested decision: bounded validation dossier

Publication class: Informative synthetic example and assessment fixture
Status: EXPERIMENTAL; fixture version 2; 2026-09-22
Assessment baseline: GR-100/110/200/210 Working Draft 0.2, preserved in the dated archive.
Predecessor: P1/v1, retained unchanged.
Assessment: Component result register; epistemic review.

112.1.1 1. Boundary, authorship and evidence status

Package `P1/v2` records an invented community water-monitoring funding case, using synthetic days −2 through 40. Its purpose is to examine whether a narrative package preserves the distinction among a missing attachment, a claim of non-calibration, an exclusion decision, challenge, evidential revision and practical consequences. The recording role is the **fixture author, a Codex assistant acting for this repository task**. The assessment role is the same assistant; this is author review, not independent review. The date of this actual documentary review is 2026-09-22. Synthetic day labels express scenario chronology, not elapsed real activity.

The collection rule includes claims C1–C7, their identified versions, material invoked for them, rule versions K1/K2, decisions D1/D2, challenge CH1, and the downstream dependencies named below. Shared context `CTX-P1/v2` consists of this section and the declared method in section 4. All those records inherit it unless a row states otherwise. The unit of inquiry is one fictional application and a claimed maintenance relation; no population-wide inference is attempted. The judgment horizon ends at day 40; the pre-submission maintenance target is day −2 or otherwise explicitly unknown. Claims about later durable environmental or social benefit fall outside the supplied evidence.

The **actual supplied evidence** is the text of this file, the historical P1/v1 text, the archived draft clauses and the linked assessment register. Every in-world actor, submission, notice, receipt, review, authority and action is fictional. The dossier supplies authored representations of them, not evidence that such procedures occurred. Text inspection can establish that a specified field or distinction is present; it cannot establish actual receipt, fair participation, competent review, enforcement, deletion or repair. Such performance remains **not assessed**.

This edition adds explicit scenario declarations, issue tracks and component assessments. These additions are authoring choices, not newly discovered historical facts. It does not fill the absent original application, original maintenance log, calibration method, instrument identity, contact details, delivery receipts or funding outcome. No real restricted material is held. The claimed protected original exists only as a scenario premise; the current file is a fully public authored demonstration of differentiated views.

The package is a **partial documentary assessment subject**. It does not claim full GR-110, GR-200 or GR-210 conformance. Its assessment register contains selected components and explicitly identified unassessed whole-requirement results. GR-200's package obligations remain applicable; nothing is removed because this is a small example. No reduced conformance profile is assumed. Neither this fixture nor its checks establish truth, legal rights, institutional legitimacy or beneficial generativity.

112.1.2 2. Scenario declaration and service schedule

`P1-PROC/v2` is a **proposed synthetic procedure**, effective for this fixture only. The fictional Fund is the operator. Secretariat records and routes submissions; Panel applies the fictional internal eligibility rule and alone can authorize funding reassessment; Reviewer B assesses the scoped evidential questions; Review Contact handles procedural reconsideration; Custodian controls the described original log. No role is an actual appointment or an available external service. The fixture supplies no jurisdiction or external legal mandate.

Covered users are the team, technician and Panel for this case. No fee is proposed. Text and assisted oral submissions, protected contact and representative submission are designed routes, not deployed channels. An issue description and target sufficient to identify a concern are the proposed minimum intake content; technical clause numbers and public identification are unnecessary. English is the authored fixture language. Translation, disability support and safety arrangements require participant needs assessment in a rehearsal; availability is not presumed. Known barriers are unequal documentation resources, possible exposure of a technician's contact details and inability to inspect a protected original. Actual experience of those barriers and adequacy of assistance have not been measured.

The following illustrative periods are local design choices. Their rationale is a small case needing prompt status communication while allowing a protected evidence request and a reply. No resource study validates their adequacy. They do not replace any external deadline. All clocks use elapsed scenario days; day of receipt is day 0 of each local clock. The proposed extension rule is one reasoned extension, authorized by Review Contact before the current due time and communicated with a new date; missed targets stay in the record. Any further extension requires a capacity review and reasoned alternative. A hold preserves pending status and receives a review point; it does not decide the merits.

Service event	Proposed owner; start → period	Notice, pause or escalation
Receipt/acknowledgement	Secretariat; receipt → 2 days	Identify case, issues and next step; failed contact recorded and protected alternative attempted if available.
Clarification/scoping	Secretariat; missing-information request → 3 days for reply, then review	Explain why information matters and available assistance; no automatic factual rejection on silence.
Urgent triage	Review Contact; identified urgent risk → 1 day	Limited temporary protection only within fictional internal authority; review after 2 days.
Reviewer assignment	Review Contact; scoped case → 2 days	Record accepted questions, competence and conflicts; unavailable reviewer triggers notice and deferral.
Grounds/reply	B; provision of usable grounds → 2 days	A material new ground restarts the relevant reply period; protection barriers can require adjustment.
Initial disposition	B; receipt of sufficiently scoped challenge → 10 days	Status notice if extension needed; refer matters outside B's competence.
Disposition notice	Secretariat; disposition → 1 day	Identify exact notice version, recipient and known delivery status.
Further-review request	Review Contact; confirmed receipt of disposition → 10 days to request	Where receipt is unknown, no expiry is inferred; acknowledge within 2 days and decide scope within 5 days.
Further review	Review Contact; accepted further-review scope → 10 days	Conflict screening and stay consideration; unavailable independence disclosed.
Action follow-up	Panel; action assigned → 5 days to first status report	Identify action-specific due/review point and completion evidence; unresolved action prevents a completed-remedy claim.
Closure	Review Contact; proposed closure → 2 days for record check	Closure distinguishes outstanding actions and their owners; reopening on new evidence or defect remains available.

Protection/continuity	Custodian/Review Contact; incident or handover concern → 1 day to triage	No onward disclosure beyond declared purpose; retention and transfer require separate documented authority.

No hearing, appointment, capacity test, acknowledgement, notice transmission or clock performance was executed. The schedule's completeness is a documentary question; its feasibility and actual fulfillment remain unassessed. It deliberately exposes a resource question: an institution with only the original decision maker cannot honestly advertise independent further review.

112.1.3 3. Inventory and temporal trace

Reference/version	Supplied representation, provenance and availability	Target / acquisition / recording / assessment time
A1/v1	Author-supplied summary of a team's application asserting an operating sensor network; full application **not supplied**.	Pre-submission operation / scenario submission day 0 / author representation in this edition / contextual review day 12.
M1/v1	Author-supplied description of an intake extract omitting a calibration attachment; extraction from A1 asserted in the scenario, not reproduced from an available packet.	Packet contents / day 2 / day 2 / day 12. Other channels and completeness unknown.
S1/v1	Exact fictional output, "The sensors were not calibrated." `SummaryTool/demo-v0`, input M1 only, task summary; no runtime, configuration, internals or reproducibility evidence.	Pre-submission calibration / M1 acquired day 3 / generated expression day 3 / reviewed day 12.
T1/v1	Authored testimony summary attributed to a protected technician: calibration before submission and maintenance labor. Original utterance and independent interview **not supplied**.	Pre-submission activity; exact interval unknown / day 7 / day 7 / day 12.
L1-excerpt/v1	Entire supplied fictional excerpt: "Day −2: station S adjusted against reference instrument." It is an invented nonpersonal excerpt, not an authenticated copy.	Adjustment day −2 / excerpt available day 8 / original entry time **unknown** / day 12.
L1-original/unknown-version	Described protected original; **not supplied**, identity/contact information imagined but not entered. Custodian's asserted protection premise is a fictional confidentiality arrangement.	Original creation/acquisition time unknown. No original examination represented.
K1/v1	Fictional internal rule: "documented calibration" requires an attachment in the application packet.	Effective scenario days 0–20; used in D1. No external authority asserted.
K2/v1	Fictional internal revision permits assessed maintenance testimony and controlled log inspection as possible evidence; does not guarantee sufficiency.	Announced day 20, effective day 21. Earlier application not silently reevaluated as if K2 existed.
D1/v1	Authored representation of Panel excluding the application using C1/v1 and K1.	Decision/action day 5; actual delivery and execution not observed.

Reference/version	Supplied representation, provenance and availability	Target / acquisition / recording / assessment time
CH1/v1	Authored challenge from team, receipt label day 8, challenging C1/v1, rule application/adequacy, attribution and consequences; legal allegation separately routed.	Concerns D1 and pre-submission conditions; entered day 8. No actual submission occurred.
AS1/v1	Authored qualitative assessment by B, day 12; examined representations M1, S1, T1 and L1-excerpt, not originals.	Evidence state limited to those items as represented by day 12.
D2/v1	Authored representation of Panel scheduling renewed assessment under K2 on day 22.	Reassessment date **unspecified**; completion/outcome **not supplied** by day 40.
X1/v1	A prior exported spreadsheet is a known scenario dependency; actual file, custodian contact and corrected version **not supplied**.	Creation/dispatch time unknown; correction unverified.

The three histories are distinct: alleged maintenance and institutional actions; recording, inference and assessment; and the K1→K2 change in admissible documentation. Record identifiers do not settle physical sensor identity. The station named S and the equipment described in A1 are an **unresolved match**, not a verified equivalence. A maintenance Relation can retain participants, duration and contribution history while the same episode also receives Event/Process descriptions. No one-to-one mapping to ultimate reality is claimed.

112.1.4 4. Claims, evidential roles and uncertainty

Assessment method `METHOD-P1/v2` is author inspection of stated claim content, source scope, derivation, alternative explanations and reasons. The in-world assessment `AS1/v1` uses qualitative claim-relative comparison, with no numerical confidence scale or assertion of independent source verification. Criteria distinguish testimony about calibration, a log of adjustment, compliance with an attachment rule, and proof of calibration quality. No combination of the supplied material establishes the last of these.

All claim assertions below are entered by the fixture author; the source column names their represented in-world origin. Each assertion concerns the single application/maintenance episode unless stated otherwise. No cross-person or cross-period aggregation is supplied. AS1's criterion and date do not silently transfer to the Panel's earlier assessment. The domain criterion for adequate calibration remains unavailable; the author's documentary judgment is that the dossier states that limit.

Claim/version; origin; target time	Assertion, epistemic mode and relevant modality	Grounds, assessment and material uncertainty
C1/v1; Panel adopting S1; before day 0	"Calibration did not occur." Inference asserting actual non-occurrence, recorded day 4.	M1→S1→Panel assumes all calibration would appear in the intake extract. Coverage unestablished; **historical unsupported conclusion**, retained as such.
C1/v2; B; before day 0	"Testimony supports calibration activity; the supplied excerpt supports reported adjustment." Retrospective assessment, day 12, of an alleged actual occurrence.	T1 and L1-excerpt support different components. Method, quality, instrument identity, source independence and actual occurrence remain qualified. Preferred present assessment within AS1's limited evidence scope, not a factual certification.
C2/v1; Panel's implied eligibility judgment; day 0	"Application met K1" is the question under review, not an established assertion of compliance. Normative rule application with unresolved factual premises.	Complete A1 unavailable; absence from M1 does not establish absence from A1. K1 application **unresolved**. The rule's adequacy is separate.

Claim/version; origin; target time	Assertion, epistemic mode and relevant modality	Grounds, assessment and material uncertainty
C3/v1; Team; D1 and effects through day 40	“Exclusion was unfair.” Ethical judgment under accessible participation and recognition of maintenance labor.	Documentation burden and omitted contribution are asserted grounds; Panel’s consistent-evidence value retained. No universal ordering or numerical net benefit. Actual burdens and other applicants’ circumstances not measured.
C4/v1; Team; D1	“D1 violated a legal duty.” Party allegation, not a determination.	Legal concept: alleged duty of fair treatment. Source, jurisdiction, competent authority, temporal applicability and procedural avenue **unresolved**. B has no asserted legal competence.
C5/v1; Technician; maintenance before day 0	“Maintenance enabled continued monitoring.” Attributed generative inference, not direct observation of the causal linkage.	Reported adjustment and continuing operation compared with reported earlier drift. Maintenance may stabilize capacity; competing equipment/operator conditions and duration of effect not examined.
C6/v1; Team; alternative to D1	“Granting the application would have preserved training.” Counterfactual proposed in CH1, not observed outcome.	Proposed costs and availability are unverified; allocation authority, funding sufficiency and feasible timing remain unknown. An available request route does not establish practical access to support.
C7/v1; Team; days 5–30 and prospective period after day 30	“Replacement was delayed and training interrupted; exclusion contributed.” Reported effects plus causal inference and prospective concern.	Split for examination into C7a/v1 (reported delay/interruption), C7b/v1 (inferred contribution of D1), C7c/v1 (possible future capacity loss). No independent follow-up or exclusion of other causes.

Assignment	Material → claim; assigned by/date	Reasoning, dependence and result
EA1/v1	M1→C1/v1; Panel/day 4	Panel’s missingness inference is preserved as its historical assignment, not adopted by author review. No demonstrated capture coverage.
EA2/v1	M1→limited statement “attachment absent from M1”; B/day 12	Supports the extract-content representation only; actual A1 coverage and channel selection remain unknown.
EA3/v1	S1→C1/v1; Panel/day 4; qualified by B/day 12	Generated restatement inherits M1’s limitation. M1, S1 and C1 are one derivation chain, not three observations. No internals invented.
EA4/v1	T1→C1/v2; B/day 12	Testimony supports a report of calibration by someone with alleged situated access. Access, memory, method and identity not independently established. Institutional status alone neither accepts nor rejects testimony.

Assignment	Material → claim; assigned by/ date	Reasoning, dependence and result
EA5/v1	L1-excerpt→C1/v2; B/day 12	Supports the narrower represented adjustment report. “Adjustment” is not automatically adequate “calibration.” Authored excerpt authenticity and actual occurrence are not verified.
EA6/v1	T1+L1-excerpt→C5/v1; B/day 12	Relevant to maintenance account; source independence unknown because testimony may derive from the log. Connection to durable monitoring remains unestablished.
EA7/v1	Team’s day-30 report→C7a/b/c; recorded by Secretariat/day 30	Reported realized effects, causal attribution and prospective risk separated. No outcome survey or causal analysis performed.

Alternative register `ALT/v2`: **retained** explanations include calibration outside the intake channel, adjustment short of adequate calibration, and identity mismatch. The inference “no attachment anywhere because none appears in M1” is **rejected as unsupported under current coverage**, not proof of the contrary. Selective preservation is a known possibility; deliberate concealment is **not examined and not alleged as established**. Independent confirmation, instrument matching, calibration-method inspection and sensitivity to another eligibility rule were **not performed**. Contradictory sources are not assigned equal weight merely to preserve pluralism.

Uncertainty register `U/v2`: identity (which instrument); observation (what occurred and was captured); method (calibration meaning and quality); dependence (T1/L1); timing (original log entry, original transmission); causal linkage (maintenance→capacity and D1→loss); boundary (other channels, funding and operating conditions); and legal/authority context. Confidence in one component supplies no universal confidence score for the others. Zero, false, unknown and unexamined retain different meanings.

112.1.5 5. Issue tracks and represented transitions

The authored receipt record `REC-CH1/v1` distinguishes receipt on day 8 from acceptance of grounds. The proposed reviewer A authored the initial uptake note; this disclosed relationship prevents an independent-review description. The fiction routes evidential review to B, whose relevant role is comparison of claim/source scope. No actual competence, availability, acceptance of appointment or independence was verified. The Review Contact is likewise a declared fictional route, not an operating appeal body.

Track	Questions and competent scenario recipient	Represented day-12 disposition; status at day 40
I1	C1/v1 warrant and missingness inference; B	Replace unqualified present reliance with C1/v2; earlier assertion and D1 use retained. Documentary correction supplied, real procedure not performed.
I2	Whether A1 complied with K1; Panel, informed by B	Cannot decide from M1; complete packet sought but absent. **Unresolved**, Panel owns follow-up.
I3	Adequacy of attachment-only rule; Panel	Rule question retained separately; K2 authored as later scenario change. Review of transition effects and meaningful response not demonstrated.

Track	Questions and competent scenario recipient	Represented day-12 disposition; status at day 40
I4	Maintenance contribution and attribution; B/Panel	Include C5 with limits; credit/payment/return decision **pending**. No entitlement follows from attribution.
I5	Asserted legal duty; outside B's competence	Allegation retained with missing legal context. **Referral proposed**, recipient/acceptance unavailable; not "legal claim resolved."
I6	Practical consequences and possible response; Panel	D2 is scheduling only. C7 remains attributed; repair and funding outcome **pending**.

State trace `STATE/v2`: received (REC-CH1) → scoped (I1–I6) → assigned in the scenario → under review (AS1's described examination) → issue dispositions (above) + action pending. The file provides no actual grounds-delivery or reply event. It therefore does **not** attest that an operative transition into a valid consequential disposition satisfied all prerequisites. A real procedure cannot skip that evidence by applying these labels. Overall case closure is not claimed, and no expiry or agreement is inferred from silence.

Proposed grounds notice `GND/v1` identifies M1, S1, T1 and L1-excerpt, the separate I1/I2/I3 questions, intended scope limitations, a two-day reply period after usable provision, protected contact and adjustment route. It is an authored specimen only; dispatch, delivery and response opportunity remain **not assessed**. A later material ground or changed criterion would need a new response opportunity under the declaration.

112.1.6 6. Revision, dependencies, actions and generative conditions

Revision `REV1/v1` links C1/v1→C1/v2, attributed to B on day 12, reason **evidence/assessment change**. It changes the current warrant and formulation, not the alleged calibration event. Revision `REG1/v1` links K1→K2, attributed to Panel, announcement day 20/effective day 21, reason **category/rule change**. The mapping is partial: an absent earlier attachment cannot be converted into a demonstrated testimony assessment under K2. Earlier D1 retains K1 and its actual represented grounds. D2's future reassessment does not retroactively supply those grounds.

Dependency register `DEP/v2` links C1/v1 to D1, S1's uptake note, the public summary and X1. The present authored summary changes to PS/v2; D1 is retained with current qualification and pending action review. X1 is outside the supplied file/control boundary: correction is **unverified**, not presumed performed. No universal downstream propagation or external recall is claimed.

Action	Scenario owner/authority; status; next review point	Evidence required and present limit
AC1 — correct current account	B within AS1 scope; documentary C1/v2 supplied day 12	This text demonstrates changed wording and linked reasons. Actual institutional correction unobserved.
AC2 — reassess application	Panel under K2; **scheduled**, D2 day 22; first proposed status review day 27	Dated reassessment, reasons and notice needed; absent at day 40. Proposed review target itself not evidence of a performed review.
AC3 — notify team and Panel	Secretariat; **notice specimen available**, dispatch/delivery unknown	Exact notice, recipient, route, dispatch and receipt evidence absent. No assertion that deadlines began.
AC4 — address X1	Secretariat; external custodian/contact unknown; **unverified**	Located copy and correction/receipt evidence needed. The unknown is not permission to declare propagation complete.

Action	Scenario owner/authority; status; next review point	Evidence required and present limit
AC5 — investigate reported capacity loss	Panel; **proposed**, authority/ resources and follow-up date unresolved	Participant account, alternative causes and actual capacity observations needed; C7 alone does not establish complete loss attribution.
AC6 — recognition and training support	Team's proposed response to contribution and loss; **not authorized or performed**	Decision, eligible recipients, transfer, return pathway and changed future conditions would need separate evidence. No numeric return, payment right or completed repair asserted.

GEN/v2 records the maintenance account's capacity (continued operation), alleged prior drift, candidate stabilizing relation, uncertain mechanism, and short observation horizon. The exclusion account identifies possible reduced practical access to replacement and training, while C7 remains a report. The possibility-field account is actor-relative and incomplete: the team could request review under the proposed route; whether it had usable resources, safety and time to exercise it was not observed. Later grant support remains counterfactual, and an alternative of a regional instrument-sharing programme introduced by this fixture's author is **retrospectively imagined only**; no evidence makes it available to the team at day 5.

No generativity-return chain is established. Generation, conversion/transfer, any return to contributors or enabling conditions, and any changed capacity require distinct support. Acknowledged contribution does not prove recirculation, an equitable distribution or entitlement. No completed restoration of training, monitoring or trust is claimed.

112.1.7 7. Views, protection and retention

View AS-VIEW/v2 is this public assessment dossier, including the invented L1 excerpt, source limitations and case tracks. View PS/v2 below is a reduced public summary derived from AS-VIEW/v2 by selecting the current assessment and action limits. The described **protected source arrangement** is a scenario design: Custodian would hold L1-original, B is authorized only for the nonpersonal excerpt, and no author or actual reviewer has examined an original. A future controlled assessment could be reported with its own reviewer, scope and limits; it could not become the present author's direct examination.

No actual personal data, restricted originals, access controls or deletion service are supplied. The proposed schedule separates substantive claims/history, testimony, contact data, protected original, reviewer working material, notices and permitted audit metadata. Custodian would review retention at closure and after any reopening; no deletion is represented as performed. Retaining an audit statement need not retain content barred from continued storage. The proposal does not identify an operative retention or disposal decision. A contextual arrangement would identify its authority, timing by a stated date, period or event, and permitted verification. These details remain design questions; their present absence does not by itself establish failure of the decision-level requirement C210-094 or permit indefinite retention.

PS/v2, produced by the fixture author on 2026-09-22:

> In this fictional case, an earlier conclusion of no calibration relied on a missing attachment in a limited intake extract. Testimony supports a report of calibration activity; the supplied maintenance excerpt reports adjustment. Instrument identity, calibration method and quality remain unresolved. A revised internal rule permits broader evidence, and reassessment is scheduled, without an evidenced funding outcome. Reported training and replacement losses, practical repair, delivery of notices and correction of an external copy remain unverified. The described original log is not supplied or independently inspected. This summary omits scenario contact information and is a partial view, not a truth or conformance certificate.

Both views preserve dissent, qualification and uncertainty without displaying a protected person's identity. Their comprehensibility, adequacy for contestation and actual access enforcement have not been tested with participants.

112.1.8 8. Failure branches and documentary checks

These are authored variants examined by comparing their text with the archived clauses. They are **not additional events in the baseline narrative** and not exercised institutional procedures. The result below concerns detectability of a documentary defect; expected procedural responses remain rehearsal tasks.

Variant	Injected change	Documentary finding and expected response
FB1	Replace C1/v2 with “Calibration definitely did not occur; three sources confirm it,” counting M1/S1/C1.	Coverage and derivation objections remain recoverable in EA1–EA3. E200-012/013 and C210-015/061 would be contradicted by adopting this result.
FB2	Label alleged calibration “unrealized” because its description is retrospective.	C1/v2 distinguishes asserted actuality from inferential access; E200-005 applies. Retrospective is not counterfactual.
FB3	Present Reviewer A as independent and close I5 as a legal ruling.	Assignment relationship and missing legal authority contradict the labels; C210-051/082 and E200-025 expose separate defects.
FB4	Announce “funding and training restored” on the basis of D2.	AC2/AC5 disclose missing implementation and outcome evidence; C210-071/077 and R110-077/081 are discriminating.
FB5	A specimen acknowledgement due day 10 is dated day 11 with no explanation.	The specimen is late against its stated target. Record a missed event, cause/limits, notice and escalation under C210-088; no merits rejection follows. No real clock was exercised.
FB6	A notice specimen has “sent” but no recipient or delivery state; then starts the further-review expiry clock.	C210-073 documentation is incomplete; receipt-start assumption unsupported. A new opportunity or alternative route would need actual performance evidence.
FB7	Replace K1 by K2 in D1, hide C1/v1 and omit X1.	REV1/REG1/DEP preserve the history and unresolved propagation; E200-017/018/019/038 and C210-075/076 address the loss.
FB8	Declare L1-original verified because B was permitted to inspect an excerpt; publicize imagined contact data.	Examination and disclosure scope are overstated; E200-023/042 and C210-090/091/095 apply. A restriction never establishes unseen examination.

The authored checks establish that these contrasts can be described and located. They do not establish inter-reviewer agreement, a functioning user interface, field burden or independent comprehension. The fixture needs a real rehearsal before any performance result changes.

112.1.9 9. Assessment boundary and next work

The linked JSON records exact requirement IDs, component, subject, applicability, result, evidence, rationale and locator. Each row also identifies method, assessor, assessment date, baseline and whether it covers an entire requirement. A **fulfilled component** means the specified documentary content was inspected and found present in that subject; it is not a fulfilled whole requirement where other claims/components are outside the check. Whole-requirement rows remain not assessed when examination is incomplete. C210-094 remains not assessed with applicability unresolved because no operative retention/disposal decision

is identified. Unperformed actions are not relabeled not applicable. During author review, C210-094 was initially marked not fulfilled by inferring a decision trigger from the proposed arrangement and treating a fixed period as mandatory. Review correction QA-01 withdrew that finding: an event-based timing condition can suffice, and an unmade decision is not invented to supply the trigger. The corrected result is recorded in the component register.

Next evidence is a bounded rehearsal with separate participants: locate the route; submit and scope CH1; handle a conflict; communicate grounds and receive a response; miss a target and recover; restrict an original; decide each issue; notify; revise dependencies; and follow an action. Retain what participants actually did, resource/time measurements and comprehension failures, with their consent and protection arrangements appropriate to that rehearsal. No current finding validates the service periods or operational capacity.

This edition changes the fixture and its documentary assessment only. A future normative edition requires a changed dependency declaration and targeted reassessment; successful 0.2 component results do not automatically transfer to 0.3.

113 revision regressions

Original source: `examples/validation_0.2/revision_regressions.md`.
Original source SHA-256: `4dfd59dbecaa8a035b58929951a3f06041339aa5ae3df04a41ff5af6c7db5443`.

113.1 Discriminating cases for the 0.3 corrections

Class: Informative synthetic review fixture
Status: EXPERIMENTAL; 2026-09-22
Basis: 0.2 findings and 0.3 dispositions

These cases distinguish the intended interpretation of the revised clauses. The comparison is an authored-text review. It does not report a real election, institutional action, transfer, historical occurrence or observed user performance. The separate P0 numerical results are recorded by the executed arithmetic checker.

113.1.1 RG-01 — An attempted ballot is not silence

Five eligible participants are represented. Two have valid approvals, one a disapproval, one an abstention, and one only an attributable unresolved attempted submission. The tally has `Y=2`, `D=1`, `A=1`, `R=4`, `I=1`, `U=0`, `N=5`.

The numerical conditions pass, but an unresolved validity/handling issue still needs disposition. Calling the fifth person a nonrespondent loses the attempt; treating the attempt as an abstention changes the valid return count. Revised D1-032 preserves `N=R+I+U` and D1-074 preserves the clarification and challenge history. A valid replacement moves that person into `R` and out of `I`. Multiple submissions from one person do not become multiple persons. An unattributable message remains separately inventoried.

Text-review result: the revised provisions express these distinctions without changing D1-031. Actual verification, participant identity and challenge handling remain untested.

113.1.2 RG-02 — No mapping does not remove a general safeguard

Candidate account A states that the six recording roles are ultimate constituents of reality and provides no metamodel mapping. Candidate B preserves operational roles separately and makes no mapping claim.

Both lack a mapping, but that fact concerns only the conditional mapping component of V100-011. Candidate A still violates the general separation. The revised Annex A assessment row asks the general question before considering whether a mapping-specific check is applicable.

Text-review result: the revised assessment instruction no longer permits the whole requirement to be skipped because a mapping is absent. This result does not settle any metaphysical thesis.

113.1.3 RG-03 — An actual effect can have disputed attribution

An account represents an effect as realized, its evidence as retrospective inference, and the proposed contributor's attribution as disputed. These are three distinct statements. A single exclusive list containing `realized`, `inferred` and `disputed` would make the combination impossible or obscure its meaning.

Text-review result: revised R110-012 permits the combination and separately requires explicit unresolved actuality where applicable. The case tests representational distinctions; it does not establish the effect or the contributor's actual role.

113.1.4 RG-04 — A transfer does not establish recirculation

A proposed return account contains the following authored components:

Stage	Supplied assertion	Grounds and uncertainty
Initial generation	A maintenance collaboration is reported to have sustained monitoring	A participant's account; extent and alternatives unresolved
Conversion/transfer	A sponsor proposes returning resources to the collaboration	A fictional proposal; no delivery evidence
Return path	The proposal names a recipient route	Feasibility and actual receipt unverified
Later generative conditions	Continued maintenance capacity is an intended effect	No follow-up evidence of realization

Candidate A summarizes the proposal as proof that regenerative capacity was restored. Candidate B retains the four stages, their connections and the stated uncertainty, and presents capacity renewal as intended and unverified.

Text-review result: R110-112 and the revised semantic/assessment schedules require these distinctions when recirculation is asserted. Candidate A's conclusion is not supported by the represented stages. Candidate B supplies a bounded, uncertain account; this is not a finding that recirculation occurred or that every GR-110 obligation is fulfilled. If no recirculation claim is made, R110-112's trigger is absent while other applicable return requirements remain assessable.

113.1.5 RG-05 — A definition reference does not import an unstated certification

A GR-210 case uses GR-100 meanings and supplies a bounded GR-200 claim package. It makes no independent claim of GR-100 vocabulary-application conformity. The revised GR-210 reference identifies exactly the imported meanings, while C210-030 continues to require the applicable GR-200 package obligations.

Text-review result: the dependency scope is explicit. Neither a claim-field-only check nor the absence of a separate GR-100 conformity declaration substitutes for assessment of the required GR-200 package.

114 MANIFEST

Original source: `foundation_manuscripts/MANIFEST.md`.
Original source SHA-256: `20b3f6b0999847d1c4f2a8c548d7560dfc840748664a47b73cd5b174817e5e26`.

114.1 Foundation Manuscript Manifest

Document class: Informative source register
Status: PROVISIONAL; initial indexing of the seven locally supplied PDFs
Indexed: 2026-09-22

114.1.1 1. Scope and source handling

This register identifies the project-local foundation corpus. FM identifiers identify particular files, not an adopted doctrine or a claim of publication precedence. Both Chapter 3 files remain separately identifiable. No PDF has been renamed or replaced.

Titles below come from the opening pages. Author attribution for the GRE chapters comes from their PDF metadata; the two metamodel papers name the author on their opening pages. Publication dates and formal publication status have not been verified. PDF creation timestamps are build metadata, not evidence of publication or approval. A filename containing `fir st_draft` is identified as a filename label rather than treated as independently verified editorial status.

Section references and page numbers refer to the supplied PDF, using one-based PDF pages. These entries provide a planning-oriented source map, not a complete collation, mathematical review, or verification of the manuscripts' external references. An external work cited inside a manuscript has not thereby been independently verified for use in a programme publication.

The companion foundation traceability map connects passages to candidate requirements, unresolved questions, and prospective pilot evidence. Those operational translations remain proposals.

114.1.2 2. Indexed manuscripts

114.1.3 FM-001 — Historical Conditions of the Contemporary Economy

- **File:** GRE_Chapter_01.pdf, 180 pages.
- **Author:** Wanhong Huang, as recorded in PDF metadata.
- **Date:** Publication/manuscript date unknown; not inferred from PDF build metadata.
- **Version/status:** Chapter 1 of *Generative Relational Economics*; formal publication and revision status unknown.
- **Primary concepts:** Historical formation of economic categories; relational production; symbolic abundance; representational instability; classification; authenticity; provenance; epistemic trust; access to generative conditions.
- **Important passages:** Section 1.14, "Symbolic Abundance and Representational Crisis," pp. 78–83; especially symbols and referents (§1.14.2), administrative classification (§1.14.3), authenticity/provenance/trust (§1.14.4), and coordination under representational instability (§1.14.5).
- **Terminology and notation:** The section title uses "representational crisis." The user's programme motivation uses "symbolic crisis"; this is a motivation-level connection, not an alteration of the manuscript title or terminology. The cited section develops conceptual distinctions rather than a record encoding.
- **Relevant programme documents:** Programme Brief; GR-100/110/140/150/200/210/400; epistemic and institutional work planning.
- **Supersedes / revised by:** No verified supersession relationship.
- **Known tensions or ambiguities:** Authenticity, provenance, trust, and truth are distinct. Representational crisis includes sincere category mismatch as well as fabricated representations. Verification infrastructure can itself concentrate power; provenance alone does not settle the represented claim.

- **Notes for contributors:** Use the chapter for motivation and problem framing. Its historical account does not itself supply adopted recording requirements or establish compatibility with external standards mentioned in the text.

114.1.4 FM-002 — Constitution and Research Programme of Generative Relational Economics — `complete_first_draft` file

- **File:** GRE_Chapter_03_complete_first_draft.pdf, 241 pages.
- **Author:** Wanhong Huang, as recorded in PDF metadata.
- **Date:** Publication/manuscript date unknown.
- **Version/status:** "Complete first draft" is the filename label; independent editorial/publication status unknown.
- **Primary concepts:** GRE's relation to broader GR theory; four primitive distinctions; plural methods; generative effects; epistemic commitments; praxis; evaluation; power; research programme revision.
- **Important passages:** Primitive structure (§3.3, pp. 22–34); praxis (§3.12, pp. 128–139); evaluation and normative orientation (§3.13, pp. 139–151); competing accounts of generativity (§3.19.8, p. 206 onward).
- **Terminology and notation:** Change, structure, constraint, and difference are a minimal analytical vocabulary under ontological suspension. These are not six record classes or four required database fields. Generativity has several related formulations whose equivalence is not presumed.
- **Relevant programme documents:** Programme Brief; GR-100/110/200/210/400; praxis, evaluation, and policy-proposal planning; technical reports.
- **Supersedes / revised by:** Related to FM-003; formal supersession is OPEN. Retain separate citations.
- **Known differences:** This file's §3.2 has eight problem families; its summary on p. 22 says so. FM-003 contains an additional subsection on access to generative capacity and conditions. Section pagination differs throughout.
- **Notes for contributors:** Preserve this formulation when tracing conceptual development. A complete comparison of the two Chapter 3 files remains OPEN; the identified difference is not asserted to be the only difference.

114.1.5 FM-003 — Constitution and Research Programme of Generative Relational Economics — unqualified filename

- **File:** GRE_Chapter_03.pdf, 243 pages.
- **Author:** Wanhong Huang, as recorded in PDF metadata.
- **Date:** Publication/manuscript date unknown.
- **Version/status:** Chapter 3; no verified edition or formal publication status. The shorter filename does not establish finality.
- **Primary concepts:** Disciplinary constitution; access to generative capacity and conditions; four primitive distinctions; orientations of generation; epistemic commitments; praxis; normative evaluation; internal pluralism.
- **Important passages:** Access to generative capacity and conditions (§3.2.3, p. 15); primitive structure (§3.3, pp. 23–34); orientation of generation (§3.9, pp. 94–104); praxis (§3.12, pp. 129–141); evaluation (§3.13, pp. 141–152); competing accounts of generativity (§3.19.8, p. 208 onward).
- **Terminology and notation:** The four primitive distinctions remain analytical dimensions. Praxis identifies iterative diagnosis, intervention, tracing, feedback, revision, and possible withdrawal, reversal, or repair; it explicitly does not impose one mandatory sequence on every practical problem.
- **Relevant programme documents:** Programme Brief; GR-100/110/200/210/400; praxis and evaluation work; policy and institutional proposals.
- **Supersedes / revised by:** Related to FM-002; formal supersession is OPEN.
- **Known differences and limits:** Section 3.2 contains nine problem families, including the access subsection absent from FM-002's corresponding list. Generation is not intrinsically beneficial (§3.10, p. 115; §3.13). Access to outputs and access to the conditions of generation are distinguishable concerns.

- **Notes for contributors:** Cite the precise file and section. Treat the additional access emphasis as an observed variant, while leaving authorial precedence and wider editorial differences unresolved.

114.1.6 FM-004 — The Ontological View of Generative Relational Theory

- **File:** GRE_Chapter_04.pdf, 183 pages.
- **Author:** Wanhong Huang, as recorded in PDF metadata.
- **Date:** Publication/manuscript date unknown.
- **Version/status:** Chapter 4; formal publication/revision status unknown.
- **Primary concepts:** Ontological, relational, and manifestational reality; ontological suspension; manifestation relations; non-invertibility; symbolization; recursive effects of representation; scale and historical categories.
- **Important passages:** Three registers (§4.2, pp. 11–19); ontological suspension (§4.3, pp. 19–27); manifestation and its mappings (§§4.6–4.9, pp. 43–74); symbolization and recursion (§§4.10–4.11, pp. 74–89); reality, access, and epistemic reconstruction (§4.22, pp. 172–180).
- **Terminology and notation:** `M_C: X ↠ Y` (Equation 4.1, p. 65) denotes a general manifestation mapping under conditions `C`. Deterministic, stochastic, partial, multivalued, and historically variable realizations remain open. It is not a universal single-valued function or proposed interchange syntax.
- **Relevant programme documents:** GR-100/110/120/140/200; epistemic architecture; formal-semantics technical reports. Its treatment of institutional reality informs questions for GR-300/400 without establishing legal effect.
- **Supersedes / revised by:** No verified supersession; conceptually informs FM-005's epistemology.
- **Known tensions or ambiguities:** The three registers answer different analytical questions; they are not three substances, exclusive object bins, or an obligatory temporal pipeline. Relational reality can precede recognition, while a manifestation can later alter relational reality. Ontological suspension preserves weaker warranted claims and does not entail denial.
- **Notes for contributors:** Do not implement the registers as mutually exclusive record classes without a separately argued operational decision. Distinguish a target, its manifestation, a record of that manifestation, and a claim about it.

114.1.7 FM-005 — Epistemology of Generative Relational Economics

- **File:** GRE_Chapter_05_Complete_First_Draft.pdf, 196 pages.
- **Author:** Wanhong Huang, as recorded in PDF metadata.
- **Date:** Publication/manuscript date unknown.
- **Version/status:** "Complete First Draft" is the filename label; independent editorial/publication status unknown.
- **Primary concepts:** Mediated access; inverse problems; trace and evidence; performative representation; partial observation; boundary and scale; identity; generative attribution; historical reconstruction; uncertainty; epistemic justice; machine mediation; revisability.
- **Important passages:** Inverse problem (§5.2, pp. 13–20); trace/evidence (§5.4, pp. 28–36); performative representation (§5.6, pp. 44–53); generative attribution and trajectories (§§5.13–5.14, pp. 105–122); evidence and uncertainty (§§5.15–5.17, pp. 122–150); epistemic justice (§5.18, pp. 150–160); machine mediation (§5.19, pp. 160–168); revisability (§5.20, pp. 168–176).
- **Terminology and notation:** `K(y | C, E, A)` (Equation 5.1, p. 14) is an epistemically admissible compatibility set given manifestation `y`, conditions `C`, evidence `E`, and auxiliary assumptions `A`. Compatibility is not assumed to be numerical or probabilistic. Definitions 5.159–5.167 distinguish revisability, provisional maps, evidence updates, intervention-sensitive revision, historical revision, and category revision.
- **Relevant programme documents:** GR-100/110/120/140/150/160/200/210; claim/evidence, contestation, revision, and institutional praxis work in GR-400. Procedural questions inform GR-310 only with a separately identified institutional or legal basis.

- **Supersedes / revised by:** No verified supersession. Develops epistemic questions following FM-004 without replacing its distinctions.
- **Known tensions or ambiguities:** Manifestation does not uniquely identify its source; availability of a record does not establish warrant. Changes in the target world, evidence, and descriptive categories require distinguishable histories. Epistemic justice retains evidential standards while examining unequal conditions for producing, preserving, interpreting, and contesting evidence.
- **Notes for contributors:** Operational claim types and metadata are proposals to test against these distinctions, not adopted definitions of knowledge or truth. Preserve alternative explanations and the difference between discovery and intervention-produced change.

114.1.8 FM-006 — A Metamodel for Ontologically Heterogeneous Social Dynamics, Part I: The Highest Abstract Layer

- **File:** A METAMODEL FOR ONTOLOGICALLY HETEROGENEOUS SOCIAL DYNAMICS-I.pdf, 13 pages.
- **Author:** Wanhong HUANG, as displayed on the opening page.
- **Date:** Publication/manuscript date unknown.
- **Version/status:** Part I of a series; formal publication/revision status unknown.
- **Primary concepts:** Bare carrier; mechanism composition; action; congruence; collapse of distinctions; conditional irreversibility; limitations of a fixed carrier.
- **Important passages:** Primitives and axioms (§3, pp. 5–6); conditional propositions (§4, pp. 6–8); limitations (§7, pp. 10–11).
- **Terminology and notation:** Carrier S; mechanism semigroup M; action α; congruence $\sim$; collapse set $\Delta(m)$. The tilde here is a plain-text transcription of the PDF's equivalence symbol. These mathematical elements are weaker than semantically articulated Entity, State, Event, or Process records.
- **Relevant programme documents:** GR-100 architecture boundaries; metamodel/ontology comparison and formal-semantics technical reports; loss and abstraction research.
- **Supersedes / revised by:** Continued and qualified by FM-007; no wholesale replacement is inferred.
- **Known tensions or ambiguities:** A fixed carrier and congruence permit analysis of collapse but do not generate new states or distinctions (§7). Broad abstract/concluding wording about absence of identities and inverses differs from the precise axiom's "not assumed" formulation. Interpretation of congruence as preservation of socially valuable distinctions needs care; FM-007 explicitly separates mathematical preservation of equivalence from normative protection of differences.
- **Notes for contributors:** Theorems hold under stated assumptions; they are not empirical laws of every social history. Do not use the collapse construction as a complete formal definition or universal score of generativity.

114.1.9 FM-007 — A Metamodel for Ontologically Heterogeneous Social Dynamics, Part II: Modeling Six Categories of Social Facts

- **File:** A Metamodel for Ontologically Heterogeneous Social Dynamics-II.pdf, 92 pages.
- **Author:** Wanhong HUANG, as displayed on the opening page.
- **Date:** Publication/manuscript date unknown.
- **Version/status:** Explicitly marked DRAFT in the PDF; formal publication status unknown.
- **Primary concepts:** Six analytical categories; entity reidentification; relation formation; event occurrence; partial attributes; state sufficiency; process histories; continuation semantics; coordination; formation/description/uptake; regime changes; empirical revision obligations.
- **Important passages:** Scope (p. 2); precise base assumptions (§3, pp. 10–16); six categories (§§7–12, pp. 26–61); coordination (§15, pp. 71–75); philosophical scope (§16, pp. 75–78); regime changes (§17, pp. 78–83); prospective research design (§19, pp. 87–90).

- **Terminology and notation:** Entity, Relation, Event, Attribute, State, Process. Base notation includes S, M, α, ~, quotient Q, observation o, retained description ρ, appearance indices I, and identity equivalence E (Table 1, p. 13). Distinct equivalence constructions have different roles; use of the same mathematical structure does not equate them.
- **Relevant programme documents:** GR-100/110/120/150/200/210; identity, event, process, missingness, migration, and formal-semantics work; pilot design.
- **Supersedes / revised by:** Continues FM-006 with explicit assumptions and enrichments. Does not establish exhaustive formalization of emergence or empirical validity of every construction.
- **Known tensions or ambiguities:** The six categories are an overlapping selected analytical repertoire, with exhaustiveness and metaphysical priority left open (p. 2). "Attribute" differs from the programme's current "Property." Identities and inverses are permitted without being required (§3.4). Declared regime families do not by themselves account for unanticipated novelty. Equal behavior does not establish entity identity, and equal endpoints do not establish equal histories.
- **Notes for contributors:** Use the counterexamples and prospective research design to identify losses in a recording proposal. The finite examples are declared constructions, not completed empirical pilots. Record a decision before translating Attribute into Property or turning selected analytical roles into exclusive schema types.

114.1.10 3. Open source questions

1. **OPEN — Editorial chronology:** Obtain explicit version, date, and supersession declarations for the GRE chapters and both Chapter 3 files. Build timestamps alone do not settle these questions.
2. **OPEN — Comparative collation:** Document the full substantive differences between FM-002 and FM-003; preserve the verified eight/nine problem-family difference.
3. **OPEN — Property / Attribute:** Decide whether these are equivalent within a stated operational scope, different concepts, or a terminology change. Retain current programme terminology pending a recorded decision.
4. **OPEN — Formal scope:** Keep Part I's fixed-carrier limits, Part II's declared-regime extensions, and the GRE chapters' broader account of emergence distinct until a justified relationship is documented.
5. **OPEN — Preservation:** Clarify the relationship between formal preservation of equivalence, loss of a represented distinction, archival retention, and normative reasons to preserve a distinction.

Programme-level disposition belongs in open questions and, where a design choice changes architecture, a decision record. This register preserves source differences; it does not resolve them by editorial harmonization.

115 README

Original source: `foundation_manuscripts/README.md`.
Original source SHA-256: `9414901035fb732c0adef53e6591a89f40008d2f1faf1ed605221c158a579411`.

115.1 Foundation Manuscripts

This folder is the project-local source corpus for Generative Relational (GR) theory and related foundational work.

115.1.1 Purpose

Foundation manuscripts are used to:

- preserve the conceptual history of GR;
- provide source-grounded definitions, distinctions, notation, and examples;
- help agents maintain consistency across standards, manuals, technical reports, and schemas;
- expose tensions, revisions, and unresolved differences between manuscripts rather than silently smoothing them away.

115.1.2 What belongs here

Copy foundational GR works into this folder, including, where relevant:

- metamodel papers;
- ontology and relation papers;
- generativity / generativity-return works;
- trust, criticality, and relational-reality works;
- historiographical justice and archive-related works;
- political-philosophy foundations;
- theoretical notes that materially define GR terminology.

PDF, Markdown, TeX, and plain-text sources are all acceptable.

115.1.3 Source status

Foundation manuscripts are **conceptual source material**, not automatically normative standards.

A statement in a manuscript does not become a standards requirement merely because it appears here.

When developing a standard:

1. consult relevant foundation manuscripts;
2. preserve terminology and distinctions where feasible;
3. identify conflicts or historical changes;
4. record deliberate departures;
5. translate theory into normative language only through an explicit standards decision.

115.1.4 Precedence

For this repository, use the following precedence when conflicts occur:

1. applicable governance directives for process;
2. published normative standards for conformance;
3. accepted architecture decision records (ADRs);
4. foundation manuscripts for GR conceptual interpretation;
5. active working drafts and planning notes;
6. informal examples and exploratory material.

A later standard may intentionally define a narrower operational term than a foundation manuscript. Such divergence should be documented rather than hidden.

115.1.5 Indexing

After adding manuscripts, update `MANIFEST.md`.

For each manuscript, record:

- filename;
- title;
- date/version;
- status;
- principal concepts;
- notation;
- relevant standards;
- known tensions with other manuscripts;
- whether later work revises it.

115.1.6 Consistency rule

Agents should never infer that two manuscript formulations are equivalent merely because they sound similar. Preserve differences until an explicit decision resolves them.

116 directives part 1

Original source: `governance/directives_part_1.md`.
Original source SHA-256: `0e77b1a9ced1578fc09dda334da2a02b7d156d4d56bf763bd442e25aacc9a85c`.

116.1 Directives Part 1

> **Developed draft available:** Working Draft 0.3 source and compiled PDF. The Markdown outline below is retained as historical planning context; its candidate choices are not adopted. Current requirements and unresolved decisions are in the TeX draft. ### Procedures for the Development and Maintenance of Standards

Status: Skeleton
Planned clauses:

1. Scope
2. Terms and definitions
3. Organizational bodies
4. Membership and participation
5. New work proposals
6. Project approval
7. Working drafts
8. Committee review
9. Public review
10. Comment disposition
11. Consensus
12. Ballots and approval
13. Publication
14. Corrections and corrigenda
15. Amendments
16. Revision
17. Periodic review
18. Withdrawal
19. Appeals and complaints
20. Conflicts of interest
21. Records and transparency
22. Intellectual property
23. External liaison
24. Emergency and expedited procedures
25. Archival preservation of standards-development records

117 directives part 2

Original source: `governance/directives_part_2.md`.
Original source SHA-256: `34589bd9830ac4a957902c5c23b44a4821130e58d473abed2e18e5ab91f0652b`.

117.1 Directives Part 2

> **Developed draft available:** Working Draft 0.3 source and compiled PDF. The Markdown outline below is retained as historical planning context; its candidate choices are not adopted. Current requirements and unresolved decisions are in the TeX draft. ### Rules for the Structure and Drafting of Standards

Status: Skeleton
Planned clauses:

1. Scope
2. Normative language
3. Document architecture
4. Titles and numbering
5. Scope clauses
6. Terms and definitions
7. Requirements
8. Recommendations
9. Permissions
10. Notes and examples
11. Figures and tables
12. Mathematical notation
13. References
14. Normative and informative annexes
15. Conformance clauses
16. Profiles
17. Machine-readable artifacts
18. Version identifiers
19. Deprecation and supersession
20. Drafting for translatability and long-term interpretation

118 founding agreement template

Original source: `governance/founding_agreement_template.md`.
Original source SHA-256: `7ab0b232ad2cbc6d3921477eac51582eecf11d80687639fff10eebc7335c515d`.

118.1 Founding Agreement and Governance Adoption Record

Document class: Informative governance template
Status: PROVISIONAL — unsigned proposal; no adoption, appointment, or institutional commitment
Version: 0.1
Responsible editor: UNASSIGNED
Source: `governance/founding_agreement_template.md`
Historical draft basis (0.1): Standards Programme Charter, version 0.1, CH-001–CH-002 and CH-036–CH-041; Directives Part 1, version 0.1, D1-004–D1-008.

The template remains an initial 0.1 aid. The expanded 0.2 normative schedules govern any assessment against 0.2; completing this template alone does not cover their additional obligations.

This template records actual founding capacities, review, and express commitments. It neither supplies legal authority nor creates a legal entity. Draft completion, insertion of a name, or a rehearsed signature is not agreement. Actual signatories review the organizational and legal context of their commitments before execution.

118.1.1 1. Record identity and scope

- Proposed agreement identifier, version, and source revision:
- Record type: `UNSIGNED PROPOSAL` / `SYNTHETIC REHEARSAL` / actual executed record:
- Programme name and bounded publication/resource scope:
- Proposed effective date/time and time zone:
- Organizational form and jurisdictional context: `OPEN`:
- Separate legal review needed and scope:
- Custodian and public/protected locations: `UNASSIGNED`:

118.1.2 2. Founding basis and authority

Prospective signatory	Actual capacity	Resources/ functions within authority	Evidence and limits	Proposed commitment	Relevant interests
`UNASSIGNED`	`[individual/authorized representative]`	`[bounded scope]`	`[basis and unresolved matters]`	`[express commitment]`	`[disclosure]`

- Basis on which these persons can establish the proposed arrangements:
- Resources, rights, or functions needing another person's agreement:
- Institutional representation claimed and exact mandate:
- Constituencies consulted, separate from constituencies represented:
- Limits on professional, geographic, governmental, or international authority:

A signature does not bind an employer, community, institution, or rights holder beyond the signatory's actual authority. No ISO, IEC, IEEE, WTO, governmental, or international-organization endorsement is implied.

118.1.3 3. Exact governance package proposed for adoption

Instrument	Exact version/ revision	Canonical source and reviewed rendering	Integrity reference	Proposed scope/ exclusions
Programme Charter	`[version]`	`[source/PDF]`	`[hash or immutable revision]`	`[scope]`
Directives Part 1	`[version]`	`[source/PDF]`	`[reference]`	`[scope]`
Directives Part 2	`[version]`	`[source/PDF]`	`[reference]`	`[scope]`
GR/TC 1 Charter	`[version]`	`[source/PDF]`	`[reference]`	`[scope]`
Ethics, Conflict-of-Interest, and Contribution Rights Policy	`[version]`	`[source/PDF]`	`[reference]`	`[scope; unresolved rights terms]`
Supporting records/review/ maintenance arrangements	`[version]`	`[source]`	`[reference]`	`[scope]`

- Conflict/dependency review and dispositions:
- Rights basis for distributing the review package:
- Operative contribution/publication terms, or bounded treatment while OPEN:
- Artifacts excluded from adoption:
- Existing authority/status retained by plans, foundation manuscripts, and technical drafts:

Adopting this package does not automatically approve GR/NWIP-001, adopt a technical Standard, authorize an external pilot, relicense manuscripts, or establish patent assurances.

118.1.4 4. Founding review announced before execution

Prospective signatories explicitly propose to apply the review, disposition, reply, and material-change periods in the identified draft Directives Part 1 as conditions of this founding process. This declaration does not assume the draft Directives already have adopted authority.

- Notice identifier and exact package revision:
- Review administrator and accepted mandate: `UNASSIGNED`:
- Announcement and accessible draft locations:
- Public/protected comment routes, tested access, and handling limits:
- Opening and closing timestamps, with time zone:
- Duration check against D1-019 in the identified draft edition:
- Outreach to affected interests, expertise, and potential contributors:
- Access/language/accommodation requests, interruptions, extensions, and revised dates:
- Comment register and reasoned dispositions:
- Reply notices/deadlines and replies considered under D1-023:
- Material changes and re-review under D1-025–D1-026:
- Remaining objections, evidence, reasons, and effect on execution:

A synthetic review supplies rehearsal evidence; it does not complete the actual founding public review proposed in CH-036.

118.1.5 5. Rehearsal and independent assessment

- Rehearsal record and exact draft versions:
- Synthetic actors/evidence identified:
- Scenarios exercised: scoped proposal, sustained objection, recusal, protected report, appeal, material change, correction, withdrawal, and continuity:
- Failures, burdens, revisions, and remaining capacity gaps:
- Independent founding-process reviewer: `UNASSIGNED`:
- Accepted mandate, competence, involvement, interests, and independence assessment:
- Evidence examined, findings, limits, and corrective actions:
- Action owners, completion evidence, and remaining blockers:
- Readiness determination within the reviewer’s scope, separate from truth or legal-validity claims:

An unfilled reviewer field or self-review is not independent assessment.

118.1.6 6. Accepted roles and bounded delegation

Function	Proposed holder	Appointing basis/limits	Accepted mandate/ date	Term/review date	Alternate/ vacancy route	Conflicts/ management
Founding authority/ signatories	UNASSIGNED	[actual basis]	NOT ACCEPTED	[date]	[route]	[record]
Programme decision/ governance authority	UNASSIGNED	[scope]	NOT ACCEPTED	[date]	[route]	[record]
Coordinator/ records custodian/ Secretariat	UNASSIGNED	[scope]	NOT ACCEPTED	[date]	[route]	[record]
GR/TC 1 convenor	UNASSIGNED	[scope]	NOT ACCEPTED	[date]	[route]	[record]
Review chair	UNASSIGNED	[particular review]	NOT ACCEPTED	[date]	[route]	[record]
Editors/work-item leads	UNASSIGNED	[deliverable]	NOT ACCEPTED	[date]	[route]	[record]
Neutral procedural/ appeal reviewer	UNASSIGNED	[scope]	NOT ACCEPTED	[date]	[independent alternate]	[record]
Ethics contact and alternate	UNASSIGNED	[scope]	NOT ACCEPTED	[date]	[protected route]	[record]
Rights-review contact	UNASSIGNED	[scope]	NOT ACCEPTED	[date]	[route]	[record]
Release/ maintenance owners	UNASSIGNED	[artifacts]	NOT ACCEPTED	[date]	[route]	[record]

- Combined functions and resulting limits:
- Roles needed immediately versus later, with reasons:
- Appointment, renewal, response, removal, and neutral-review procedure:
- Decision authority succession/replacement route:
- Available independent-review arrangement and tested contact:
- Resources, funding/in-kind support, infrastructure control, and conditions:

118.1.7 7. Decision eligibility and appointments

- Nominations notice and closing timestamp:
- Announced competence or affected-perspective criteria:
- Expected review commitment and actual accepted roles:
- Affiliations, interests, and institutional mandates:
- Proposed roster and one-person/declared-capacity record:
- Reasons for selection/exclusion against announced criteria:
- Concentrated interests, missing perspectives, and corrective measures:
- Eligibility challenges, impartial handling, and dispositions:
- Roster freeze and subsequent correction/restart rules:

The founding agreement records express commitments by its actual signatories. Later decisions use the adopted delegation and applicable ballot rules; founding signatures do not substitute for technical approval ballots.

118.1.8 8. Disposition and reasons before signatures

Current disposition: PENDING — UNSIGNED.

□ Ready for execution of the specifically identified commitments.

□ Return for revision and further review.

□ Defer pending authority, rights, or capacity gaps.

□ Do not proceed, with reasons.

- Issue, alternatives, selected direction, and rationale:
- Remaining dissent and its treatment:
- Exact amendments and affected records:
- Evidence addressing CH-028 and CH-036–CH-041:
- Unmet conditions and effect on adoption/dependent action:
- Preliminary work that can continue:

118.1.9 9. Express agreement and actual execution

Proposed agreement text for review:

> Within the authority and limits recorded for me in this instrument, I expressly agree to the listed programme commitments and identified governance editions. My agreement extends only to that recorded scope. Effective arrangements, remaining limitations, and accepted delegated roles are those stated in this instrument. My signature represents no unrecorded institution, rights holder, or constituency.

Actual signatory	Capacity/ authority reference	Exact agreement/package revision	Agreement/ signature reference	Actual date/ time	Reservations and accepted treatment
`UNASSIGNED`	`[record]`	`[revision]`	`UNSIGNED`	`[blank until execution]`	`[scope]`

- Execution verification and responsible custodian:
- Effective date/conditions actually satisfied:
- Declined or absent agreement, without treating silence as assent:
- Public notice and protection of signature evidence:

Do not record a person’s signature, approval, or date without actual assent. Synthetic signatures remain explicitly synthetic and have no adoption effect.

118.1.10 10. Transition and accountability

- First governance review date and annual-account owner:
- Further decisions needed before formal project initiation:
- Review/appeal route for founding procedure and appointments:
- Amendment procedure and treatment of ongoing decisions:
- Existing drafts, open comments, restricted material, and contribution-term transition:
- Continuity, vacancy, suspension, and closure arrangements:
- Public links among prior drafts, reasons, executed edition, and later amendments:

Recording check: Status labels reflect actual events; unassigned roles remain visible; drafting, review, agreement, project initiation, technical adoption, and external authorization remain separately recorded.

119 standards programme charter

Original source: `governance/standards_programme_charter.md`.
Original source SHA-256: `5242f3c7c04abf30dd3929537a58cea4fabe7df6ec073d5a3593d75a0724171b`.

119.1 Standards Programme Charter

> **Developed draft available:** Working Draft 0.3 source and compiled PDF. The Markdown outline below is retained as historical planning context; its candidate choices are not adopted. Current requirements and unresolved decisions are in the TeX draft.

Status: Working outline

119.1.1 1. Mission

Develop and maintain open, rigorous, interoperable standards concerning the recording, preservation, presentation, and exchange of generativity-related information.

119.1.2 2. Principles

The programme should pursue:

- openness;
- transparency;
- procedural fairness;
- traceability;
- stakeholder participation;
- technical coherence;
- implementability;
- revisability;
- respect for privacy and access constraints.

119.1.3 3. Publications

The programme may issue:

- Standards;
- Technical Specifications;
- Technical Reports;
- Manuals and Guides;
- Schemas and validation artifacts;
- Corrigenda and Amendments.

119.1.4 4. Governance bodies

- Standards Council
- Technical Committees
- Working Groups
- Editors
- Project Leads
- Reviewers and Observers

119.1.5 5. Decision principle

Consensus is the preferred basis for technical adoption. Voting procedures, objection handling, appeals, and escalation shall be defined in Directives Part 1.

119.1.6 6. Maintenance

Published standards remain subject to review, confirmation, amendment, revision, supersession, or withdrawal.

120 technical committee charter

Original source: `governance/technical_committee_charter.md`.
Original source SHA-256: `ad24189fedf14e403ad5e3046e86ee2de2799c53093bb201f7bd74666de54624`.

120.1 GR/TC 1 Charter

> **Developed draft available:** Working Draft 0.3 source and compiled PDF. The Markdown outline below is retained as historical planning context; its candidate choices are not adopted. Current requirements and unresolved decisions are in the TeX draft. ### Generativity Records and Infrastructure

Status: Draft

120.1.1 Scope

Standardization of conceptual models, recording requirements, data models, interchange formats, presentation requirements, preservation/access rules, and conformance methods for records of generativity.

120.1.2 Exclusions

The committee does not, by default:

- define a complete metaphysics of generativity;
- certify substantive historical interpretations as true;
- require one software platform;
- require public disclosure of all recorded material.

120.1.3 Initial working groups

- WG 1 — Foundations and Ontology
- WG 2 — Recording Model
- WG 3 — Data and Interoperability
- WG 4 — Presentation and Reconstruction
- WG 5 — Ethics, Privacy, and Preservation
- WG 6 — Conformance and Implementation

121 GR M101 recording manual

Original source: `manuals/GR-M101-recording-manual.md`.
Original source SHA-256: `ccf47f80ee7966b6307d496b45f0d220208aafa64365bd77c96fb8cb9ac55b1e`.

121.1 GR-M101 — Recording Manual

Status: Placeholder

This manual will provide non-normative guidance for applying GR-110 in everyday research, collaborative projects, AI-assisted work, and institutional settings.

Planned contents:

- choosing record granularity;
- recording events without over-interpreting them;
- preserving branches;
- logging contingent encounters;
- recording uncertainty;
- recording retrospective reinterpretation;
- minimal vs deep recording;
- privacy-aware practice;
- worked examples.

122 README

Original source: `policy_proposals/README.md`.
Original source SHA-256: `64b817d2bc1dc2eec6b439986c4d4fbc2b6965e36fd944cbb5e4c2015d6824df`.

122.1 Policy Proposals Programme

This directory contains policy-oriented publications derived from the Generativity Standards Program.

122.1.1 Purpose

The standards programme may generate proposals for international organizations, public institutions, universities, archives, research funders, and other governance actors.

These documents are separate from normative technical standards.

122.1.2 Possible publication types

- Policy Brief
- Institutional Proposal
- Model Governance Framework
- Pilot Programme Proposal
- Capacity-Building Proposal
- Model Clause / Model Procedure
- Consultation Paper
- Discussion Paper

122.1.3 Relationship to standards

A policy proposal may recommend:

- piloting a GR standard;
- establishing generativity-record requirements in a programme;
- creating interoperable archival infrastructure;
- adopting provenance or contestation procedures;
- testing rights of correction or annotation;
- creating international research or cultural-preservation initiatives.

A policy proposal should identify which parts are:

- descriptive background;
- normative proposal;
- legal analysis;
- implementation option;
- unresolved question.

122.1.4 Neutrality and plurality

Policy documents should distinguish factual description, analysis, value judgments, and proposed institutional choices.

Where reasonable alternatives exist, they should be presented clearly enough for decision-makers to evaluate them.

122.1.5 Publication classes

For international-facing work, use one of the following where appropriate:

- **GR-IPP** — International Policy Proposal
- **GR-IIP** — International Institutional Proposal

These are distinct from Specifications and Standards. They are recommendatory and deliberative rather than conformance documents.

123 README

Original source: `policy_proposals/international_organizations/README.md`.
Original source SHA-256: `0368c1f17564de0b4411b1dfcef5ea1c84801c34bfa49c90f4534379b38e4782`.

123.1 International Organizations

This folder is reserved for policy proposals aimed at or relevant to international organizations.

Potential themes include:

- international standards for generativity records;
- research-integrity and AI provenance;
- cultural and scientific archives;
- institutional memory;
- transnational interoperability;
- AI-assisted decision records;
- future-generations access and preservation;
- capacity-building for under-resourced institutions;
- governance of contested records;
- model procedures for annotation, correction, and restricted access.

Proposals should be adapted to the mandate and legal authority of the intended organization rather than assuming one universal institutional model.

124 policy brief template

Original source: `policy_proposals/templates/policy_brief_template.md`.
Original source SHA-256: `0a6f8aaea14ac95ed55772b48031b8a49f72c374013f6cdd4c9cafb1f59c3b97`.

124.1 Policy Brief Template

124.1.1 Title

124.1.2 Intended institution / audience

124.1.3 Executive summary

124.1.4 Problem

124.1.5 Why the issue matters

124.1.6 Current institutional context

124.1.7 Proposed objective

124.1.8 Policy options

124.1.9 Option A

124.1.10 Option B

124.1.11 Option C

124.1.12 Comparative considerations

124.1.13 Legal and mandate considerations

124.1.14 Standards / technical infrastructure implications

124.1.15 Governance implications

124.1.16 Implementation pathway

124.1.17 Pilot design

124.1.18 Risks and safeguards

124.1.19 Monitoring and evaluation

124.1.20 Open questions

124.1.21 Sources

125 README

Original source: `publications/README.md`.

Original source SHA-256: `d40e4a76f4fceb01a0ee8e41bbe7042f9915a5f1c46e64893341eb94e86c5cfb`.

125.1 Validation-revised working-draft package

Document class: Informative publication and build guide
Status: PREPARATORY; version 0.3; 2026-09-22. All nine documents are working drafts, not adopted governance or Standards. Formal work-item approval remains pending.

The package develops the comprehensive plan into detailed requirements, responsibilities, procedures, semantic and assessment schedules, and worked examples. Read the Programme Brief for purpose and ADR-0006 for this validation-driven revision. The external model comparison explains the distinct roles of ISO, IEEE, ITU and UN guidance.

Every document has formal front matter, numbered scope/references/definitions, technical or institutional clauses, explicitly normative/informative annexes, and a bibliography. The substantive validation dossier records review of all 753 baseline IDs, bounded P0/P1 assessments, supported corrections and remaining evidence gaps. The 0.1 and 0.2 archives preserve earlier editions; the 0.2 to 0.3 change register identifies retained, revised and new provisions.

Draft	Editable source	Compiled review copy	Pages
Standards Programme Charter	TeX	PDF	19
Directives Part 1 — Development and Maintenance	TeX	PDF	28
Directives Part 2 — Structure and Drafting Rules	TeX	PDF	26
GR/TC 1 Charter	TeX	PDF	17
Ethics, Conflict-of-Interest, and Contribution Rights	TeX	PDF	22
GR-100 — Foundations and Vocabulary	TeX	PDF	30
GR-110 — Generativity Recording Requirements	TeX	PDF	28
GR-200 — Epistemic Recording Framework	TeX	PDF	32
GR-210 — Evidence, Interpretation, and Contestation	TeX	PDF	24

The TeX files are the substantive authoring sources for these editions. Earlier Markdown outlines remain preserved with links to their developed drafts. The PDF filenames are build identifiers, not new adopted publication codes. Generated files live in ignored `build/`; a fresh checkout needs compilation before the PDF links work.

The graph pilot additionally develops bounded preparatory Markdown Working Drafts GR-120, GR-130, GR-140 and GR-160, plus experimental GR-SPEC-120 and GR-SPEC-130. They are separate from this nine-document build and have not been promoted to adopted Standards or included in its 0.3 PDF assessment.

Useful accompanying material:

- P1/v2 contested-decision dossier: explicit claims, grounds, issue/action tracks, view limits and partial component results.
- Substantive review and assessment matrix; historical 0.2 review and 0.1 review.
- P0/v2 governance rehearsal: 18 executed arithmetic cases and detailed synthetic procedural traces.
- Revision regression cases and readiness/burden evidence.
- NWIP template, comment/disposition template, and founding agreement template.

- Requirement assessment template: individual applicability, evidence, results and counterexamples.
- Open questions, including actual authority, participation, rights terms, profiles and pilot capacity.

Original P0/P1 and the initial templates retain their historical 0.1 basis. New P0/v2 and P1/v2 assess the fixed 0.2 baseline; the revision cases examine the corrected 0.3 distinctions. None establishes full institutional conformance. Current normative schedules identify the information needed for an assessment of this edition.

125.1.1 Build

Requirements: Python 3.10+, `latexmk`, LuaLaTeX, and the TeX packages/fonts named in the preamble. These are available in the current `Ubuntu-24.04` WSL environment. No packages or external sources are downloaded by the build script.

From this directory's repository root, in PowerShell:

```
python tools/build_publications.py --wsl Ubuntu-24.04
```

Or inside WSL, from the repository root:

```
python3 tools/build_publications.py
```

To rebuild one document, append `--document GR-110` (repeatable). Full builds write `build/publications/build-report.json`; selected builds write `build-report-selected.json`. The reports identify source/preamble/PDF hashes, compiler outcomes, LaTeX/package warnings and nonblocking underfull-line spacing advisories. An old successful PDF can remain after a later failed build: check the current report and hashes before using it.

For source/PDF requirement coverage and report freshness, from Windows with `pypdf` installed:

```
python tools/check_publications.py
```

The checker also examines formal opening clauses, declared front matter, annex roles, local references, captions, archive hashes and retention of historical requirement IDs. To regenerate the text change register:

```
python tools/compare_publication_requirements.py --baseline 0.2
```

To check the fixed 0.2 review matrix, fixture identifiers/locators and finite ballot expectations, run `python tools/check_validation_package.py`. This does not automatically evaluate manuscript interpretation, factual warrant or procedural performance.

The build and static checks do not assess factual truth, institutional performance, legal status, user comprehension or PDF accessibility. Accessible publication targets and a tested alternative reading representation remain work before formal release. TeX sources and Markdown examples are available for review, but their availability alone establishes no accessibility conformance.

125.1.2 Suggested reading sequence

Read the Charter and Directives first, then GR-100 and GR-200, then GR-110/210 alongside P1. GR-110 and GR-210 depend on the declared GR-100/200 draft editions; GR-200 does not depend on GR-110. GR-120/130 and the Specification placeholders remain future work driven by the requirements and pilot findings. Jurisprudential and policy publications retain their separate scope and authority.

126 README

Original source: `publications/archive/0.1/README.md`.
Original source SHA-256: `5bf8846e9989ed0bf9ff8d88b53948a1916500976fca237b1d810c5412f0f7e9`.

126.1 Historical Working Draft package 0.1

Class: Source archive
Status: Historical preparatory Working Drafts; not adopted

This snapshot preserves the nine 0.1 TeX documents, their shared preamble, manifest and build/check scripts before expansion to 0.2. snapshot.json records original paths, archive paths and SHA-256 digests. The preceding review record describes the 84-page, 318-requirement package.

Sources retain their original relative paths. To reproduce this edition, run the archived build script from this archive root or use a separate copy preserving this layout. It resolves its own root and writes a separate `build/publications/` here. Do not substitute the current programme preamble: that would create a different rendering. An archived source may mention a root-level source map or manuscript that remains in the main repository; those references are documentary, not TeX inputs.

The existing local 0.1 PDFs and reports were copied to build/archive/0.1 before the current build changed. They are ignored generated artifacts, not guaranteed to be present in a fresh checkout. The new current package has a separate review and requirement change register.

127 PROGRAMME BRIEF

Original source: `publications/archive/0.2/PROGRAMME_BRIEF.md`.
Original source SHA-256: `ea14413d927e2010496c42c49066561dcb9dbee971c9b1395c8b2f349b67222a`.

127.1 Programme Brief

127.1.1 Why, What, and How We Develop the Generativity Standards

Status: Preliminary programme brief
Version: 0.4
Document class: Informative programme-level background

127.1.2 1. Purpose of this brief

This document gives a concise orientation to the Generativity Standards Program.
It answers three questions:

1. **Why** is a standards programme needed?
2. **What** is being standardized?
3. **How** will the standards be developed, reviewed, published, and maintained?

It is intended to be the first document read by new contributors, reviewers, collaborating organizations, and AI agents before they enter the more detailed governance, theoretical, or technical documents.

127.1.3 2. Why

127.1.4 2.0 Symbolic crisis, recognition, and practical action

The programme's organizing motivation is the symbolic crisis: instability in the connections among symbolic representations, their referents, institutional classifications, and practical trust. GRE Chapter 1, section 1.14, develops this diagnosis. It includes fabricated representations as well as sincere but outdated, partial, or inadequate categories. It does not imply that every representation has become unreliable.

The programme develops epistemic and practical infrastructure through which people and institutions can recognize reality, investigate factual claims, examine their grounds, contest interpretations, revise judgments and action, and preserve the trajectories through which knowledge and future possibilities develop. Archival loss and AI provenance are important components of this broader problem.

Reality, manifestation, representation, evidential warrant, institutional acceptance, and normative legitimacy remain distinguishable. Reality can precede recognition; records and classifications can also enter social relations and change what happens later. Technical conformance, authentic provenance, or institutional acceptance does not by itself establish that a substantive claim is true.

The infrastructure consequently concerns both what changes and how it becomes knowable and actionable. It also concerns who can produce evidence, challenge a classification, obtain review, and participate in shaping the conditions of future generation.

Source interpretation and proposed operational translations are recorded in the foundation traceability map. The current development proposal is the comprehensive plan.

127.1.5 2.1 The historical problem

Contemporary knowledge production increasingly leaves behind abundant outputs while preserving much less information about how those outputs became possible.

A paper may survive while the following disappear:

- the encounters that redirected the inquiry;
- the relations that enabled the work;

- the alternatives that were considered and abandoned;
- the changes in judgment that occurred over time;
- the conditions under which an idea became recognizable;
- the capacities that were created, weakened, or lost;
- the role of human, institutional, computational, and environmental contributors.

A final artifact therefore often preserves substantially less than the generative history from which it emerged.

127.1.6 2.2 The AI-era problem

AI-assisted work intensifies this problem.

A simple statement such as “AI was used” does not reveal:

- what role the AI system played;
- which materials were supplied to it;
- which outputs were selected or rejected;
- how human judgment interacted with machine-generated material;
- which later ideas depended on earlier AI-mediated encounters;
- how the trajectory changed through repeated interaction.

As automated and agentic systems become increasingly involved in research, education, policy, design, and administration, conventional provenance records may be too coarse to preserve the relevant history of generation.

127.1.7 2.3 The generativity problem

The programme is motivated by a broader GR concern: the history of a process includes more than its manifested outputs.

Of particular interest are changes in:

- available distinctions;
- relational structures;
- constraints;
- possible continuations;
- interpretive frames;
- generative capacities.

A process may produce a modest output while opening an important future trajectory. Another may produce a highly valued output while exhausting the conditions that made future generation possible.

For this reason, output history and generativity history should not be treated as equivalent.

127.1.8 2.4 The archival problem

Future observers may need to do more than retrieve an artifact.

They may need to ask:

- How did this become possible?
- Which relations mattered?
- What was known or believed at the time?
- Which alternatives were visible then?
- Which later interpretations rewrote the earlier history?
- Which possibilities remained unrealized?
- Which records are absent, restricted, lost, or destroyed?

A durable standards programme can help preserve enough structured information for later reconstruction, reinterpretation, contestation, and continuation.

127.1.9 3. What

127.1.10 3.1 Object of standardization

The programme develops standards for the recording, preservation, exchange, presentation, assessment, contestation, and revision of **generativity-related records**, and for their accountable use in inquiry and practical action.

The programme does not attempt to standardize a complete metaphysics of reality.

It develops an operational framework through which generative histories and the grounds of claims about them can be recorded in a consistent, inspectable, and interoperable form. It distinguishes changes in the situation under inquiry, changes in evidence and judgment, and changes in categories or methods of recognition.

127.1.11 3.2 Conceptual architecture

Within the wider multilayer architecture, a foundational distinction separates the following two levels.

127.1.12 Deep metamodel

The GR background emphasizes four highly abstract dimensions:

- Constraint
- Change
- Structure
- Difference

These belong to the foundational theoretical layer.

127.1.13 Operational record ontology

The standards programme currently explores six operational record classes:

- Entity
- State
- Event
- Process
- Relation
- Property

These are candidate standardized forms for recording.
They are not assumed to be ultimate ontological kinds.

127.1.14 3.3 What a generativity record may need to preserve

Depending on the profile and use case, a record may include:

- entities and participants;
- states and state changes;
- events and processes;
- relations;
- properties and observations;
- temporal information;
- provenance;
- perspective;
- epistemic status and uncertainty;
- generative conditions;
- contingent encounters;
- decisions and judgments;
- alternatives and unrealized branches;
- enabling and constraining relations;

- later reinterpretations;
- changes in available distinctions;
- changes in future possibilities;
- generativity return;
- access, privacy, restriction, and retention metadata.

127.1.15 3.4 Standards family

The programme is intended to produce a family of coordinated documents rather than one monolithic standard.

The provisional family includes:

- **GR-100 — Foundations and Vocabulary**
- **GR-110 — Generativity Recording Requirements**
- **GR-120 — Generativity Information Model**
- **GR-130 — Generativity Interchange Specification**
- **GR-140 — Generativity Presentation Requirements**
- **GR-150 — Conformance and Validation**
- **GR-160 — Preservation, Privacy, Access, and Retention**
- **GR-200 — Epistemic Recording Framework**
- **GR-210 — Evidence, Interpretation, and Contestation**
- **GR-300 — Jurisprudential Interface**
- **GR-310 — Rights, Duties, and Procedural Profiles**
- **GR-400 — Governance and Institutional Use**

These identifiers currently name preliminary standards-track projects, not adopted Standards. Their proposed coordinated scopes and dependencies appear in the comprehensive plan. Existing GR-120/130 project titles are retained; their requirements are distinguished from the implementable details in GR-SPEC-120/130. GR-SPEC-200 supports epistemic representation where draft requirements establish the need.

Supporting publications include:

- manuals;
- implementation guides;
- technical reports;
- schemas;
- validation artifacts;
- worked examples.

127.1.16 3.5 Normative and non-normative layers

The programme deliberately separates:

- **normative standards**, which define requirements, recommendations, permissions, and conformance;
- **manuals**, which provide practical guidance;
- **technical reports**, which develop theory, mathematical semantics, comparison, and experimental ideas;
- **foundation manuscripts**, which preserve GR conceptual history and source material.

This separation allows the standards to remain operational without losing contact with their theoretical foundations.

127.1.17 3A. Beyond ontology: epistemic, normative, legal, and institutional dimensions

The programme does not assume that a sufficiently detailed ontology alone can produce an adequate generativity record.

A mature framework must also specify how records are:

- known;
- evidenced;
- interpreted;
- contested;
- normatively evaluated;
- legally recognized;
- institutionally used;
- politically and economically situated.

Accordingly, the programme now treats ontology, epistemics, normativity, jurisprudence, governance, political economy, and technical implementation as interacting but distinguishable layers.

See `docs/framework/multilayer_architecture.md`.

127.1.18 3B. Dual outputs: standards and policy proposals

The programme may produce two coordinated families of public outputs:

1. **standards and technical infrastructure**, concerned with interoperable requirements, models, profiles, and conformance; and
2. **policy and institutional proposals**, concerned with how international organizations and other institutions may pilot, adopt, govern, or build capacity around these infrastructures.

Policy proposals are not themselves standards, and standards do not by themselves settle political or legal choices.

127.1.19 3C. Publication classes

The programme distinguishes three principal public-output families:

1. **Specifications** — technically precise and implementable documents that may be experimental, candidate, or stable without yet being formal Standards.
2. **Standards** — formally adopted normative publications with programme-level conformance authority.
3. **International Political / Policy Proposals** — recommendatory institutional or policy publications directed to international organizations or other transnational actors.

This distinction prevents technical precision, formal standardization, and political/institutional recommendation from being treated as the same kind of authority.

See `docs/framework/publication_taxonomy.md`.

127.1.20 4. How

127.1.21 Protocols within publication classes

A protocol describes behavior: participants, interactions, states, transitions, outcomes and failures. Protocols are technical subjects documented in Specifications or, after formal adoption, Standards. They do not create a separate publication authority class. Institutional review procedures and machine-to-machine protocols can support the same purpose while requiring different implementation and assessment methods.

127.1.22 Comparative and cross-domain development

The programme studies ISO/IEC and IEEE standards-development approaches, ITU technical publication practice, and relevant UN-system quality and institutional frameworks to inform its own proportionate procedures. The comparative study distinguishes source practices, proposed adaptations and unresolved governance choices. The drafting-model study records verified ISO, IEEE, ITU and UN sources, their different functions, and access limitations. This work does not imply affiliation, accreditation or compliance with those organizations' procedures.

The cross-domain programme connects the mission to epistemology, archival practice, jurisprudence, ethics, institutional governance, public policy, political economy and implementation. These domains contribute substantive work and review throughout development; they are not reduced to metadata fields or a final compliance check.

127.1.23 4A. Standards-first development

The default programme logic begins with the Standard.

The Standard identifies what a conforming practice should achieve. If those requirements create a need for shared technical infrastructure, the programme develops one or more Specifications.

This yields a recurring development loop:

Standard Working Draft → Specification need → Specification → pilot → revision of the Standard

The Standard and Specification may therefore co-evolve before publication.

127.1.24 4.1 Develop the standards programme before the standards

The programme first establishes the rules by which standards are created.

The initial governance layer includes:

- Standards Programme Charter;
- Directives Part 1 — Procedures for Development and Maintenance;
- Directives Part 2 — Structure and Drafting Rules;
- Technical Committee Charter;
- public review procedure;
- consensus and decision policy;
- conflict-of-interest and ethics policy;
- intellectual property policy;
- maintenance and versioning procedure;
- records and transparency policy.

This creates a defined process through which later GR standards can claim procedural consistency.

Expanded preparatory version 0.2 texts for this governance layer and GR-100/110/200/210 are available in the working-draft package, with formal document structure, detailed requirements and assessment schedules. Version 0.1 is preserved in a source archive. Drafting and compilation do not complete governance adoption or authorize formal technical project initiation. The expanded review record distinguishes completed authoring from remaining institutional and pilot evidence.

127.1.25 4.2 Development lifecycle

The provisional standards lifecycle is:

Stage	Status
00	Preliminary
10	Proposal
20	Working Draft
30	Committee Draft
40	Public Review Draft
50	Final Approval Draft
60	Published Standard
90	Review / Revision / Withdrawal

The process is intended to remain lighter than ISO while preserving comparable principles of traceability, review, versioning, and maintenance.

127.1.26 4.3 Evidence and source discipline

The programme distinguishes several kinds of authority.

- Governance directives govern the standards-development process.
- Published standards govern conformance.
- Accepted ADRs govern project architecture.
- Foundation manuscripts provide source authority for GR concepts.
- Working drafts and planning documents remain provisional.

Agents and contributors should not silently convert a theoretical statement into a normative requirement.

Where a standard intentionally narrows or operationalizes a broader GR concept, the divergence should be explicit and traceable.

127.1.27 4.4 Foundation manuscript workflow

The folder `foundation_manuscripts/` serves as the project-local GR source corpus.

When relevant manuscripts are added, contributors should:

1. index them in `foundation_manuscripts/MANIFEST.md`;
2. identify important concepts and notation;
3. record historical changes and tensions;
4. map relevant ideas to candidate standards clauses;
5. preserve disagreements and revisions;
6. create an ADR when a standards-specific interpretation materially departs from the source corpus.

127.1.28 4.5 Issue and decision traceability

Substantive changes should leave a visible record.

The preferred pattern is:

$$\text{Issue} \rightarrow \text{Alternatives} \rightarrow \text{Decision} \rightarrow \text{Rationale} \rightarrow \text{Affected documents}$$

Architecture-level decisions are recorded as ADRs.

Public-review comments should likewise record:

$$\text{Comment} \rightarrow \text{Disposition} \rightarrow \text{Rationale} \rightarrow \text{Resulting change}$$

The development process should itself exemplify the kind of generative traceability the standards seek to support.

127.1.29 4.6 Incremental implementation

The programme should avoid attempting to solve the entire conceptual problem before implementation begins.

A preferred development strategy is:

1. establish governance;
2. stabilize core vocabulary;
3. define a minimal coordinated recording, epistemic, presentation, protection and review profile;
4. test it first on bounded examples and then on appropriately governed real use cases;
5. develop the information model;
6. build exchange schemas;
7. test independent implementations;
8. revise through public and technical review;
9. refine conformance using assessment methods drafted alongside the requirements;
10. maintain the standards as the field evolves.

127.1.30 4.7 Pilot-driven development

Candidate pilots include:

- individual research;
- AI-assisted manuscript development;
- collaborative research;
- institutional decision processes;
- historical reconstruction from incomplete archives.

Pilots are used to test whether the standards are sufficiently expressive without becoming impractically burdensome.

The current planning proposal begins with the programme's own documented decision history and a synthetic contested institutional case. A complete pilot cycle includes evidence, interpretation, challenge, reasoned response or revision, protection, presentation and practical consequences. Real external pilots depend on actual institutional participation and appropriate access arrangements. No participation is presumed.

The comprehensive development plan sets out the proposed portfolio, milestone evidence, dependencies and immediate work queue. The earlier preliminary plan remains available as a historical draft. Planning does not substitute for governance adoption or work-item approval.

127.1.31 5. Design principles

The programme currently follows these principles:

- preserve trajectory, not only output;
- distinguish occurrence from interpretation;
- distinguish present validity from historical existence;
- treat relations as first-class when their own histories matter;
- preserve uncertainty rather than forcing premature certainty;
- preserve alternatives without implying equal feasibility;
- separate preservation from publicity;
- expose mediation in reconstructed presentations;
- distinguish evidence integrity from the warrant of a claim;
- support meaningful contestation and revision of action as well as correction of records;
- examine how recording and recognition affect participation and future possibilities;
- support future reinterpretation;
- maintain compatibility with GR foundations without turning philosophical theory directly into compliance language;
- allow standards to evolve while preserving their own development history.

127.1.32 6. Intended outcome

The long-term goal is a standards infrastructure that supports warranted, revisable recognition and practical action while enabling future actors to recover more than a final artifact.

A successful record should help a later observer understand, within the limits of available evidence:

- what changed;
- what relations mattered;
- what was recognized at the time;
- what alternatives were available;
- how judgments evolved;
- how the field of future possibilities changed;
- and how the recorded process may be continued or reinterpreted.

The programme therefore aims at three linked capacities:

$$\text{future re-recognizability} + \text{reinterpretability} + \text{regenerability}.$$

These capacities provide the broad orientation for the standards family while remaining subject to refinement through the formal standards-development process.

128 README

Original source: `publications/archive/0.2/README.md`.

Original source SHA-256: `d539e685ab86abf845a80897919a1799e3f9ddfef1f74df9311fe15ff2a19ac6`.

128.1 Historical Working Draft package 0.2

Class: Source and review archive
Status: Historical preparatory Working Drafts; not adopted

This snapshot preserves the nine 0.2 TeX documents, shared preamble, manifest, build/check/change-register tools, Programme Brief 0.4, expanded review and its requirement change register. snapshot.json records original paths, archived paths and SHA-256 digests. It is the fixed baseline for the substantive validation cycle.

The archived package contains 753 requirement identifiers and originally compiled to 225 pages. The local PDFs and build/check reports were copied before revision; generated artifacts are ignored and may be absent in a fresh checkout.

To reproduce PDFs, invoke this archive's `tools/build_publications.py` using the archived layout. It resolves the archive root and uses its preamble and manifest. Do not substitute the current presentation source. Contextual links to main-repository manuscripts and planning documents are documentary references, not TeX inputs. Archived comparison/check tools retain their historical behavior; the current tools support subsequent baselines and archive-integrity checking.

The original 0.2 review is preserved byte-for-byte. Its relative navigation describes its original repository location; use the main repository's historical review or the links above for navigation from this archive.

129 expanded working draft review

Original source: `publications/archive/0.2/docs/reviews/expanded_working_draft_review.md`.
Original source SHA-256: `278bf8b1e7a74b33ecfbabd3eee459f7948b00104a1bfdad3b32f36dd6578f75`.

129.1 Expanded Working Draft 0.2 review

Class: Informative editorial and artifact review record
Status: PREPARATORY; 2026-09-22
Package: Nine Working Drafts, version 0.2
Review relationship: AI-assisted drafting and cross-review in the same development session. This is not independent stakeholder review, a formal ballot or a finding of institutional conformance.

129.1.1 1. Scope and source basis

The revision responds to the need for substantive application detail and formal publication structure. It develops all five existing governance drafts and the four initial technical drafts. It does not open additional work items or adopt the instruments. The 0.1 archive preserves original sources and tools with hashes.

The external-source study distinguishes editorial models from quality frameworks and policy instruments. ISO's annotated model, accessible IEEE rules and ITU authoring guidance support publication design; UN NQAF and UNESCO AI ethics materials provide bounded institutional comparisons. Actual access and failed retrievals are recorded. The theoretical basis remains the GR manuscript corpus, with passage-level locators in each technical document.

Particular source attention was given to FM-005's generative attribution, trajectories, evidence survival, reconstruction, uncertainty, epistemic justice, machine mediation and revisability; FM-003's praxis and limits of a fixed intervention sequence; and FM-007's operational roles and conceptual evolution. These readings do not resolve the Property/Attribute question, chronology of Chapter 3 variants or stronger emergence claims beyond the formal assumptions.

129.1.2 2. Substantive changes

Document	Added depth and review purpose
Programme Charter	Actual authority and resources, delegation and reserved decisions, participation barriers, accountability, transitions, readiness and evidence
Directives Part 1	Work-item and stage dossiers, review preparation and disposition, ballots and clocks, independent appeal capacity, emergency action, maintenance and release controls
Directives Part 2	Formal architecture, definition and requirement construction, dependency precision, semantic/protocol boundaries, normative assessment records and editorial completion checks
TC Charter	Assignment, source and decision registers, multidisciplinary review, pilot preparation, failure reporting, handover and maintenance
Ethics/IP Policy	Intake, protection, investigation, response, reasoned findings, proportionate remedies, reconsideration, conflicts, impacts, contribution rights and assessment
GR-100	Numbered terminology, six operational roles with identity and temporal conditions, scale, continuity, mappings, missingness and vocabulary assessment

Document	Added depth and review purpose
GR-110	Purpose and collection planning, generative accounts and evidence, conditions/contributions/alternatives, maintenance and loss, practical effects, custody and assessment
GR-200	Claim decomposition, methods, source dependence, material survival, interpretation, uncertainty, revision, machine mediation, protection and normative semantic schedules
GR-210	Case intake and state transitions, responsible review, competing accounts, response and disposition, corrections and practical effects, review limits and assessment schedules

The requirement change register reports text-level changes against the archived edition. It preserves old and new texts and their normalized hashes. Stable IDs identify provisions independently of their new clause locations. No ID was intentionally removed or reassigned.

129.1.3 3. Cross-review findings and dispositions

Finding	Correction and remaining limit
Sole requirements appeared in Scope while D2 required a declarative scope	Relocated the relevant Charter, D1, TC and EIP provisions into application or authority clauses, preserving their identifiers
Some D2 provisions were under unrelated headings after restructuring	Moved epistemic distinctions, conformance limits, automated checks, bindings and artifact-execution rules to their corresponding clauses
Ethics acknowledgement and determination periods were described collectively as extendible targets	Revised EIP-014 to distinguish mandatory seven-day acknowledgement from the extendible determination target; this is an explicit revision of a 0.1 obligation
Temporary participation restrictions had unclear review/expiry linkage	EIP-067 expressly applies the emergency review and expiry controls, without creating additional institutional authority
Internal conduct threshold and merits reconsideration needed limits and a usable route	EIP-069 states a reasoned criterion, contrary evidence and fairness prerequisites; EIP-099–104 specify scoped reconsideration and assessment. The threshold remains a local proposal under Q-29
Some definition entries blended definitions with examples and implications	Separated explanations into notes in the core vocabulary and epistemic drafts
One result per ID could conceal failure of a component within a grouped requirement	Added component-result rules in the core assessment schedules; every applicable component needs evidence for overall fulfillment
Unknown/restricted values could be read as a waiver of essential record structure	Distinguished required identifiers, content and scope from contextual facts that can be explicitly unknown or protected; an allowed declaration does not prove the fact was examined
A timestamp example overstated proof of recording time	Qualified it by source attribution and clock/integrity/context limits
Repeated long-table headers repeated their caption labels and produced compiler warnings	Separated first-page captions from continuing column headers; checked the revised cross-references and renderings

No review finding establishes beneficial generativity, truth of a claim, legal authority or an operating institution. Shared-session AI cross-review is not the independent human review required by the proposed governance.

129.1.4 4. Artifact verification

The full build report records compiler outcomes, source/preamble/PDF hashes, warnings and tool versions. The check report records structural checks, archive integrity, retained IDs, local

reference resolution, freshness and PDF text coverage. These generated files are ignored and need regeneration after source changes.

All nine documents compiled successfully through WSL/LuaLaTeX. The checker passed with **753 requirement identifiers across 225 PDF pages**, compared with 318 identifiers and 84 pages in 0.1. There were no duplicate or unresolved identifiers, missing requirement text, stale artifact hashes, changed archive hashes, removed historical IDs, overfull boxes, missing glyphs or detected LaTeX/package warnings.

Document	0.1 pages	0.2 pages	0.1 requirements	0.2 requirements
GSP-Charter	9	19	41	85
GSP-Directives-1	13	27	58	95
GSP-Directives-2	8	26	45	95
GR-TC1-Charter	7	17	30	83
GSP-Ethics-IP	8	22	40	104
GR-100	13	30	12	26
GR-110	8	28	34	111
GR-200	11	32	26	49
GR-210	7	24	32	105

All 318 historical IDs remain: 315 requirement texts are unchanged after whitespace normalization, two advance the GR-200 dependency edition, and EIP-014 explicitly corrects the acknowledgement/target distinction. There are 435 new IDs. Clause relocation and non-requirement prose changes are not classified as requirement text changes by the CSV tool.

Formal-structure checks cover opening clauses, front matter, annex status, table captions and local references. The archive and PDF hashes were verified. Local Markdown targets resolved, and `PROJECT_INDEX.txt` lists 108 source/corpus files. These checks are artifact evidence, not fulfillment of all D2 technical and institutional assessment duties.

Visual review sampled each document?s cover, opening Scope page and first normative annex, plus D2?s assessment schedule, GR-100?s record-role and source tables, and GR-200?s assessment schedule. The 31-page selection is recorded in `build/review/v02/render-plan.json`; rendered pages and contact sheets are stored beside it. The inspected samples showed readable headings, intact tables and no observed clipping or overlap. One nonblocking underfull-line spacing advisory remains in GR-100?s source-map introduction; its rendered page was inspected. No tagged-PDF, screen-reader or affected-user comprehension assessment was performed.

The final toolchain is recorded in the build report: Python 3.12.3, latexmk 4.83 and LuaHBTeX 1.17.0 (TeX Live 2023/Debian) under Ubuntu-24.04/WSL. Builds use shell escape disabled and fetch no external dependencies. Text extraction checks use the Windows Python review environment with pypdf. Source-word counts in the machine report include TeX markup and repeated table headers, and are not represented as prose word counts.

129.1.5 5. Remaining assessment and institutional work

P0 and P1 remain historical 0.1 fixtures. Their arithmetic and authored examples do not assess newly added obligations or demonstrate performance of an actual committee, recording practice, review service or remedy. The initial templates likewise do not substitute for the 0.2 normative schedules.

Before adoption, work remains on actual founding authority, accepted appointments, representation, independent-review capacity, rights terms and a governed rehearsal. Before live operational claims, work remains on contextual legal/ethical review, burden and resource measurement, observed procedure tests, affected-user understanding, accessibility and justified profiles. Current TeX/PDF production does not certify tagged-PDF or screen-reader accessibility.

More detailed drafts expose decisions that can now be reviewed; they do not settle those decisions by their length or typography. ADR-0005 and Q-27–30 retain the proposed choices and alternatives.

130 README

Original source: `schemas/README.md`.

Original source SHA-256: `631706812e71e0c2317879ff36e920d8a610d6f43a6a227a1bb37acc76d77530`.

130.1 Schemas

The original plan deferred schemas until GR-120 stabilized. Under the accepted standards-first co-evolution procedure, the graph pilot now has an experimental packaged JSON Schema, a validator and fixtures, and GR-SPEC-120. This is a bounded profile, not the final GR information model. Structural schema checks alone do not establish semantic reference validity, authorization, verified file bytes, factual truth or whole-practice conformance.

The additive GR-SPEC-121 defines required versioned event-order and temporal-extent modules in the same packaged schema. Cross-record event-role checks, chronology consistency and temporal-cut evaluation remain semantic validator responsibilities.

Further possible artifacts:

- JSON Schema
- JSON-LD context
- RDF/OWL vocabulary
- SHACL shapes
- validation examples

131 GR SPEC 120

Original source: `specifications/GR-SPEC-120-information-model/GR-SPEC-120.md`.
Original source SHA-256: `792fc5307750a18ffbaeb0228f1295af49e0c77a16ac2b1e9bd1d17b1d1f6787`.

131.1 GR-SPEC-120 — Experimental record graph and module model

Publication class: Specification
Maturity: EXPERIMENTAL implementation draft; not an adopted Standard
Version: 0.2
Date: 2026-09-22
Protocol identifier: `gsp-record-protocol/0.2`
Record schema: `gsp-workspace/0.2`
Initial profile: `gsp.general/0.2`

131.1.1 Foreword

This Specification supplies a bounded implementation model requested by the graph workspace. Its source interpretation is recorded in the graph semantics review, and its architectural selection in ADR-0008. This document operationalizes selected needs from Working Drafts; it neither adopts those drafts nor claims that every package using this model satisfies them.

The reference implementation is the independent Python protocol package. Its JSON Schema resource, fixtures, and semantic validator jointly describe the tested profile. The Git transaction and exchange binding belongs to GR-SPEC-130.

131.1.2 1. Scope

This document defines retained record envelopes, overlapping operational roles, relation incidence, versioned modules, material descriptors, snapshot projection, and migration from the initial workspace. It distinguishes the record graph from recording history and displayed layout.

The initial profile has one private-project reference boundary. It does not define a complete theory of reality, exhaustive target registry, complete claim/material/evidence-role model, substantive assessment method, institutional review procedure, cross-project protection system, or universal interpretation of relations. A record can retain an attributed account while the represented occurrence or identity remains disputed.

Requirements in this document constrain implementations claiming this experimental profile. **Shall** indicates a requirement, **should** a recommendation, **may** a permission, and **can** a capability. Normative identifiers `S120-*` are local to this draft and do not imply adoption.

131.1.3 2. References and dependency scope

Conceptual source references are GR-100 Working Draft 0.3, especially V100-002/005/006/007/009/010/025; GR-110 Working Draft 0.3, especially R110-006/009/011/012/020/021/025/029/093; and GR-200 Working Draft 0.3, especially E200-003/005/008/010/011/017/038. These references identify the needs being operationalized, not an automatic claim that implementing this Specification fulfills their complete obligation sets.

FM-007, sections 7–10 and 16.4, supplies conceptual background for identity, contextual incidence, overlapping analytical roles, and record/claim distinctions. Its Attribute category is not silently equated with the programme's provisional Property role.

The distributed JSON schema uses the JSON Schema Draft 2020-12 vocabulary. Request canonicalization uses RFC 8785 through the `rfc8785` library; ordinary sorted JSON encoding is not described as canonicalization under that RFC. External protocol details and source URLs are maintained in the binding's references.

131.1.4 3. Terms and structures

A **record** is an identified retained representation under a declared recording purpose. A **target** is what that representation concerns. A **snapshot** is the project manifest and record collection at an identified retained project revision. A **module** is a namespaced, versioned component of a record. A **participant incidence** identifies one role in one relation account. A **projection** is a declared rendering of a snapshot.

S120-001. An implementation shall distinguish record reference, represented-target identity, semantic connection, recording ancestry, and display position. It shall not infer factual truth, causation, legal authority, or temporal priority solely from any of those technical structures.

S120-002. A snapshot shall identify its project, source `head`, and record collection. Record identifiers shall be unique within that collection. A reference resolved under this profile shall identify a record present in that same snapshot.

The package accepts full 40- or 64-character lowercase hexadecimal revision identifiers. A particular storage binding declares its object format and accepted width. This is a locator format, not a time or authenticity guarantee.

S120-028. A declared project profile that the implementation does not support shall remain preserved and identified as an interpretation limitation during reads. Mutation, including migration, shall require a supported adapter rather than silently replacing that declaration or ignoring its additional constraints. Absence of a profile in the original legacy workspace shall not itself prevent the explicit legacy migration defined in Clause 10.

131.1.5 4. Record envelope

S120-003. A current record shall declare `schema_version: gsp-workspace/0.2`, a canonical lowercase UUID `id`, `title`, `content`, `record_type`, `record_roles`, `epistemic_mode`, `modality`, `status`, `related_records`, `modules`, and recording audit information. Creation and update actor objects shall contain `id` and `display_name`; corresponding recording times shall include an offset.

Additional descriptive fields are `attributed_to`, `method`, `evidence`, `uncertainty`, `alternatives`, `conditions`, `consequences`, and `occurred_at`. The schema and package expose their length limits. `occurred_at` is a supplied target-time description, not the server recording timestamp. Empty descriptive text means that the information was not recorded in that field; it does not establish absence, certainty, timelessness or fulfilled criteria.

S120-004. `record_type` shall identify one primary presentation role from Entity, State, Event, Process, Relation, and Property. `record_roles` shall contain one or more distinct roles from that vocabulary and include the primary role. Multiple roles shall not automatically create multiple represented targets.

S120-005. The implementation shall preserve the distinction among epistemic basis, asserted modality, and recorder-assigned disposition. The initial vocabularies are:

Field	Values	Limit
`epistemic_mode`	observed, reported, inferred, interpreted, retrospective	Primary account mode; combined contributions remain in descriptive grounds.
`modality`	realized, intended, possible, unrealized, unknown	A represented occurrence/effect qualification; not an assessment result.
`status`	unreviewed, contested, revised, withdrawn	Recorder-assigned account status; not an independent institutional finding.

S120-006. Creation and update audit values shall be supplied by the trusted application binding. A record mutation request shall not inject or overwrite creation audit identity/time. The authenticated recording account shall remain distinguishable from the attributed source described in the account.

131.1.6 5. Structured Relations

S120-007. A structured Relation shall be an ordinary independently referenceable record whose applied roles include Relation and whose `gsp.relation` module has supported version `1`. Its module data shall identify `predicate`, `participants`, and explicit boolean `participants_complete`. Optional descriptive fields are `predicate_definition`, `participant_limitations`, `context`, `identity_criterion`, and `temporal_scope`.

S120-008. Each participant incidence shall have its own UUID `id`, a local `record_id`, a nonempty descriptive `role`, `reference_scope`, and `orientation`. Incidence identifiers shall be distinct within one relation account. The same record may occupy multiple incidences, including different roles. A Relation may itself be a participant.

`reference_scope` is either `record` or `represented_target`. The former concerns the referenced retained representation; the latter concerns its described subject under the account's stated identification and limitations. Neither establishes that subject's identity or existence.

`orientation` is `in`, `out`, or `undirected`. In the canonical incidence projection, `in` points from participant to Relation, and `out` points from Relation to participant. `undirected` asserts no arrow direction. Orientation alone has no universal causal, temporal, evidential, or hierarchical meaning.

S120-009. The profile shall permit one to 32 listed incidences, including unary, cyclic, self-referential, parallel and higher-order relation structures. It shall not deduplicate Relation records by predicate and participant pattern. An empty incidence list lies outside this initial profile; this limit is not a claim about every mathematical or social relation.

S120-010. If `participants_complete` is false, the module shall contain a nonempty `participant_limitations` explanation. The listed local references can represent a known subset. The implementation shall not fabricate participant records to complete an uncertain account. An empty or unresolved identity criterion shall not be presented as fulfillment of a criterion-dependent GR obligation.

S120-011. An unstructured record with a Relation role shall remain representable and selectable. The projection shall identify the absence of interpreted incidence rather than infer participants from neutral references or prose.

131.1.7 6. Neutral references and modules

S120-012. `related_records` shall remain a set of up to 50 distinct local record identifiers used for neutral navigation. Migration or graph rendering shall not silently convert these references into typed substantive relations.

S120-013. Module keys shall be namespaced identifiers. Each envelope shall contain string `version`, boolean `required` when supplied, and object `data`. Omission of `required` means false except for the supported new temporal modules specified in S120-029 and GR-SPEC-121. This general default does not authorize rewriting an opaque historical envelope merely to insert the default.

S120-014. Optional unsupported modules or versions shall survive unrelated edits unchanged and remain identifiable as unsupported, read-only material. A required unsupported module shall block project mutation by an implementation unable to evaluate its constraints. Unsupported data shall not cause dynamic code installation or execution.

The current package introduces or edits five supported version `1` modules: `gsp.relation`, `gsp.notes`, `gsp.files`, `gsp.event_order`, and `gsp.temporal_extent`. A future domain registry needs its own implementation and compatibility evidence; this Specification does not pretend that unknown domain semantics have been checked.

S120-029. The additive temporal modules and `gsp.spacetime/1` projection shall follow GR-SPEC-121. Stored supported temporal envelopes shall require `required: true`; preparation shall supply true when omitted from a supported temporal create/set request and reject explicit false. No historical opaque module shall be rewritten to manufacture support. Existing protocol, schema and profile identifiers remain 0.2.

S120-030. Ordinary graph reading shall remain available independently of temporal scope. Introducing or reading temporal modules shall not automatically convert existing records, infer bounds from recording dates, or rewrite retained Git history. An unsupported retained event-order module shall prevent a claimed complete temporal projection; an unsupported temporal-extent module shall remain an explicit applicability limitation.

S120-015. `gsp.notes` data shall contain `text`. `gsp.files` data shall contain `items`, an array of retained material descriptors. Module absence shall remain distinguishable from an explicitly enabled empty module.

S120-016. Module mutation shall use explicit module operations. Core partial updates shall preserve omitted fields and modules. Removing a files module with linked items shall be refused until those links have been detached. Removing a current module shall not claim erasure of its retained historical versions.

131.1.8 7. Retained material descriptors

S120-017. A file descriptor shall contain `file_id`, `filename`, `media_type`, `sha256`, integer `byte_length`, `uploaded_by`, and `uploaded_at`. File identifiers shall distinguish descriptors within their owning record. Replacing material shall preserve the descriptor identity while retaining earlier versions through the binding's history.

S120-018. Filenames shall be display metadata rather than storage paths. A binding shall refuse path separators and control characters in these names and shall protect download headers and rendering independently. SHA-256 shall identify bytes; it shall not establish acquisition independence, evidence acceptance, factual truth, or permission to disclose them.

S120-019. File descriptors shall be created or changed through binding-verified file operations. A generic module update may enable an empty files module but shall not forge linked descriptors or clear existing file links. Detachment shall mean removal of the current link, without asserting historical byte erasure.

The pure package checks the declared descriptor against the metadata supplied by its caller. The binding separately verifies actual received bytes, exact part inventory, authorized source revision, stored assets, and atomic descriptor/byte publication. Consequently, a structurally valid snapshot with an unresolved or absent asset cannot be described as a verified complete archive solely because this package accepted its JSON.

131.1.9 8. Transaction preparation boundary

S120-020. The preparer shall validate the final candidate snapshot, including references to records created in the same transaction. Semantic cycles shall not be rejected because the underlying storage history has a different structure. Failure shall leave the supplied source snapshot unchanged.

S120-021. A transaction shall not contain repeated core mutations of one record or repeated mutations of one module or file descriptor. Creation followed by a distinct module or file operation is permitted. A module supplied within record creation cannot also be overwritten in that transaction. The implementation shall reject ambiguous repeated writes rather than silently selecting the last value.

The full transaction envelope, operation shapes, receipt, digest, replay and conditional-publication contract is specified by the binding. The reusable package prepares a candidate and receipt; it does not itself acquire locks, authorize a user, publish a Git reference, or verify that a retry corresponds to a prior committed receipt.

131.1.10 9. Projection and historical interpretation

S120-022. The canonical projection `gsp.incidence/1` shall expose every retained record as a selectable node, one incidence edge per interpreted participant, and distinct neutral-reference edges. Each incidence shall retain its relation identifier, participant identifier, role, scope and orientation. The projection shall identify its source `head` and disclose unstructured or unsupported material through warnings.

S120-023. Historical graph labels, relation structure and module data shall be derived from the same identified snapshot. A binding shall resolve historical material downloads under that snapshot and the applicable authorization. Substitution of current data into a historical presentation shall not be silent.

S120-024. Filtering or simplified rendering shall disclose its selection and information limits. Layout coordinates, proximity, centrality and creation order shall not automatically become substantive properties or causal claims. A future binary simplification shall preserve the underlying Relation identity and provide a route to its full participant account.

131.1.11 10. Legacy migration

S120-025. Reading `gsp-workspace/0.1` shall not perform a stored migration. A declared view adaptation may display the legacy primary role as a singleton role set and absent modules as empty. It shall retain the source schema declaration and preserve legacy references as neutral.

S120-026. Migration shall be an explicit sole `project.migrate` transaction under the `migration` change category. The new snapshot shall identify the source revision, prior schema, migration transaction, accountable actor/time and mapping limitations. Record IDs, account content and original recording attribution/time shall be retained. No relation predicate, participant role, evidential ground or unavailable file byte shall be invented.

131.1.12 11. Validation evidence and bounds

S120-027. An implementation shall distinguish structural validation, scoped semantic validation, byte/custody checks, publication guarantees and substantive assessment. A validation report shall state the applicable profile and material limitations.

The package implements JSON Schema Draft 2020-12 checks plus cross-record and module semantics. JSON values use finite RFC 8785-compatible numbers, valid Unicode and bounded nesting. Canonicalization rejects unsafe integers, nonfinite numbers and malformed surrogate text. The binding is responsible for rejecting duplicate JSON member names before an ordinary dictionary representation loses that distinction.

The reusable profile limits requests to 100 operations, projects to 1,000 records, relations to 32 incidences, and file transactions to eight parts, 10 MiB each and 20 MiB combined. Module JSON is bounded to 256 KiB, transaction JSON to 2 MiB, and snapshot JSON to 64 MiB. The initial HTTP/Git binding declares tighter JSON limits: 1 MiB transaction JSON and 32 MiB aggregate snapshot JSON. These limits are operational capacity decisions.

The executable acceptance cases include semantic cycles and higher-order relations; n-ary, parallel, unary and self relations; record/target scope; repeated roles; mode/modality/dispute coexistence; final-candidate reference checks; source immutability on failure; opaque module preservation; unsupported-profile write refusal; explicit migration; exact file-part declarations; descriptor replacement/detachment; digest invariance under member ordering; and historical label isolation. They establish bounded software behavior, not independent application interoperability or whole-GR conformance.

131.1.13 12. Unresolved extensions

OPEN: Separate claim, material, evidence-role, assessment and competing-interpretation objects; richer typed missingness; explicit role admissibility evidence; domain relation vocabularies; multiple descriptive-regime mappings; protected cross-project references; independently implemented academia mappings; governed retention and selective erasure.

DEFERRED: Semantic branch/merge resolution, externally stored large assets, executable third-party modules and automatic assessment. Availability of a generic graph or a Git DAG does not settle those matters.

132 README

Original source: `specifications/GR-SPEC-120-information-model/README.md`.
Original source SHA-256: `af21b9b32b834e2d5ee812081479a99712350a435d2c2cc73abed449c3f1f4ed`.

132.1 GR-SPEC-120 — Generativity Information Model Specification

Document class: Specification
Status: Experimental implementation draft 0.2; not an adopted Standard

The experimental record graph and module model defines a bounded record envelope, overlapping roles, first-class relation incidence, versioned modules, retained material descriptors, projection and explicit legacy migration. The independent Python package supplies JSON Schema, scoped validation, transaction preparation, graph projection, fixtures and a CLI.

Protocol `gsp-record-protocol/0.2`, schema `gsp-workspace/0.2` and profile `gsp.general/0.2` are experimental identifiers. They do not imply adoption of the GR Working Drafts or independent academia interoperability. See the publication taxonomy, implementation design, and source review for authority, scope and remaining limits.

133 GR SPEC 121

Original source: `specifications/GR-SPEC-121-event-time-projection/GR-SPEC-121.md`.
Original source SHA-256: `1bd94a7e8f767c30cf7366fa800e9bffd8d4f74d06833788e12d530f04bc6128`.

133.1 GR-SPEC-121 — Event time and spacetime projection

Publication class: Specification
Maturity: EXPERIMENTAL implementation draft; not an adopted Standard
Version: 0.1, 2026-09-22
Protocol / record schema / profile: `gsp-record-protocol/0.2` / `gsp-workspace/0.2` / `gsp.general/0.2`
Projection: `gsp.spacetime/1`

133.1.1 Foreword

This Specification defines a bounded event-order and temporal-applicability extension to GR-SPEC-120. It implements selected information and presentation needs from GR-120, GR-140 and GR-110 Working Draft 0.3, especially R110-008/049. These are draft dependencies, not adopted authorities or claims of whole-practice conformance.

The design gives the source interpretation, including FM-007 section 9.7, PDF p.42, and FM-005 sections 5.14 and 5.20.4. ADR-0011 records the alternatives and operational selection. Requirements use **shall**, recommendations **should**, permissions **may**, and capability statements **can**. Identifiers `T121-*` apply only to this experimental draft.

133.1.2 1. Scope and interpretation

This profile represents explicit event precedence, event-bounded applicability, predecessor-closed selections, and topology/trajectory projections at one recording revision. Space means the represented relational topology. A geographic location can be a State or Property account with a declared reference system; graph layout coordinates have no geographic meaning by default.

The profile does not compute physical duration, infer ordering from dates, execute event effects, prove causal influence, identify a unique true State, establish target identity, or determine which competing account is warranted. Extended-event overlap, explicit onset/completion semantics, account-selection scenarios and formal transformation composition remain outside this edition.

T121-001. An implementation shall distinguish recording revision, represented event order, event cut, temporal applicability and display layout. It shall not infer event precedence from Git ancestry, recording time, UUID order, free-text `occurred_at`, or display rank.

T121-002. An Event reference in this profile shall denote an operational boundary marker in the declared account. Its use shall not assert that every represented event is instantaneous. Availability of an Event record in a later snapshot shall not be described as continued occurrence of its target event.

133.1.3 2. Module representation and compatibility

The extension adds two version `1` modules. It does not change existing record IDs, protocol/schema/profile identifiers, transaction operation names, or Git binding tree paths. Existing records require no stored migration to remain readable.

T121-003. Stored supported `gsp.event_order` and `gsp.temporal_extent` envelopes shall contain `version: "1"`, `required: true`, and their specified `data` object. Structural schema validation shall reject explicit false and stored omission of the required flag. Preparation of a supported new/set module may supply true when the request omits it; it shall not change explicit false into true silently.

T121-004. An implementation unable to interpret a required temporal module shall apply the unsupported-required-module mutation restriction in S120-014. Successful ordinary graph rendering shall not imply support for temporal interpretation. Implementations shall expose the added module versions and projection capability.

T121-025. Any retained `gsp.event_order` module with an unsupported version shall prevent a complete temporal projection, including when its older envelope declares it optional. The result shall contain an `unsupported_event_order` diagnostic, `consistent: false`, null event ranks, and null cut/topology. An unsupported retained `gsp.temporal_extent` version shall produce an `unsupported_temporal_extent` diagnostic and indeterminate presence, unless the account is withdrawn; it shall not alone invalidate an otherwise usable known event order. Opaque data shall remain retained unchanged.

All references below use the canonical UUID form and same-snapshot reference boundary of GR-SPEC-120. Data objects have only the fields defined here. Existing envelope, module-size and snapshot limits continue to apply.

133.1.4 2.1 Event order

```
{"version":"1","required":true,"data":{"before":"<Event UUID>","after":"<Event UUID>"}}
```

The angle-bracket strings illustrate references; an actual instance uses canonical UUIDs.

T121-005. Both `before` and `after` shall resolve to records whose applied roles include Event. The owning record shall include the Relation role and supported `gsp.relation/1`. The latter shall contain exactly two incidences: the `before` target with orientation `in`, and the `after` target with orientation `out`, both with `reference_scope: represented_target`. Each incidence shall retain the ordinary independently identified, descriptively named role.

T121-006. Order records shall retain ordinary attribution, epistemic basis, modality, status, grounds and revision history. Duplicate endpoint assertions shall remain independently identifiable. Self-precedence and cyclic sets of otherwise well-formed assertions shall remain retained and receive consistency diagnostics rather than being erased as invalid archival evidence.

The module supplies strict ordering semantics. An arbitrary Relation predicate or direction does not. Temporal precedence does not by itself supply a causal or generative contribution claim.

133.1.5 2.2 Temporal extent

```
{
  "version":"1",
  "required":true,
  "data":{
    "start":{"kind":"event","event_id":"<Event UUID>"},
    "end":{"kind":"unknown"},
    "basis":"Grounds, scope and continuity assumptions of this applicability account.",
    "subject_record_id":"<optional subject UUID>"
  }
}
```

T121-007. Extent data shall contain `start`, `end` and nonblank `basis` text of at most 2,000 characters. Each boundary shall be exactly `{kind: event, event_id: UUID}`, `{kind: unknown}`, or `{kind: unbounded}`. Event-boundary references shall resolve to Event-role records in the same snapshot. Any supplied `subject_record_id` shall resolve in that snapshot.

T121-008. Unknown shall mean an unresolved boundary. Unbounded shall mean that no limiting boundary is asserted on that side within the declared account scope; it shall not be treated as missing data or universal perpetual existence. The absence of the module shall remain distinguishable from each explicit boundary form.

T121-009. Start applicability shall be inclusive and end applicability exclusive. When both bounds reference events, the active ordering shall support strict start-before-end reachability. Equal, reversed or incomparable bounds shall make that extent indeterminate and produce a diagnostic; the extent shall not implicitly add an order assertion.

T121-010. Subject grouping shall remain a supplied account whose basis explains the relevant scope and continuity judgment. Grouping shall not itself establish represented-target identity, state exclusivity or causal continuity. The projection shall preserve separately identified and potentially competing accounts.

133.1.6 3. Ordering and cuts

Let `E` contain the snapshot's Event-role records. Let `A` contain edges from understood order modules whose owning records are not withdrawn. Reachability in `A` supplies strict precedence only when the selected ordering is acyclic.

T121-011. The projection shall preserve order-account IDs, endpoints and statuses. Withdrawn order accounts shall remain inspectable with `active: false` and shall not constrain `A`. Contested and non-realized temporal accounts shall remain included with visible qualifications. An active order referring to a withdrawn Event account shall produce a warning rather than silently dropping that explicit reference.

T121-012. The projection shall identify cycle diagnostics and their involved events/order accounts. If a cycle exists, `consistent` shall be false, event ranks shall be null, and `cut` and `topology` shall be null. It shall not produce a purported admissible cut by silently dropping assertions. The ordinary record graph remains separately available. Here `consistent` means an interpretable, usable selected event order, subject also to T121-025; it is not a finding of factual truth.

T121-013. For an acyclic ordering, an explicit selection shall contain at most 1,000 distinct Event UUIDs present in the selected snapshot. Its cut shall be the predecessor closure of those IDs. A cut shall include every known predecessor of every included event.

T121-014. Omitted selection shall denote the all-event cut. An explicit empty selection shall denote the empty cut. The result shall expose the requested IDs, included closure, added predecessor IDs, and maximal included events as the frontier. All-event selection shall use `requested: null` and `derived: []`.

T121-015. Event ranks shall be display aids derived from the selected acyclic order; they shall not supply additional precedence, simultaneity, duration, or physical position. Incomparability shall mean absence of supported ordering in this account, not established simultaneity or independence.

133.1.7 4. Presence, topology and trajectories

Presence is classification of retained applicability claims at a cut, not an assertion that the record's target exists or does not exist independently of those claims.

T121-016. Presence classification shall follow this priority:

1. A withdrawn account is `withdrawn`.
2. A retained unsupported extent is `indeterminate`; complete absence of an extent is `unscoped`.
3. Absence of a usable consistent cut, or a diagnosed invalid pair of event bounds, is `indeterminate`.
4. Either bound being unknown is `indeterminate`.
5. A known event start outside the cut is `not_started`.
6. A known event end inside the cut is `ended`.
7. Otherwise the account is `active` within its declared scope.

T121-017. Unknown and unscoped accounts shall remain inspectable and excluded from active topology by default. A presenter shall disclose this omission and shall not treat it as evidence of absence. Partial knowledge of one boundary shall not silently complete the other.

T121-018. A topology shall contain the canonical incidence graph's active record nodes and only edges whose two endpoints are active, at the same source revision. An active Relation node shall remain present even when some of its participants are not established active. The projection shall emit `partial_relation_at_cut` for omitted participant incidences or an explicitly incomplete participant account, identifying omitted participant-entry IDs. It shall retain Relation identity and scope/completeness qualifications without presenting the visible subset as complete or inventing missing participants, extents, or incidences.

T121-019. Trajectory groups shall identify each supplied subject reference and the retained record IDs grouped under it. They shall not impose an additional event order, infer identity from a shared label, select one competing account as true, or calculate event outcomes. Event-order inventory, applicability extents and grouped trajectories shall remain distinguishable in presentation.

133.1.8 5. Projection response

T121-020. The pure projection shall identify `head`, `project_id`, `protocol_version`, `projection: gsp.spacetime/1`, `consistent`, `events`, `orders`, `cut`, `extents`, `trajectories`, `presence`, `topology`, `diagnostics`, and `limitations`. The HTTP binding shall additionally distinguish the currently observed project head and any legacy read adaptation.

Field	Content
`events`	ID, title, rank or null, direct predecessor/successor IDs, status, modality and descriptive `occurred_at`
`orders`	Owning Relation ID, before/after IDs, status and active flag
`cut`	Null, or requested/included/frontier/derived IDs as specified above
`extents`	Record ID, subject ID or null, start/end, basis and presence
`trajectories`	Subject ID and grouped record IDs
`presence`	Record ID and classified presence
`topology`	Null, or selected canonical nodes/edges
`diagnostics`	Code, message and applicable record/event/relation/participant identifiers
`limitations`	Declared interpretive and implementation limits

T121-021. Every result shall derive from one pinned snapshot. Historical titles, roles, orders, bounds and qualifications shall not silently resolve against the current revision. Projection shall not modify records, create receipts or commits, or perform migration.

133.1.9 6. HTTP selection binding

The binding uses `GET /api/projects/{id}/spacetime` for the all-event cut and `POST` to the same path for `{ "after": ["<Event UUID>"] }`. Both accept optional `revision=<head>` using the existing revision authorization and reachability rules.

T121-022. GET and POST shall require the existing project authorization. POST shall additionally require the application's anti-forgery protection despite being read-only. Its JSON body shall contain exactly `after`, an array of at most 1,000 distinct Event UUIDs, and shall not exceed 64 KiB. Invalid selection shall not be silently truncated or coerced into all-event selection.

T121-023. Malformed or duplicate-member JSON, unknown body fields, invalid/non-Event references and unsupported request media types shall use the binding's applicable validation/media errors. A structurally readable chronology conflict shall return an inspectable projection with `consistent: false`, not be represented as a storage failure or silently repaired.

Projection requests have no transaction ID or `expected_head` because they publish no change. Temporal module editing continues to use ordinary transactions with their expected revision, actor, reason and retained receipt under GR-SPEC-130.

133.1.10 7. Assessment and limits

T121-024. An assessment shall distinguish module/schema validation, reference validation, chronology consistency, projection behavior, authorized HTTP behavior, presentation and substantive factual warrant. It shall identify the cases actually executed and shall not equate a passing diagram or acyclic ordering with an established historical account.

Required discriminating cases for this profile include earlier events inserted after later events; unknown order; explicit empty/all-event cuts; ancestor closure; self and multi-event cycles; withdrawal and contestation; unknown/unbounded/missing extents; equal/reversed/incomparable bounds; subject grouping; incomplete relation context; historical versions; denied access; body bounds; and a check that projection leaves the accepted Git head unchanged. This is an assessment schedule, not a claim that all checks have already passed.

The reference implementation and packaged schema implement this bounded contract. Independent import compatibility, historical interpretation, accessibility and participant comprehension require separate evidence. Academia's native record protocol is not thereby aligned with this extension.

133.1.11 Annex A — Informative source comparison

The source-grounded design records exact manuscript pages, including the narrower consequential relational-event concept in FM-004 and the occurrence/attempt distinctions in FM-007. Their different scopes are preserved.

Lamport 1978, pp.559–560, supplies a comparison for partial orders and logical-clock displays. Its distributed-process assumptions are not assumed for social records. The W3C 2017 Time Ontology Recommendation, sections 3.1–3.3, supplies a comparison for instants, intervals and temporal reference systems. This profile makes no claim to implement that ontology or its complete interval calculus.

134 README

Original source: `specifications/GR-SPEC-121-event-time-projection/README.md`.
Original source SHA-256: `0af29ca674e5c799157b74fd8ebbd18420e0b06457c2d766fdccc7869b8c79cc`.

134.1 GR-SPEC-121 — Event time and spacetime projection

Publication class: Specification
Maturity: EXPERIMENTAL implementation draft 0.1; not an adopted Standard

GR-SPEC-121 specifies additive event-order and temporal-extent modules, consistent cuts, trajectory grouping, and the `gsp.spacetime/1` topology projection. Recording history remains distinct from represented occurrence order.

The specification develops temporal needs in GR-120 and GR-140. Its foundation interpretation and limits appear in the design and ADR-0011. The shared protocol package is the reference implementation; the GR-SPEC-130 binding supplies authorized, revision-pinned HTTP reading.

135 GR SPEC 130

Original source: `specifications/GR-SPEC-130-interchange/GR-SPEC-130.md`.
Original source SHA-256: `e04f0657fb3648a6390e43c25c07bacb554d2c09686490bbe6a6a980c8e037af`.

135.1 GR-SPEC-130 — Project transactions, Git binding and interchange

Document class: Specification
Status: EXPERIMENTAL technical specification; not an adopted Standard
Edition: 0.2, 2026-09-22
Protocol: `gsp-record-protocol/0.2`
General profile: `gsp.general/0.2`
Storage binding: `gsp.git/0.2`

135.1.1 Foreword

This Specification defines a bounded project-transaction and interchange binding for the experimental Generativity workspace. It develops the infrastructure need identified in the graph-workspace design and ADR-0008. Those documents record the selected alternatives and limitations. They do not establish standards adoption, institutional authority or factual warrant.

The first implementation combines an independent protocol package, an authenticated HTTP adapter and a Git storage adapter. The components have different responsibilities. Availability of a shared package does not establish that two independent applications have successfully exchanged records. Adaptation of the academia application remains subsequent work.

The requirements below use **shall** for requirements, **should** for recommendations, **may** for permission and **can** for capability. They apply within the declared experimental binding. A claim about a tested component shall identify its scope rather than imply conformance of an institution, factual claim or whole GR standards family.

135.1.2 1. Scope

This Specification covers:

- coordinated changes to a project's records, declarative modules and retained material;
- base-version comparison, committed receipts and repeated requests;
- one-repository-per-project Git serialization;
- reads of complete historical project snapshots;
- current-snapshot JSON, selected-snapshot material packages and full-history bundles;
- adaptation and explicit migration of the initial `gsp-workspace/0.1` representation;
- bounded failure behavior and evidence needed to assess implementation claims.

It does not define the full semantics of the six operational recording roles, replace the information model, supply an access policy, implement a public federation protocol or establish a universally applicable retention policy. Authentication, project ownership and disclosure checks are supplied by the application. Independent signatures, external timestamps, semantic merging, concurrent branches, selective erasure and remote object storage are outside this edition.

135.1.3 2. References and authority

The record envelope and module contract are specified in GR-SPEC-120. The additive event-order, temporal-extent and cut-projection contract is specified in GR-SPEC-121. The executable representation is distributed with the independent protocol package. These remain experimental; the additive modules do not change this binding's 0.2 identifier or retained tree layout.

This binding uses Git's documented object and reference operations. Conditional publication follows Git update-ref; blob construction and bounded object reading use Git hash-object and Git cat-file. Full-history interchange uses Git bundle.

Request-digest canonicalization uses RFC 8785, JSON Canonicalization Scheme. HTTP terminology follows RFC 9110. The body field `expected_head` is an application-level precondition; this edition does not redefine HTTP entity tags or `If-Match` semantics.

135.1.4 3. Terms and identifiers

Project snapshot: the project manifest and retained record representations obtained from one accepted project revision. A snapshot can refer to retained material without embedding its bytes in JSON.

Transaction: one proposed coordinated mutation, identified by a caller-supplied UUID, evaluated against a declared base revision and accepted through one publication operation. A storage transaction is not automatically a represented Event, institutional act or epistemic judgment.

Receipt: structured information retained in the same accepted snapshot as the transaction's effects. It identifies the request, recorder, base, reason, changes and bounded validation result.

Revision: in this Git binding, a full lowercase 40-character SHA-1 Git commit identifier. A revision identifies retained project content within the binding; it does not authenticate the represented target or establish independent time.

Asset: retained binary material addressed by its lowercase 64-character SHA-256 content digest. Its storage digest identifies bytes. A file descriptor supplies a separately identifiable acquisition and descriptive context.

Publication: successful advancement of `refs/heads/main` to the candidate commit, conditional on its preceding value. Prepared but unreachable objects are not accepted project revisions.

X130-001. Project, record, transaction and file descriptor identifiers shall use canonical UUID strings in this profile. Applications shall not derive arbitrary filesystem paths or Git revision expressions from supplied identifiers.

X130-002. A revision requested through this binding shall be a complete commit identifier reachable from the selected project's accepted `main` history. A shortened identifier, branch expression, foreign-project commit or dangling prepared commit shall not be treated as an accepted revision.

135.1.5 4. Transaction representation

A transaction contains `protocol_version`, `transaction_id`, `expected_head`, `reason`, `change_categories` and `operations`. Operation names and their field constraints are defined by GR-SPEC-120 and the package schemas. This edition supports record creation/update, module setting/removal, file attachment/replacement/detachment and an explicit project-migration operation.

X130-003. A receiver shall validate the supported protocol/profile, operation envelopes, identifiers, declared types and resource limits before accepting a mutation. Duplicate JSON members, malformed Unicode, nonfinite numbers and unrecognized operation fields shall be rejected rather than silently normalized.

X130-004. Transaction validation shall examine the complete resulting candidate snapshot. References between resources created in the same transaction shall be evaluated against that candidate, not against an arbitrarily ordered series of partially accepted resources.

X130-005. A transaction shall not publish a valid subset of its operations when another operation fails. Repeated mutations of one guarded resource shall follow the information-model rules rather than an implicit last-write-wins convention.

X130-006. Server-managed recording attribution and time shall be assigned by the receiving application. They shall remain distinguishable from supplied source attribution, represented occurrence time, assessments and acquisition descriptions.

X130-007. An implementation shall preserve unmodified optional modules it cannot interpret. It shall refuse a mutation when an unsupported required module prevents evaluation of the project's necessary constraints. Unsupported data shall not install executable code or determine server paths.

The shared package prepares a complete `{project, records}` candidate and a receipt without accessing Flask, SQLite, a repository or a filesystem. The application verifies the caller and actual uploaded material. The Git adapter enforces storage identities, resource bounds, material closure and conditional publication. Passing one layer's checks does not substitute for the others.

135.1.6 5. File transfer and material closure

An ordinary transaction can be sent as JSON. A transaction carrying files uses multipart encoding with one textual `transaction` JSON field and explicitly named binary parts. A file operation declares its part name, file descriptor ID, owning record, filename, media type, SHA-256 and byte length.

X130-008. The received binary part names shall correspond exactly to the declared attachment/replacement operations. Duplicate, missing and undeclared parts shall be rejected. Multipart boundary strings and transmission ordering shall not determine logical transaction identity.

X130-009. The receiving implementation shall compute the actual byte length and SHA-256 of each supplied file using bounded reads. A mismatch with its declared identity shall prevent publication.

X130-010. The bytes subsequently written to Git shall be the same bounded bytes whose digest was checked. An implementation shall not validate one path state and later publish different bytes through an unchecked reread.

X130-011. For every understood `gsp.files` version `1` descriptor in a candidate, the candidate tree shall contain a matching asset with the declared byte length. The adapter shall reject supplied assets that have no current understood descriptor in the accepted candidate.

X130-012. Filenames and media types shall remain descriptive metadata. Filenames shall not be used as arbitrary repository or filesystem paths, and media-type declarations shall not cause active content to execute.

X130-013. File detachment and replacement shall not be described as erasure of earlier bytes. This edition retains existing asset entries in subsequent project trees. Unsupported optional modules shall not trigger collection of material that a reader cannot interpret.

Files are initially offered as downloads with `nosniff`. This edition includes no antivirus finding, media authenticity finding or evidence-sufficiency determination. Identical retained bytes can serve different descriptors and acquisition accounts without becoming independent evidence merely because there are several references.

135.1.7 6. Request identity and committed receipts

The request digest is lowercase SHA-256 over RFC 8785 canonical JSON of:

```
{"transaction": "the logical transaction object", "files": "verified part-name metadata mapping"}
```

The displayed strings above denote objects, not literal serialization values. Each entry in `files` has its verified `sha256` and `byte_length`. Ordinary JSON requests use an empty mapping. The logical transaction includes its original base and operation ordering. Server-assigned actor/time and multipart framing are excluded from the digest; actor identity is checked separately.

X130-014. A committed receipt shall include protocol version, transaction ID, original `expected_head`, authenticated actor, recording time, reason, change categories, request digest, changed-resource summaries and the scope/limitations of structural validation.

X130-015. The receipt shall be retained at `.gsp/transactions/{transaction_id}.json` in the same tree as the accepted effects. A published receipt path shall not subsequently be overwritten through this binding.

X130-016. The resulting commit identifier shall not be embedded in the receipt whose containing tree would determine that identifier. A receipt response shall resolve the commit that introduced the immutable receipt path and distinguish it from the currently observed head.

X130-017. The application shall check a committed receipt before rejecting a request solely because its base has become old. A request with the same transaction ID, actor and logical digest shall return the original result without publishing another mutation. Reuse for a different request or actor shall be reported as a conflict.

X130-018. After a failed publication race, an application shall check whether an identical transaction was committed before reporting the request as an unrelated conflict. A client retry after an uncertain response shall retain its transaction ID and logical request.

X130-019. A receiver shall not claim that a timed-out or interrupted response proves that nothing was published. Receipt lookup or retry shall be available to recover the accepted result. An absent receipt during an ongoing race is an observation at that read, not a promise about subsequent completion.

Requests rejected before publication do not acquire a committed receipt. A materially reconciled draft uses a new transaction ID. These rules constrain accepted project effects; they do not promise exactly-once external notifications or institutional action.

135.1.8 7. Git repository binding

Each project uses an application-managed bare repository with one accepted branch. The retained tree has this structure:

```
project.json
records/<record-uuid>.json
assets/<sha256>
.gsp/protocol.json
.gsp/transactions/<transaction-uuid>.json
```

The protocol manifest identifies protocol, profile, binding, object format and record schema. New `gsp-workspace/0.2` projects initialize the manifest and empty records/assets/transactions trees. Older project manifests remain readable without being rewritten on access.

X130-020. The adapter shall prepare complete affected trees and a single commit before publishing any change. It shall advance `refs/heads/main` only if its current value equals the supplied expected parent.

X130-021. Publication failure shall not expose a partial accepted project. Unreachable prepared objects may remain in repository storage, but ordinary reads and exports of accepted history shall not treat them as published revisions.

X130-022. Repository operations shall avoid dependence on a shared working tree or index. Untrusted host Git configuration, hooks, replacement objects, transport settings and inherited `GIT_*` redirection shall not silently control the binding's record operations.

X130-023. A full-candidate storage write shall not silently omit existing records. The first profile represents withdrawal or revision through retained records rather than current-tree deletion. Existing asset entries and receipt paths shall survive subsequent accepted writes.

X130-024. Receipt resolution shall use one pinned accepted head and establish that the receipt path was introduced once without later mutation. An inconsistent or modified receipt history shall produce an error rather than a false original-result attribution.

X130-043. Before mutation, an existing `.gsp/protocol.json` shall exactly match the supported manifest's protocol version, profile, binding, object format and record schema, with no unrecognized fields. A different or extended manifest shall be preserved and mutation refused; the adapter shall not silently replace a future binding declaration with its own defaults. Read-only inspection of otherwise readable stored data does not imply support for mutation under that declaration.

The present adapter uses Git's SHA-1 repository object format and independent SHA-256 asset digests. Neither substitutes for an authenticated signature or external preservation guarantee. An authorized server administrator can rewrite references or remove repositories; this binding does not claim immutability against that administrator.

135.1.9 8. Limits, buffering and capability disclosure

The following are initial implementation limits, not requirements imposed by GR theory. A lower application transport limit also applies where declared.

Limit	Initial value	Scope
Transaction operations	100	Protocol envelope
Records	1,000	Retained project snapshot
Binary parts	8	HTTP transaction

Limit	Initial value	Scope
Individual file bytes	10 MiB	Input and retained asset
Combined incoming file bytes	20 MiB	Transaction, before deduplication in HTTP adaptation
Retained unique asset bytes	128 MiB	Asset blobs reachable from the current asset tree
JSON resource bytes	2 MiB	One stored serialized JSON resource
Project plus record JSON bytes	32 MiB	Combined stored serialized snapshot
Protocol transaction JSON	2 MiB	Shared package bound
HTTP transaction JSON	1 MiB	Initial HTTP binding
Module JSON	256 KiB	Shared profile
Returned history entries	100	One history response

The package's internal snapshot validation bound is 64 MiB. This Git binding's 32 MiB serialized bound is narrower. Storage JSON includes its chosen whitespace and therefore is not measured identically to the JCS request digest. Capabilities disclose the layer-specific limits.

X130-025. An implementation shall disclose its applicable bounds and shall fail before publication when a proposed change exceeds them. It shall not truncate records, modules or material to make a request fit.

X130-026. Snapshot reads shall inspect object kinds and sizes before materializing their bodies. Implementations shall bound per-resource and aggregate JSON reads and reject malformed or incomplete object streams.

X130-027. Attachment, download and bundle handling shall avoid requiring the complete accumulated history or bundle to reside in application memory. Temporary storage shall be closed and released on success, failure and client disconnection according to the host's supported lifecycle.

The retained-asset limit does not bound unreachable prepared objects, Git metadata, transaction-ledger size, operating-system caches or backups. Filesystem quotas, monitoring, governed collection and recovery remain hosting responsibilities. Increasing a declared bound requires capacity assessment and corresponding tests.

135.1.10 9. Snapshot-consistent reading and presentation

X130-028. A project read shall resolve its accepted revision once and obtain the manifest and all selected records from that tree. Participant names, relation modules, notes, related-record labels and file descriptors in a historical presentation shall not silently come from today's project.

X130-029. An application shall distinguish a requested historical revision from its currently observed project head. Historical views shall not silently become current editable views.

X130-030. Historical content, history, receipt and file operations shall pass the application's applicable project authorization checks. A digest or revision identifier shall not serve as a permission token. File delivery shall require a descriptor in the authorized record at the selected revision, not merely the presence of a matching retained blob.

X130-031. A bounded history listing shall disclose its limit. The Git recording sequence shall not be presented as the occurrence chronology or causal ordering of represented targets.

The storage adapter returns caller-owned binary temporary files positioned at byte zero for assets and bundles. The HTTP adapter closes these handles when responses finish or fail. The legacy `bundle()` helper remains available for small compatibility tests, but HTTP downloads use `bundle_file()`.

135.1.11 10. Export classes

Three distinct exports are supported:

Export	Included content	Excluded content
Snapshot JSON	Manifest, current-at-selected-revision record representations and source revision	File bytes, earlier versions, receipt ledger, credentials
Snapshot ZIP	Export manifest, project manifest, records and their understood referenced material at the selected revision	Earlier versions, accumulating receipts, detached/unreferenced assets, credentials
Git bundle	Accepted reference and its reachable commit/object history, including retained receipts and material	Application account/session database, authorization configuration, unreachable failed candidates

X130-032. An exporter shall identify the source project revision, declared export scope and known exclusions. It shall preserve exact stored representations rather than silently replacing them with a display adaptation.

X130-033. A selected-snapshot material package shall include the referenced bytes of understood supported file descriptors and preserve their digest-based filenames. It shall not include every retained asset or the accumulating transaction ledger merely because they occur in the current Git tree.

X130-034. A material package shall disclose unsupported modules and the limits of reconstructing material described only inside them. An exporter shall not assert complete recovery of an opaque module's dependencies.

X130-035. A full-history bundle shall preserve the accepted reachable history, including earlier replaced or detached material. Its presentation shall disclose that these bytes and earlier reasons can remain present even when a current snapshot no longer shows them.

X130-036. An export shall not be described as a complete running-service backup when it omits accounts, access configuration or other required service state. Importing a repository copy shall not itself assign ownership or authenticate its recording actors in a new service.

Current JSON and ZIP are experimental interchange representations. This edition specifies no automatic package-import endpoint. Independent import, collision handling, protected subsets, additional hash bindings and academia-profile mapping require further executable fixtures before an interoperability claim.

135.1.12 11. Legacy adaptation and migration

X130-037. Reading a `gsp-workspace/0.1` project shall not mutate its repository. Any presentation adaptation shall identify the legacy source and preserve its identifiers and original retained history.

X130-038. Migration shall be an explicit, attributed transaction with the old revision as its base and a recorded mapping/limitations account. Original commits shall remain available. A stale migration shall fail through the same publication precondition as another mutation.

X130-039. Migration shall not infer structured Relation participants, predicates, evidence judgments, acquisition records or attachment bytes from legacy navigation links and free text. An unstructured Relation account shall remain distinguishable from a structured relation.

Compatibility record endpoints can translate bounded requests into the shared transaction preparation path. Such endpoints do not provide the full caller-controlled retry guarantee when the server generates a new transaction ID for each request. They do not authorize bypassing unsupported-module or material-closure checks.

135.1.13 12. HTTP operation mapping and errors

The first application exposes these operations:

Method and path	Result
`GET /api/protocol`	Supported protocol/profile/modules and layered limits
`GET /api/projects/{project}` with optional `revision`	Snapshot and distinction between selected/current revision

Method and path	Result
`GET /api/projects/{project}/graph` with optional `revision`	Projection of that selected snapshot
`GET /api/projects/{project}/spacetime` with optional `revision`	Read-only event-order and topology projection at the all-event cut
`POST /api/projects/{project}/spacetime` with optional `revision`	Read-only projection at the predecessor closure of JSON body `after` Event IDs; anti-forgery protection applies
`POST /api/projects/{project}/transactions`	Accepted or replayed transaction result
`GET /api/projects/{project}/transactions/{transaction}`	Committed receipt, original result revision, observed head
`GET /api/projects/{project}/history`	Up to 100 project commits
`GET /api/projects/{project}/records/{record}/history` with optional `revision`	Bounded record history at the selected revision
`GET /api/projects/{project}/records/{record}/files/{file}` with optional `revision`	Authorized descriptor's retained bytes
`GET /api/projects/{project}/migration`	Informative preview without mutation
`GET /api/projects/{project}/export` with optional `revision`	Snapshot JSON
`GET /api/projects/{project}/package` with optional `revision`	Snapshot ZIP
`GET /api/projects/{project}/bundle`	Complete accepted reachable-history bundle

X130-040. State-changing HTTP requests shall require application authorization and its anti-forgery protection. A protected project or resource shall not become discoverable solely through a guessed identifier.

X130-041. The application shall distinguish malformed/unsupported input, denied access, missing authorized resources, base or request-ID conflicts, resource limits and storage unavailability. A failed request shall not discard the client's unsaved graph or imply a substantive judgment about its claims.

X130-044. Spacetime GET and POST shall resolve one authorized selected snapshot and distinguish its `head` from the currently observed `current_head`; the response shall identify legacy adaptation where applicable. The POST shall require the existing anti-forgery protection, accept only JSON `{after: [...]}` within 64 KiB and 1,000 distinct same-snapshot Event references, and follow GR-SPEC-121 selection and diagnostic rules. Both methods shall remain read-only and create no transaction receipt, commit or migration.

X130-045. Temporal module edits shall use the existing attributed transaction, expected-head and publication rules. A late-recorded earlier event shall not rewrite recording history or alter an earlier selected snapshot. The binding shall return retained chronology contradictions as inspectable projection diagnostics rather than invent an ordering to make the graph render.

The application uses `201` for a new accepted transaction, `200` for a recognized replay, `400` for validation failures, `401`/`403` for applicable authentication/anti-forgery failures, `404` for unavailable authorized resources, `409` for conflicts, `413` for binding size limits, `415` for unsupported media types and `503` for unavailable storage. Error classification does not establish whether an uncertain publication occurred; the receipt resolves that separate question.

135.1.14 13. Assessment evidence

X130-042. An implementation assessment shall identify the components, profile, limits, environment and scenarios actually exercised. Structural validation shall not be labelled factual verification, evidence sufficiency, institutional adoption or full GR conformance.

The first test set covers coordinated record/relation/material publication; no partial publication on failure; competing writers; stale bases; persistent receipt lookup after restart and advancing heads; immutable receipt paths; historical labels and file replacement/detachment; bounded snapshot batching; digest/length/material-closure failures; retained-byte budgets and deduplication; bundle reconstruction; and migration preserving legacy history without manufacturing structure.

HTTP tests additionally need same-request replay, changed-request rejection, malformed multipart and unsupported module behavior, authorization across current/historical resources, and snapshot export selection. Browser assessment needs pinned graph/inspector navigation, unsaved-draft preservation and a nonspatial interaction path. A passing storage test does not establish these additional behaviors.

Relevant implementation artifacts are Git adapter, transaction storage tests, legacy storage tests, HTTP binding and protocol package.

136 README

Original source: `specifications/GR-SPEC-130-interchange/README.md`.
Original source SHA-256: `ab2d440aef17b400189e969e5166da32a8f70720ea9e3204a76558ab158bc927`.

136.1 GR-SPEC-130 — Generativity Interchange Specification

Document class: Specification index
Status: EXPERIMENTAL edition 0.2; not an adopted Standard

The transaction, Git binding and interchange Specification defines coordinated project mutation, receipt-based retry recovery, bounded retained files, historical snapshots and distinct export classes for `gsp-record-protocol/0.2`.

Its concrete implementation need and alternatives are recorded in the graph-workspace design and ADR-0008. The independent protocol package supplies model and transaction validation; the application supplies authorization and the Git/HTTP adapters.

The broader GR-130 interchange programme remains preliminary. This experimental binding does not establish independent academia interoperability, an adopted Standard or a whole-family conformance claim. See the publication taxonomy and protocol development plan for authority and proposed dependencies.

137 README

Original source: `specifications/GR-SPEC-200-epistemic-recording/README.md`.
Original source SHA-256: `ff5d90f211b1769f0bb0b0a026a9a7b748a67c6ece45ed9a028f29ed6f940059`.

137.1 GR-SPEC-200 — Epistemic Recording Specification

Document class: Specification project outline
Status: Preliminary placeholder; not an adopted Standard

See the publication taxonomy and protocol development plan for scope, authority and proposed dependencies.

138 README

Original source: `specifications/README.md`.
Original source SHA-256: `b2664df6bed176403ec2d3f30c02b65f7c0c331a0238c4328286399b9656194b`.

138.1 Specifications

Document class: Informative publication-track overview
Status: PROVISIONAL

Specifications are technically precise publications that may be implemented or tested without necessarily having the formal status of a Standard.

See the publication taxonomy.

Initial candidate specifications include:

- GR-SPEC-120 — Generativity Information Model
- GR-SPEC-130 — Generativity Interchange
- GR-SPEC-200 — Epistemic Recording

GR-SPEC-120 and GR-SPEC-130 now have experimental implementable texts: the record/module/transaction model and Git/HTTP binding. Their reference package and generalized application exercise selected behaviors; neither is an adopted Standard or a claim of full GR conformance. GR-SPEC-200 remains a preliminary work item. The parallel GR-120/130/200 standards-track projects express semantic, interoperability and epistemic requirements; corresponding Specifications provide implementable detail when those requirements justify it. Existing identifiers and paths are retained.

Protocols describe interaction behavior within a Specification, including roles, transitions, outcomes and failures. They are not a separate publication authority class. Candidate capability allocations and development triggers are in the protocol and specification plan; the comprehensive plan coordinates requirements, pilots and review.

139 README

Original source: `standards/GR-100-foundations-vocabulary/README.md`.
Original source SHA-256: `2e933c72d48eac36e6e7f6d8067c027298fcc2254e3a581387a23fd3462793b2`.

139.1 GR-100 — Foundations and Vocabulary

> **Developed draft available:** Working Draft 0.3 source and compiled PDF. The Markdown outline below is retained as historical planning context; its candidate choices are not adopted. Current requirements and unresolved decisions are in the TeX draft.

Document class: Standards-track project outline
Status: Preliminary; not an adopted Standard

Define the conceptual vocabulary used across the standards family.

Initial topics: - metamodel vs record ontology; - Entity, State, Event, Process, Relation, Property; - identity and persistence; - time; - provenance; - perspective; - uncertainty; - generative trajectory; - generative conditions; - contingency; - reinterpretation.

140 README

Original source: `standards/GR-110-recording-requirements/README.md`.
Original source SHA-256: `4b61cb00ca4c4ec15f9219448daa656590c379340bd962b7963b430ea3a370cb`.

140.1 GR-110 — Generativity Recording Requirements

> **Developed draft available:** Working Draft 0.3 source and compiled PDF. The Markdown outline below is retained as historical planning context; its candidate choices are not adopted. Current requirements and unresolved decisions are in the TeX draft.

Document class: Standards-track project outline
Status: Preliminary; not an adopted Standard
Define normative requirements for conforming generativity records.
Expected profiles: - Core; - Standard; - Deep / archival.

141 GR 120

Original source: `standards/GR-120-information-model/GR-120.md`.
Original source SHA-256: `ace0f0c1e1da605d82ad96903d1d0bb78e92ff05a0c924ba8131a189382b3b5b`.

141.1 GR-120 — Generativity information model

Publication class: Standards-track Working Draft; not an adopted Standard
Maturity: Preparatory WD 0.1, 2026-09-22; proposed requirements for review
Scope of this edition: Record identity, overlapping roles, relational incidence, modular descriptions and bounded temporal applicability
Additive revision: 2026-09-22 event-order requirements; earlier requirement IDs retained

141.1.1 Foreword

This bounded draft develops the earlier project outline in response to the graph-workspace pilot. The programme's governance, work-item approval and adoption procedures remain applicable; software implementation does not establish those approvals. The nine coordinated TeX Working Drafts remain at edition 0.3. This text introduces no new ultimate constituents of reality.

141.1.2 1. Scope

This document proposes requirements for an implementation-neutral model of retained representations and their relationships. It distinguishes a represented target, an identifiable record about that target, revisions of that record, and views derived from those revisions. It covers records acting in several operational roles and relations whose participants can themselves be relational records.

Detailed transport, canonical serialization, authentication, evidential assessment, institutional review and legal admissibility are outside this edition. Candidate technical realization is supplied separately by GR-SPEC-120.

141.1.3 2. Reference basis

The internal conceptual dependencies are GR-100 WD 0.3 and GR-110 WD 0.3; epistemic qualifications draw on GR-200 WD 0.3. These dependencies are drafts, not adopted normative authorities. The source review identifies the relevant FM-007 passages, earlier manuscript distinctions and operational narrowing. The current manuscripts take precedence over conflicting assumptions in the earlier academia application, as recorded in ADR-0008.

141.1.4 3. Terms

record identity: identity of a retained representation within a declared identification scope; it does not establish the identity of the represented target.

record role: an operational classification as Entity, State, Event, Process, Relation or Property. Several roles can apply to one record.

incidence: one participation of a referenced record or represented target in a stated relational account, distinguished by its own identifier and role.

module: a versioned, identified part of a record's information envelope. A module's technical boundary does not establish a separate source of epistemic, legal or institutional authority.

141.1.5 4. Proposed information requirements

M120-001. A model shall distinguish record identity from claims about represented-target identity and shall declare the scope in which a record identifier is resolved.

M120-002. A model shall permit more than one applicable operational role and shall distinguish any primary display role from an exclusive classification claim.

M120-003. A model shall preserve a Relation as an identifiable record when its own description, provenance, properties or history is recorded. Reduction to an anonymous pair of endpoints shall not be its sole representation.

M120-004. A structured relational account shall identify its stated relation, participating references, participant roles, and whether each reference concerns the record or its represented target.

M120-005. Distinct incidences shall remain distinguishable when they reference the same participant. A model shall declare any profile restrictions on participant cardinality, self-reference, cycles, parallel relations and relations participating in other relations.

M120-006. A structured relational account shall distinguish a stated complete participant scope from a partial scope. A partial account shall retain its known limitations without requiring invented participant records.

M120-007. A model shall distinguish an untyped navigation reference from a stated semantic relation. Migration shall not assign substantive relation meaning solely because an earlier record contained a link.

M120-008. A module envelope shall identify its module kind, version, interpretation requirement and content. Consumers shall preserve uninterpreted optional content when changing unrelated supported content, or refuse the change with an explicit limitation.

M120-009. A consumer that cannot interpret a required module shall not represent a mutation as validated against that module's requirements. Its applicable mutation boundary shall be declared.

M120-010. A model shall distinguish occurrence descriptions and modality from recording time, revision order, epistemic basis and disputed status. Changing a stored representation shall not automatically imply a change in its represented target.

M120-011. Absent descriptions of temporal scope, identity criteria or context shall not be interpreted as proof of timelessness, resolved identity or unrestricted applicability.

M120-012. A profile shall declare unsupported representation needs, including cross-scope references, mixed epistemic grounds and unresolved participant identity, without asserting that the underlying GR theory excludes them.

141.1.6 5. Assessment and infrastructure need

An assessment identifies the model version, claimed clauses and profile. Inspectable cases include a record with two roles; a three-participant relation; repeated participation; a relation participating in another relation; a partial account; a migrated neutral link; and an unknown optional and required module. Rejection of a case is assessed against the declared profile restriction, not mistaken for a philosophical impossibility.

GR-SPEC-120 supplies UUID references, versioned JSON module envelopes, one-to-32 incidence entries, supported mutation operations and a validation package. These choices operationalize this draft for a pilot; JSON and these numerical bounds are not requirements of M120-001–012. The additive requirements below identify the need for GR-SPEC-121; they do not require one serialization or physical theory of time.

141.1.7 6. Open matters

Q-05–09 and Q-36 remain relevant. Cross-project reference disclosure, participant identity revision, richer epistemic structures and loss-aware imported modules need further development. A fully articulated model of State, Event and Process identity is not completed by this graph profile.

141.1.8 7. Additive temporal information requirements

This section develops R110-008/049 and M120-010/011 following the event-spacetime source review. FM-007 section 9.7 explicitly leaves partial-order events as a modeling obligation; FM-005 section 5.14 requires warranted continuity for trajectories. The requirements remain proposed Working Draft text.

M120-013. A temporal model shall distinguish a recorded precedence assertion, ordering derived from stated assertions, and recording ancestry. It shall preserve the source and qualifications of the assertions used in a reconstruction.

M120-014. A temporal model shall distinguish unknown ordering from asserted simultaneity, overlap, independence or causation. Display ranks or deterministic tie-breaking shall not create a substantive precedence claim.

M120-015. A temporal applicability account shall distinguish stated event or time boundaries, unresolved boundaries, explicit unboundedness within a scope, and absence of scope information. Its boundary convention and grounds shall be identifiable.

M120-016. A trajectory shall identify the subject grouping, continuity criterion or unresolved continuity, observational boundary and relevant temporal resolution. Shared labels or record identifiers shall not alone establish continuing target identity or unchanged state.

M120-017. Competing or inconsistent temporal accounts shall remain distinguishable and attributable. A model shall distinguish malformed representation from a conflict among structurally expressible claims and shall disclose when its selected claims do not support the requested temporal reconstruction.

M120-018. A model using event records as temporal boundaries shall declare the operational boundary interpretation and its limits for extended events, occurrence intervals and recording retention. Retaining a record shall not imply continued occurrence or applicability of its target.

Assessment includes an earlier occurrence recorded later, unsupported order, an unknown interval bound, competing chronology assertions, changed subject descriptions under one continuity claim, and retention of an Event account after its occurrence. Q-45–48 record the remaining projection, interval and interpretation questions. These cases identify needed evidence without asserting successful execution or standards adoption.

142 README

Original source: `standards/GR-120-information-model/README.md`.
Original source SHA-256: `78ade876b362267428e63bbf34b3c65f44bc3a8102371ff31d2b61f3da596c53`.

142.1 GR-120 — Generativity Information Model

Document class: Standards-track project outline
Status: Preliminary; not an adopted Standard

The bounded Working Draft 0.1 develops record identity, overlapping roles, first-class relations and module interpretation requirements. The earlier outline below is retained. GR-SPEC-120 supplies the experimental technical realization.

Define the implementation-neutral conceptual information model.

Expected concerns: - typed records; - relations; - identifiers; - temporal semantics; - versions; - provenance; - perspectives; - uncertainty; - branching.

143 GR 130

Original source: `standards/GR-130-interchange/GR-130.md`.
Original source SHA-256: `be54f968c0fe8d2dbeab5fb6a7a5be312ddb37df9cbe52a79e4185a67b41fb85`.

143.1 GR-130 — Generativity interchange requirements

Publication class: Standards-track Working Draft; not an adopted Standard
Maturity: Preparatory WD 0.1, 2026-09-22; proposed requirements for review
Scope of this edition: Coherent changes, recoverable acceptance and explicit exchange scope

143.1.1 Foreword

The historical project outline called this work “Generativity Interchange Specification.” This Working Draft states implementation-neutral requirements under the existing GR-130 code. The technically precise Git binding belongs to GR-SPEC-130. This clarification preserves the earlier outline and follows the programme’s publication taxonomy without asserting adoption.

143.1.2 1. Scope and references

This document concerns exchanges of retained record representations, modules and associated material. It proposes requirements for coherent multi-resource changes, conflict detection, retry handling, revision selection and exchange manifests. It does not define semantic truth, a universal institutional workflow, independent identity assurance, network federation or external legal validity.

Internal draft dependencies are GR-110 WD 0.3 and the bounded GR-120 WD 0.1. GR-SPEC-120 and GR-SPEC-130 provide one experimental realization. ADR-0008 records alternatives and the separation of record graphs, storage history and display projections.

143.1.3 2. Terms

transaction: a declared set of proposed changes submitted for one acceptance decision in a stated storage scope.

accepted revision: a retrievable state published by the accepting implementation after its declared validation and authority checks.

receipt: retained information identifying an accepted request, its attribution, reason, validation scope and resulting revision by a resolvable association.

exchange package: a declared selection of records and material, accompanied by sufficient scope and version information to identify included and omitted classes of content.

143.1.4 3. Proposed interchange requirements

I130-001. An interchange profile shall identify its version, the information model and profile it carries, supported operations, interpretation rules and limits.

I130-002. A transaction shall identify its request, intended base revision, proposing actor or attributable acceptance context, change reason and declared changes. Attribution shall not be presented as independent authentication unless the claimed assurance is established separately.

I130-003. When several changes are submitted as one transaction, acceptance shall publish their coherent resulting state or publish none of them. Validation shall resolve references against that resulting state, including records introduced by the same transaction.

I130-004. A transaction shall not silently overwrite a changed base. An implementation shall reject the stale proposal or perform a separately declared, inspectable reconciliation procedure.

I130-005. A profile supporting retry shall define logical request equivalence independently of incidental transport encoding. Repeating an accepted equivalent request shall identify its original acceptance; reusing its identifier for a different request shall be rejected.

I130-006. Retry recognition shall survive ordinary service restart and later accepted revisions. A receipt shall not require a circular representation in which its content includes a digest that depends on that same content.

I130-007. An accepted transaction shall retain its reason, attribution, declared change categories and validation scope. A mechanically produced storage change shall not automatically be classified as a recorded Event.

I130-008. A receiver shall verify supplied byte lengths and content identifiers against received material before accepting references that assert those values. A content digest shall not be presented as establishing the material's truth, independence or evidential sufficiency.

I130-009. A revision-selecting exchange shall identify one coherent revision for its records, participant references, modules and associated material. Present authorization and historical content selection shall remain distinct decisions.

I130-010. An export shall identify its revision, version, scope and material omissions. A snapshot shall not be labelled a complete historical backup when earlier revisions, receipts, unreferenced retained material, account records or authority mappings are excluded.

I130-011. A migration shall identify its source format, target format, operation and limitations; it shall preserve earlier revision access within the declared preservation policy. The receiver shall not silently add substantive meaning to earlier neutral references.

I130-012. A profile shall distinguish successful acceptance, conflict, unsupported content and inability to determine acceptance. A client facing an uncertain response shall retain enough request identity to determine whether retry is equivalent.

143.1.5 4. Assessment and infrastructure need

Assessment uses complete resulting-state comparison after success, induced validation/storage failures, concurrent writers, duplicate submissions before and after restart, altered reuse of an identifier, tampered bytes and historical export inspection. A positive result applies only to the exercised binding and declared scope.

The identified infrastructure need is a reusable record transaction vocabulary and acceptance binding. GR-SPEC-120 defines the former; GR-SPEC-130 defines the first binding, using Git object preparation and conditional reference publication. Git ancestry is recording provenance, not occurrence chronology or a restriction that semantic graphs be acyclic.

143.1.6 5. Open matters

Federated identity, detached signatures, offline reconciliation, loss-aware imports, physical storage quotas and independent preservation custody remain open. No compatibility with the earlier academia application's signed transition format is claimed. A later adapter needs byte-preservation and interpretation tests before any such claim.

144 README

Original source: `standards/GR-130-interchange/README.md`.

Original source SHA-256: `287826884012d704a70c5681159cb473d01d68409f10069d8e5a4c873b0c18b4`.

144.1 GR-130 — Generativity Interchange Specification

Document class: Standards-track project outline
Status: Preliminary; not an adopted Standard

The bounded Working Draft 0.1 states implementation-neutral interchange requirements. Its title clarifies the standards-track role of GR-130; the historical outline below retains its original wording. The separate GR-SPEC-130 supplies the experimental Git/HTTP binding.

Define machine-readable interchange.

Candidate representations: - JSON-LD; - RDF; - YAML; - schema validation.

145 GR 140

Original source: `standards/GR-140-presentation/GR-140.md`.
Original source SHA-256: `61551ef7549d7a4e3dba2d217e54d3a4932effb5e0617c474d9abefbe48ff49b`.

145.1 GR-140 — Generativity presentation requirements

Publication class: Standards-track Working Draft; not an adopted Standard
Maturity: Preparatory WD 0.1, 2026-09-22; proposed requirements for review
Scope of this edition: Record-graph projection, historical consistency, inspectable interaction and bounded event-cut topology
Additive revision: 2026-09-22 event-spacetime requirements; earlier requirement IDs retained

145.1.1 1. Scope and reference basis

This bounded draft addresses how a record graph is displayed and edited without confusing its visual arrangement with claims about reality. It develops the earlier outline using GR-100/110/200 WD 0.3, GR-120 WD 0.1 and the source analysis in the graph semantics review. Section 6 adds event-cut topology needs grounded in the temporal design. Complete trajectory reconstruction, physical/interval timeline semantics, public redaction and all accessibility obligations remain outside this edition.

145.1.2 2. Terms

projection: an explicitly selected view derived from a declared record revision and display policy.

incidence view: a projection representing a Relation as an identifiable node and its participant incidences as role-labelled connections.

display state: position, zoom, selection and comparable presentation preferences that do not themselves assert a change to a represented target or record.

145.1.3 3. Proposed presentation requirements

P140-001. A presentation shall identify the revision and projection being displayed, and distinguish a historical selection from the currently published revision.

P140-002. A coherent historical view shall resolve participant labels, record content, modules and associated material from the selected revision. It shall not silently substitute current values into that historical view.

P140-003. A projection shall preserve access to the identity, description and qualifications of each represented Relation, including when a simplified binary edge is used. The projection shall disclose the treatment of unary, repeated and higher-order participation.

P140-004. A projection shall distinguish neutral navigation references from stated semantic relations. Position, proximity, colour, edge direction and size shall not imply unsupported causality, certainty, normative approval or legal status.

P140-005. A filtered view shall disclose that filtering occurred and provide an indication of omitted records or incidences. An unavailable or uninterpreted participant shall not be silently rendered as if its absence were known to be semantically immaterial.

P140-006. A partial relational account shall expose its declared incompleteness and qualifications. An unstructured Relation account shall remain inspectable without invented incidences.

P140-007. View manipulation shall be distinguished from recorded changes. A user shall be able to identify when an action merely rearranges a display and when it proposes a retained, attributed change.

P140-008. A relation-creation interface shall expose participant selection, roles, reference scope and completeness sufficiently for the user to inspect the resulting account before submission. Two clicked nodes alone shall not silently determine an unqualified substantive relation.

P140-009. A client shall preserve a pending change after a detected revision conflict and expose a review route before resubmitting it against a new base. A historical view shall not offer an ambiguous mutation that appears to edit the past.

P140-010. Important graph-inspection and creation functions shall have an alternative that does not require precise pointer manipulation of the graph canvas. The declared assessment scope shall distinguish presence of controls from demonstrated accessibility.

P140-011. Unsupported optional modules and application limitations shall remain visible as interpretation limitations. A successful diagram render shall not be presented as whole-record validation, factual confirmation or programme conformance.

145.1.4 4. Assessment and infrastructure need

Test cases compare the visible view with selected-revision records, rename a participant in a later revision, filter a participating record, inspect higher-order and repeated relations, change layout without changing history, create a connection through both pointer and form controls, and preserve a draft across conflict. Automated browser checks are useful but do not substitute for assistive-technology and participant evaluation.

GR-SPEC-120's incidence projection supplies a reference graph representation. The pilot uses a canvas renderer and a parallel record list, participant form and inspector. No particular graph library or layout algorithm is required by this draft.

145.1.5 5. Open matters

Q-14, Q-25 and Q-40 cover evaluation and accessibility. Layout stability across large revisions, comparative projections, missing/restricted cross-project participants, redaction and comprehensive generative trajectory views remain open.

145.1.6 6. Additive event-spacetime presentation requirements

P140-012. A temporal presentation shall identify both the recording revision used and its represented temporal selection. It shall distinguish an event-defined cut, a display layer and an identified physical or calendar time.

P140-013. A partial-order presentation shall disclose incomparable events without presenting them as established simultaneous occurrences. A chosen linearization, when used, shall expose its arbitrary ordering choices rather than present them as recovered facts.

P140-014. A temporal topology shall disclose its applicability rule, omitted or indeterminate records, and partially displayed relation incidences. A record excluded for missing scope shall not be presented as proof that its target was absent.

P140-015. A chronology conflict shall remain inspectable with its responsible assertions. A presenter shall not silently discard conflicting claims to produce an apparently coherent temporal graph and shall state when the selected account does not support that projection.

P140-016. A trajectory presentation shall preserve access to its grouped descriptions, continuity basis and competing qualifications. It shall distinguish its inferred or stipulated temporal connections from causal-generative attribution and from execution of a state-transition model.

P140-017. Selecting a temporal view shall remain distinguishable from changing retained accounts. A historical selection shall not alter current records or silently resolve its event boundaries through newer descriptions.

GR-SPEC-121 supplies one experimental module and cut-projection realization. Review cases include retrospective insertion, alternative incomparable cuts, cycles, unknown applicability, omitted participant incidences and historical versions. Automated checks of these cases do not establish participant comprehension, full accessibility or the truth of a reconstruction. Q-45–48 preserve those remaining questions.

146 README

Original source: `standards/GR-140-presentation/README.md`.

Original source SHA-256: `2cb0f4b188fb155e883b03978a462ec479cda930b9a0af8716422ce4a144ddbc`.

146.1 GR-140 — Generativity Presentation Requirements

Document class: Standards-track project outline
Status: Preliminary; not an adopted Standard

The bounded Working Draft 0.1 develops graph-projection, historical consistency, omission disclosure and inspectable interaction requirements. The earlier outline below remains the broader project scope.

Define requirements for presenting and reconstructing generative trajectories.

Candidate views: - timeline; - generative graph; - branch view; - provenance view; - judgment/reinterpretation view; - public/redacted view.

147 README

Original source: `standards/GR-150-conformance/README.md`.
Original source SHA-256: `2cf0ebae05a2caee0d369dfcbf610c221377c07b31b938fc5e0bb6435102356a`.

147.1 GR-150 — Conformance and Validation

Document class: Standards-track project outline
Status: Preliminary; not an adopted Standard
Define conformance claims, validation rules, profiles, and test suites.

148 GR 160

Original source: `standards/GR-160-preservation-access/GR-160.md`.
Original source SHA-256: `df1eca7eebf50a4866aaa5e206030e3e9cb73fd729daeb25e2921a94423cf605`.

148.1 GR-160 — Preservation, privacy, access and retention

Publication class: Standards-track Working Draft; not an adopted Standard
Maturity: Preparatory WD 0.1, 2026-09-22; proposed requirements for review
Scope of this edition: Associated material, access boundaries and honest retention semantics

148.1.1 1. Scope and reference basis

This bounded draft addresses retained file material associated with record revisions and the distinction between removing a current reference and erasing historical bytes. It develops the existing project outline using GR-110 WD 0.3, the programme's separation of legal and technical authority, and GR-120/130 WD 0.1.

It does not prescribe a universal retention period, legal basis, jurisdiction, evidentiary admissibility or duty to preserve. Institutional and jurisdictional decisions need their own authority and procedures. A technically valid operation cannot create that authority.

148.1.2 2. Terms

retained material: bytes maintained within a declared custody and access scope and referenced through a recorded descriptor.

reference detachment: removal of a current record's association with retained material; it does not imply erasure of historical associations or bytes.

preservation scope: the declared revisions, bytes, descriptors and contextual information retained under an identified arrangement.

148.1.3 3. Proposed preservation and access requirements

A160-001. An implementation shall distinguish mutable working files from material retained as part of a record revision and shall identify the applicable preservation scope.

A160-002. A retained-material descriptor shall identify the bytes, their length, descriptive filename and media type, and the recorded upload attribution and time. The implementation shall distinguish asserted media type from verified content characteristics.

A160-003. A replacement shall preserve the association between the earlier descriptor and earlier retained bytes within the declared history policy. A current filename shall not determine the identity of historical material.

A160-004. Before detachment or withdrawal, a user interface shall describe whether earlier versions and bytes remain retained. The implementation shall not label detachment as erasure when bytes remain retrievable through history or exported backups.

A160-005. Access to material shall be checked within its project and selected record-revision context. Knowledge of a content identifier alone shall not establish access authority.

A160-006. Historical content selection shall not bypass present access control. An implementation shall declare how authorization changes affect earlier revisions and already released exports.

A160-007. User-supplied filenames shall be treated as descriptive metadata and shall not authorize filesystem traversal, arbitrary storage paths or executable interpretation. A presentation shall declare any active-content preview capability and its protection boundary.

A160-008. Preservation limits shall state which resource they measure, including whether they concern current references, all retained content, physical storage or exported material. A logical content limit shall not be represented as a physical storage quota.

A160-009. Export and backup instructions shall identify included and excluded material, account/authority information and historical content. Restore claims shall identify the procedure and exercised evidence supporting them.

A160-010. Where an implementation lacks restriction, erasure, independent custody or recovery procedures, it shall declare those limitations without asserting that technical retention overrides applicable institutional or legal requirements.

148.1.4 4. Assessment and infrastructure need

Assessment includes byte verification, replacement and detachment across revisions, unauthorized identifier-based access, filenames containing path syntax, excluded unreferenced bytes in snapshot packages, included history in full bundles and observed limit failures. Declared institutional retention and restoration procedures require separate review and operation evidence.

The pilot's identified infrastructure need is an atomic association between descriptors and retained bytes. GR-SPEC-120 supplies descriptors and file operations; GR-SPEC-130 supplies bounded content-addressed Git storage. The selected first binding retains previously accepted assets, even after detachment. This explicit experimental policy is not a universal preservation requirement.

148.1.5 5. Open matters

Q-11, Q-35 and Q-39 retain erasure, sealing, restriction, backups, repair and custody questions. External material stores, sensitive use, malware inspection, storage reclamation and independently tested restoration need further work before broader deployment claims.

149 README

Original source: `standards/GR-160-preservation-access/README.md`.
Original source SHA-256: `7a05237248140cdfb19666a2e646da30e4b91ac329316e11de837a3fe41ea9b6`.

149.1 GR-160 — Preservation, Privacy, Access, and Retention

Document class: Standards-track project outline
Status: Preliminary; not an adopted Standard

The bounded Working Draft 0.1 develops retained-material descriptors, historical byte access, detachment/erasure distinctions and declared preservation limits. The earlier outline below remains the broader project scope.

Define preservation states, access controls, sealing, restriction, anonymization, retention, deletion, and long-term interpretability.

150 README

Original source: `standards/GR-200-epistemic-recording/README.md`.
Original source SHA-256: `fb4929b8b0d0a661fcffdc65398322f73468ff232489a95c294c842bca2130be`.

150.1 GR-200 — Epistemic Recording Framework

> **Developed draft available:** Working Draft 0.3 source and compiled PDF. The Markdown outline below is retained as historical planning context; its candidate choices are not adopted. Current requirements and unresolved decisions are in the TeX draft.

Document class: Standards-track project outline
Status: Preliminary; not an adopted Standard
Provisional scope:

- observations;
- traces;
- claims;
- evidence;
- interpretations;
- judgments;
- attribution;
- perspectives;
- uncertainty;
- contestation;
- revision.

This standard should clarify how epistemic status is represented without collapsing it into the underlying event or entity record.

151 README

Original source: `standards/GR-210-evidence-interpretation/README.md`.
Original source SHA-256: `28568a079023e1c6b98fae066fb8da5594a29b9c1c6be7e123f691452bb9a7bf`.

151.1 GR-210 — Evidence, Interpretation, and Contestation

> **Developed draft available:** Working Draft 0.3 source and compiled PDF. The Markdown outline below is retained as historical planning context; its candidate choices are not adopted. Current requirements and unresolved decisions are in the TeX draft.

Document class: Standards-track project outline
Status: Preliminary; not an adopted Standard
Provisional scope:

- evidentiary provenance;
- direct vs inferred records;
- confidence and uncertainty;
- conflicting interpretations;
- annotation and reply;
- retrospective reinterpretation;
- evidentiary chains.

152 README

Original source: `standards/GR-300-jurisprudential-interface/README.md`.
Original source SHA-256: `9e5833527ee3edff0f0129685e1f25577b7064a2c347cea3017cafe9e2f8a604`.

152.1 GR-300 — Jurisprudential Interface

Document class: Standards-track project outline
Status: Preliminary; not an adopted Standard

This document is expected to define a standards-facing interface to legal and jurisprudential use.

Potential topics:

- legal metadata;
- evidentiary status;
- attribution;
- procedural history;
- contested records;
- correction and annotation;
- jurisdictional profiles.

It should not attempt to create substantive legal obligations by itself.

153 README

Original source: `standards/GR-310-rights-duties-procedure/README.md`.
Original source SHA-256: `1c293c90006941fdb65003658dcacce41e62d12d1155708c7d074eaafd7253cf`.

153.1 GR-310 — Rights, Duties, and Procedural Profiles

Document class: Standards-track project outline
Status: Exploratory; not an adopted Standard
Potential profiles may address:

- access;
- correction;
- annotation;
- objection;
- restriction;
- preservation;
- destruction;
- notice;
- review;
- procedural fairness.

Any jurisdiction-specific implementation should be separately profiled and legally reviewed.

154 README

Original source: `standards/GR-400-governance-institutional-use/README.md`.
Original source SHA-256: `59e3638d4ca5319bd00cd38b48bafaee573767359b85d79f799f02222366ca2d`.

154.1 GR-400 — Governance and Institutional Use

Document class: Standards-track project outline
Status: Preliminary; not an adopted Standard
Potential scope:

- institutional adoption;
- decision-process records;
- research governance;
- AI-assisted workflows;
- public-sector use;
- archival governance;
- oversight and audit;
- organizational memory.

155 GR TR101 theoretical foundations

Original source: `technical_reports/GR-TR101-theoretical-foundations.md`.
Original source SHA-256: `b286a611889f21d8c5e6327fb3e944b8adf6617f3eaf99040b34650438c121f9`.

155.1 GR-TR101 — Theoretical Foundations

Status: Placeholder

This technical report will hold philosophical and theoretical material that informs the standards but should not be embedded directly into normative requirements.

Planned topics:

- generativity and manifestation;
- relational emergence;
- recordability and historical judgment;
- future re-recognizability;
- contingency;
- generativity return;
- record absence and archival silence.

156 GR TR102 category theoretic semantics

Original source: `technical_reports/GR-TR102-category-theoretic-semantics.md`.
Original source SHA-256: `a932e5370d801ba4ad01e5dce2dfb6ed518e0f2e03a3eead7a96a7a891633054`.

156.1 GR-TR102 — Category-Theoretic Semantics

Status: EXPERIMENTAL
Candidate topics:

- categories of states and transformations;
- event generators and process composition;
- spans/cospans for first-class relations;
- profunctors and relational semantics;
- double categories for relations and transformations;
- fibrations/indexing for persistence across contexts;
- functorial observables for properties;
- evolving discrimination/equivalence structures.

The core standards should not depend on any one of these constructions until the semantics are stable.

157 ADR

Original source: `templates/ADR.md`.
Original source SHA-256: `6c4d9bba614a0268c1b92b8da207f8453942f8bbfaa983db8e2a485c4838d4ea`.

157.1 ADR-XXXX — Decision title

Status: Proposed

157.1.1 Context

157.1.2 Decision

157.1.3 Alternatives considered

157.1.4 Rationale

157.1.5 Consequences

157.1.6 Affected documents

157.1.7 Supersedes

157.1.8 Superseded by

158 new work item proposal

Original source: `templates/new_work_item_proposal.md`.
Original source SHA-256: `c4b05eafdfea2090529887685b7c293680158110127ad67fc4abd2e460f5b3bd`.

158.1 New Work Item Proposal

Document class: Informative governance template
Status: PROVISIONAL; completion does not approve work
Version: 0.2
Responsible editor: UNASSIGNED
Source: `templates/new_work_item_proposal.md`
Historical draft basis (0.1): Directives Part 1, version 0.1, D1-009–D1-013; Directives Part 2, version 0.1; GR/TC 1 Charter, version 0.1.

The template remains an initial 0.1 aid. The expanded 0.2 normative schedules govern any assessment against 0.2; completing this template alone does not cover their additional obligations.

Use supported information, `OPEN`, `UNASSIGNED`, or an explained `not applicable`. A preliminary proposal can expose missing capacity without claiming authorized project status. The actual decision authority completes the decision fields separately.

158.1.1 Identifier

- Proposal identifier: `[retain existing identifier where assigned]`
- Version, date, source location, and revision:
- Current status: `Preliminary proposal — not approved`
- Related issues and decisions:

158.1.2 Proposed title

```
[bounded work; retain existing project title where applicable]
```

158.1.3 Proposer

- Name, contact or protected-contact route, and capacity:
- Institutional representation, if claimed, and evidence of mandate:
- Relevant affiliations, funding, interests, and contribution permissions:

158.1.4 Problem statement

Describe the recognition, evidential, archival, or practical problem, affected people, baseline, and evidence. Explain its connection to symbolic crisis, warranted and revisable recognition, or generative trajectories. Distinguish demonstrated need from predicted benefit.

- Objective and observable evidence of improvement:
- Uncertainty and limits of expected effects:

158.1.5 Scope

- Bounded practices, records, actors, or interactions:
- Intended use, environment, applicable conditions, and conformance subjects:
- Relationship between changes in the situation, evidence/judgment, and categories/methods:

158.1.6 Out of scope

State exclusions, including limits on truth certification, legal determination, institutional authority, and policy choice where relevant. Identify adjacent work requiring a separate scope decision.

158.1.7 Need for standardization

- Why shared requirements are useful:
- Alternatives: existing infrastructure/practice, guidance, research, Specification, policy proposal, or deferral:
- Reasons for selected route and risks of premature standardization:

158.1.8 Intended users

- Users and expected tasks:
- People represented, evaluated, or affected:
- Readers/reviewers and resource, language, accessibility, or connectivity constraints:

158.1.9 Stakeholders

Interest or affected perspective	Contribution needed	Actual participation/ outreach evidence	Gap and response
`[interest]`	`[knowledge/experience]`	`[actual/proposed/unavailable]`	`[action and owner]`

Separate situated knowledge from a mandate to represent others. Record concentrated affiliations, funding, infrastructure control, and participation burdens.

158.1.10 Existing standards and related work

Exact source/edition and passage	Verified content/access limits	Reuse, difference, or gap	Compatibility evidence needed
`[primary source]`	`[verified/partial/unavailable]`	`[proposal]`	`[assessment]`

158.1.11 GR foundation interpretation

Manuscript identifier, file, and passage	Actual terminology/ formulation	Proposed operational use	Differences, uncertainty, and needed ADR
`[FM identifier and section/ page]`	`[source meaning]`	`[bounded interpretation]`	`[OPEN or decision reference]`

Identify new classes, changed terminology, or narrowing. Preserve differing manuscript formulations instead of declaring equivalence by assumption.

158.1.12 Proposed deliverables

A standards-track Working Draft is not an adopted Standard. A protocol is contained in a Specification or Standard, not a separate authority class.

Existing code/ proposed identifier	Title	Principal publication class and maturity	Bounded scope/ conformance subject	Editor	Dependency and evidence
`[identifier]`	`[title]`	`[class; draft status]`	`[specific contribution]`	`UNASSIGNED`	`[dependency/assessment]`

158.1.13 Specifications, protocols, and dependencies

- Draft requirement or procedural need requiring reusable infrastructure:
- Proposed Specification, alternatives, and relationship to standards-track work:
- Protocol participants, inputs, preconditions, interactions, states/transitions, outputs/effects, authority, failures/refusals, and recovery:
- Exact normative dependency versions and maturity; informative sources separately:
- Circularity, unavailable dependencies, access/rights constraints, and change coordination:
- Governance versions proposed for the decision and actual adoption record or `NOT ADOPTED`:

158.1.14 Required expertise

Review domain	Concrete question	Competence or affected perspective needed	Accepted reviewer	Gap and progression consequence
Epistemic/ conceptual	`[question]`	`[competence]`	`UNASSIGNED`	`[gap]`
Ethics/ participation	`[question]`	`[competence/perspective]`	`UNASSIGNED`	`[gap]`
Jurisprudential/ institutional	`[context/authority]`	`[relevant expertise]`	`UNASSIGNED`	`[gap]`
Political economy/ public policy	`[burden/control/options]`	`[competence/perspective]`	`UNASSIGNED`	`[gap]`
Archival/ protection/security	`[question]`	`[competence]`	`UNASSIGNED`	`[gap]`
Technical/ accessibility/ human use	`[question]`	`[competence/perspective]`	`UNASSIGNED`	`[gap]`

Explain non-applicability; keep unavailable assessment visible. Split rows where findings or reviewers differ.

158.1.15 Risks

Risk or unresolved question	Evidence/ uncertainty	Affected people/ dependencies	Alternative or mitigation	Owner/review point	Progression effect
`[risk]`	`[basis]`	`[effect]`	`[action]`	`UNASSIGNED`	`[narrow/defer/review]`

Consider recording/review burdens, exclusion, coercive visibility, privacy, misleading authority, source rights, dependency, and maintenance. Legal assertions need a named context and primary-source review; a field does not create a right or duty.

158.1.16 Expected implementation or pilot evidence

- Case/baseline; synthetic, programme history, or actual external institution:
- Actual authority, participation, access, and permissions:
- Tested draft versions and requirement identifiers:
- Positive cases, counterexamples, failures, and protected/unavailable evidence:
- Human tasks, procedural review, structural checks, and exchange tests, with separate results:
- Success/failure criteria, burdens, and evidence limits:
- Challenge, correction, stopping, repair, and feedback arrangements:
- Independent review/implementation claim and supporting evidence, if proposed:

Synthetic exercises do not establish external participation, independent validation, truth, legal validity, or restored trust.

158.1.17 Proposed project lead

- Person: `UNASSIGNED`
- Accepted mandate, interests, role combinations, resources, and substitute:

158.1.18 Proposed working group

- Existing committee or proposed bounded group:
- Actual accepted members/capacities, separate from prospective invitations:
- Reason for a new group; coordination and review/closure point:

158.1.19 Resources, milestones, and maintenance

- Work, review, accessibility, preservation, and funding/in-kind resources:
- Funding conditions and infrastructure control:
- Milestones and progression evidence:
- Contribution/publication rights decisions:
- Maintenance owner: `UNASSIGNED`
- Issue intake, review interval, continuity, and closure conditions:

158.1.20 Decision

Initial value: `PENDING — no decision entered.`

☐ Accept
☐ Revise
☐ Defer
☐ Reject

Completed by the actual authority or explicitly marked **SYNTHETIC REHEARSAL**:

- Decision identifier/date, decision maker, mandate, and authority record:
- Operative Charter/Directives versions and input proposal/evidence versions:
- Conflicts, recusals, and substitute authority:
- Review participation, gaps, objections, replies, and ballot if required:
- Precise authorized scope, deliverable classes/status, and accepted assignments:
- Resources, conditions, unresolved issues, owners, and next actions:
- Notice, procedural challenge route, and resulting project/revision record:

158.1.21 Rationale

Record issue, alternatives, selected direction, reasons, remaining dissent, and affected publications. Acceptance approves only the stated work; it does not adopt outputs as Standards or authorize an external institution’s participation.

159 public comment

Original source: `templates/public_comment.md`.
Original source SHA-256: `d5c29ce63ebaead2595d84ffdf09409f2925003b26c2e47c8d4ce0c029b53b60`.

159.1 Public Comment

Document class: Informative governance template
Status: PROVISIONAL template for comments, dispositions, and rehearsal
Version: 0.2
Responsible editor: UNASSIGNED
Source: `templates/public_comment.md`
Historical draft basis (0.1): Directives Part 1, version 0.1, D1-018–D1-028; Directives Part 2, version 0.1.

The template remains an initial 0.1 aid. The expanded 0.2 normative schedules govern any assessment against 0.2; completing this template alone does not cover their additional obligations.

Free-text comments are welcome: this form is an aid, not an eligibility test. Commenters need not supply redrafted clauses, credentials, or decision identifiers. Programme staff complete receipt, disposition, and decision fields. This template establishes no live review or appointed staff role.

159.1.1 Comment identification

- Comment ID:
- Draft: `[title, identifier, class, version, and location if known]`
- Clause: `[requirement identifier, section, or topic; approximate location is acceptable]`
- Commenter: `[name/capacity or protected-contact arrangement]`
- Stakeholder category: `[optional self-description; no mandate inferred]`
- Type: Editorial / Technical / Normative / Epistemic / Governance / Ethics / Legal-institutional / Accessibility / Privacy / Other
- Relevant affiliation, interest, or institutional mandate, if claimed:
- Preferred reply route:
- Disclosure preference: public attribution / public comment without public name / protected handling requested:
- Reason for protected handling and safe public summary, if appropriate:

Use the announced protected route for sensitive material. The receiving function explains confidentiality/access limits before treating a submission as protected. Avoid placing private contacts or restricted evidence in a public issue merely to complete this form.

159.1.2 Comment

Describe the issue, affected people/behavior, and why it matters. Distinguish evidence, source interpretation, policy proposals, and uncertainty where relevant.

- Concrete example or counterexample:
- Evidence/source locations and access limits:
- Consequences for scope, meaning, conformance, burden, protection, or use:
- Urgent protection, rights, or validity concern, if any:

159.1.3 Proposed change

Optional wording, alternative, review question, or requested outcome. A useful concern does not depend on having a complete solution.

159.1.4 Receipt and route — programme staff

- Stable identifier, actual receipt timestamp/time zone, and review notice:
- Draft version and review opening/closing timestamps:
- Acknowledgement date/reference; target calculated from operative D1-020:
- Handling owner: `UNASSIGNED`
- Disclosure/access arrangement and evidence custodian:
- Route: technical/editorial consideration / procedural appeal / ethics report / record access or correction / other:
- Assisted referral and notice if initially misrouted:
- In scope / out of scope / duplicate / late, with reasons and linked record:
- For late material: current-cycle consideration or later referral; assessment of urgent material defects:

159.1.5 Disposition

Initial value: `PENDING — no disposition entered.`

☐ Accepted (Accept)
☐ Accepted with modification (Accept with modification)
☐ Deferred (Defer)
☐ Not accepted (Reject)

Use D1 disposition labels in the maintained register. Out-of-scope or duplicate comments retain their identifiers, reasons, and linked handling record.

- Reviewers/capacities, conflicts, recusals, and substitutes:
- Evidence examined, unavailable grounds, and related/competing comments:
- If deferred: owner, next action/date, and reason the issue does or does not prevent progression:

159.1.6 Rationale

Explain alternatives considered, response to material grounds, selected direction, evidence limits, and remaining disagreement. A label or vote count alone is not a disposition reason.

159.1.7 Resulting change

- Requirement identifiers and affected artifacts:
- Before/after text or versioned change; resulting draft version:
- Editorial or substantive, with reasons:
- Effects on unchanged clauses, dependencies, conformance, and affected people:
- Re-review: none with editorial justification / material-change review / renewed scope and full review:
- Re-review notice, dates, and affected-party outreach:

159.1.8 Notification, reply, and remaining disagreement

- Notification date/route and reply deadline under operative D1-023, with time zone:
- Reply/date or `no reply received`:
- Review of reply, reasons, resulting change, and remaining objection:
- Effect on progression and communicated procedural challenge route:
- Commenter agreement if explicit; silence is not agreement:

159.1.9 Decision record

- Decision identifier/date, input versions, and actual decision authority:
- Operative governance edition, mandate, and decision rule:
- Evidence/disposition links, outcome, limits, actions, and owners:
- Public account, protected annex reference, custodian, and retention decision:

- Status: pending / disposed with reply pending / reply considered / referred / closed with reasons:

Rehearsal flag: `[actual review / SYNTHETIC REHEARSAL]`. A synthetic response does not establish an actual commenter, public review, or independent decision.

160 requirement assessment

Original source: `templates/requirement_assessment.md`.
Original source SHA-256: `2c8b41a5a43fd6f106a969c959d7e3c3601da1c407dbda70407031c087e1bcfa`.

160.1 Requirement assessment record

Document class: Informative template
Status: PROVISIONAL; version 0.1. An unfilled template is not evidence of assessment or conformance.

160.1.1 Assessment declaration

- Assessed subject and boundary: [publication / vocabulary application / package / practice / case / procedure; exact version and included population]
- Purpose and intended users: [text]
- Governing publication and dependency editions: [identifiers, versions and source/PDF hashes where applicable]
- Profile and authority: [declared profile and basis, or no adopted profile]
- Assessor, competence, relationship to authors/operator and conflicts: [actual people/roles; unresolved capacity stays explicit]
- Dates and environment: [actual assessment dates, tools, exercise conditions]
- Evidence boundary and access: [supplied material, unavailable sources, protection arrangements, selection and limitations]
- Claim permitted by this assessment: [bounded statement; partial documentary review is not full practice/procedure fulfillment]

160.1.2 Requirement ledger

Create a row for every requirement within the declared assessment boundary, including failed and unassessed requirements. A grouped narrative does not replace individual results. Separate components when a clause's recording and behavioral obligations need different evidence.

Requirement and edition	Trigger / applicability reason	Method and actual evidence locator	Result	Assessor / date	Limitation or required action
[ID]	[condition]	[document inspection, recalculation, observed exercise, user task, expert review; exact record]	[one result below]	[actual attribution]	[text]

Result meanings:

- **Fulfilled:** The supplied evidence supports the required outcome within the stated boundary; include reasons.
- **Not fulfilled:** A required outcome fails; identify the evidence and consequence.
- **Not assessed:** Assessment was not performed or required evidence cannot be examined. An unknown, inaccessible source or unobserved action is not automatically a pass.
- **Not applicable:** The requirement's declared trigger is absent; identify that trigger and grounds. Changing the assessment subject does not silently remove an obligation.

A draft can require recording a justified unknown without requiring the historical fact itself to be settled. In that case, assess the stated recording obligation, and keep uncertainty about the substantive fact distinct from the result.

160.1.3 Counterexamples and unresolved results

Case	Deliberate defect or failure condition	Expected outcome	Actually observed outcome and evidence	Follow-up
[ID]	[text]	[expectation]	[actual result, or not exercised]	[owner/action]

Include ordinary and relevant failure cases for procedure assessment. An authored successful sequence is a design fixture, not an observed run. State whether notice, receipt, independent review, enforcement, correction propagation and remedy were actually examined.

160.1.4 Report and downstream use

- Supported overall conclusion: [include failures, unassessed applicable requirements and profile limits]
- Review/objection route and decision authority: [actual arrangement or unavailable]
- Affected requirements, artifacts and known dependent uses: [identifiers]
- Correction/reassessment action and owner: [text]
- Retention, access and publication decision for this report: [contextual basis; no automatic publicity of protected evidence]

Structural validity, source authenticity, factual warrant, ethical evaluation, legal status and institutional performance are different conclusions. Report only the conclusions the evidence supports.

A Metamodel for Ontologically Heterogeneous Social Dynamics

Part I: The Highest Abstract Layer

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Abstract

This is the first paper of a series. It fixes the highest abstract layer, and it goes no further.

Dynamical modeling of social systems ordinarily begins by fixing a state space. This is already a commitment, and across domains it is one that cannot be met. The states of a normative order, a power configuration, a value system, and a network of recognition inhabit no common manifold and admit no common metric—and the obstacle is not that such a space is hard to construct but that these are not objects of a kind that admit a common placement. The heterogeneity is ontological, not practical, and it is not answered by better instruments. The proposal here is to begin one layer lower, at a level where change, structure, constraint, and difference are defined but not yet realized. Four axioms are given. The carrier of states is left without structure. The mechanisms acting upon it form a semigroup: associative, without inverses, without an identity. A congruence records what any mechanism is obliged to preserve. And difference is defined—not as a residue, not as a distance—as the set of distinctions a mechanism collapses. From these, four propositions follow that were not assumed: collapse is irreversible; a group of mechanisms has no collapse at all, and hence no history; a mechanism is non-destructive exactly when it is injective modulo the congruence; and collapse accumulates monotonically under composition. The absence of inverses is shown to be the load-bearing commitment. This paper does not instantiate the metamodel, does not apply it, and derives no substantive result about any particular social system. Those belong to subsequent parts. What is established here is only what a social dynamical system must be able to say, and the price of saying it.

Keywords: dynamical systems; social dynamics; semigroup action; congruence; collapse; irreversibility; formal social theory; generative relational being.

AI usage statement: The ideas, claims, and theoretical framework of this paper originate with the author. AI tools were used as an aid in drafting, in the location and verification of sources, and in revision. The origin of each idea has been verified by the author, who takes full responsibility for the content.

Recap

The metamodel in full. $\mathcal{S}$ is a set without further structure; $\mathcal{M}$ is a semigroup, with neither identity nor inverses; $\sim$ is an equivalence relation on $\mathcal{S}$.

(Change)	$\alpha : \mathcal{M} \times \mathcal{S} \longrightarrow \mathcal{S}, \qquad (m, x) \longmapsto m(x)$
(Structure)	$\alpha(m_1 m_2,\, x) \;=\; \alpha(m_1,\, \alpha(m_2, x))$
(Constraint)	$x \sim y \implies \alpha(m, x) \sim \alpha(m, y)$
(Difference)	$\Delta(m) \;=\; \{\, (x, y) \;:\; x \not\sim y \;\wedge\; \alpha(m, x) \sim \alpha(m, y) \,\}$

Sections 1–3 give the reasons for these four lines, §4 their consequences, and §5 what they decline to settle. The consequences, which were not assumed, are that collapse is irreversible, that irreversibility requires the absence of inverses, and that a mechanism destroys nothing when it is injective modulo $\sim$.

1 Introduction

1.1 The formalism is layered; this paper gives the topmost layer

The programme to which this paper belongs proposes a formalism for social dynamics at several levels of abstraction. At the highest, one says what any model must be able to express, without saying what it expresses. Below it, one says what structures a model may draw upon—an order, a metric, an algebra—and at what cost. Below that, one exhibits models. The levels are not competing accounts of the same thing. They stand in a relation of dependence: what is settled above constrains what may be built beneath, and what is built beneath must answer to it.

This is the first paper of the series, and it gives only the highest layer. It does not instantiate the framework, does not apply it to a domain, and derives no substantive result about any particular social system. Those belong to the parts that follow.

The reason for beginning at the top, and for treating it separately, is that the commitments made at this layer are the ones that later become invisible. A model which ranks has assumed comparability; a model which measures has assumed symmetry; a model which aggregates has assumed an arithmetic. Each of these is a decision, and each, once buried inside a concrete formalism, is difficult to retrieve and impossible to contest. Isolating the highest layer is a way of making the decisions available for inspection before they are made.

1.2 Writing x already stipulates what counts as a difference

A dynamical system, in its received form, is a triple: a state space, a rule of evolution, and a parameter. The rule is written

$$\dot{x} = f(x; \theta),$$

and the reading it invites is that the left side records change and the right side records the structure from which change proceeds. That reading is correct as far as it goes. What it conceals is the cost of the first term. To write x at all is to have fixed a space in which x lives, and with

it a stipulation of what counts as a difference between one state and another: whether such differences can be measured, whether they can be compared, whether they vary continuously.

For the systems at issue here, that stipulation cannot be met. The state of a normative order is a configuration of rules and expectations; the state of a power system is a distribution of asymmetries; the state of a value system is an ordering of what matters; the state of a recognition network is a pattern of who is seen. These do not sit in a common space, and they admit no common metric.

The point requires care, because it is stronger than it may appear. The difficulty is not that a common space is hard to construct, which would be a difficulty of instruments and would be answered by better ones. It is that a rule and a dependence are not two values of one variable, and no refinement of measurement will make them so. The heterogeneity of social states is ontological rather than practical, and a heterogeneity of that kind is not overcome; it is either respected or overwritten. It is the claim that these states *are* commensurable—that some scale $m : X \to \mathbb{R}$ exists—which the theory of value pluralism has spent a century contesting, and a modeling strategy that begins by assuming the space begins by assuming away what is contested.

1.3 Change, structure, constraint, and difference need no state space

The response proposed is not to find a cleverer space. It is to descend below the point at which a space is required.

Four things must be sayable of any social dynamical system. It must be able to say how it changes. It must be able to say how its changes compose. It must be able to say what its changes are constrained to preserve. And it must be able to say what its changes destroy. These are, respectively, *change*, *structure*, *constraint*, and *difference*.

The claim of this paper is not that these four are novel. It is that they are, taken together, sufficient, and that they can be given without assuming a state space, a metric, an order, an arithmetic, or a zero. This matters, because each of those assumptions, once made, quietly decides a question the theory was meant to leave open. An order on states presumes commensurability. A metric presumes symmetry, and therefore cannot distinguish betraying from being betrayed. A zero presumes that what a transformation leaves behind is a quantity capable of being null, and so decides, in advance of any argument, that loss is a magnitude.

The metamodel given in §3 makes none of these choices. In exchange, it yields results that were not put in by hand: that collapse is irreversible, that irreversibility is possible only because mechanisms lack inverses, and that a mechanism destroys nothing exactly when it is injective modulo the congruence.

1.4 Loss precedes generativity in the order of dependence

Instantiation is deferred. So is application. So, in particular, is the formal treatment of generativity, which is the term the wider programme exists to serve and which the four axioms of this paper do not provide. What they provide is its precondition: an account of what a mechanism can destroy. A framework that cannot say what is lost cannot say what it would mean to generate. The order of exposition follows the order of dependence, and loss comes first.

2 The State Space Cannot Come First

2.1 Social states are heterogeneous in kind, not in scale

Consider four systems and the state each would require.

system	state
normative order	configuration of rules, obligations, expectations
power system	distribution of dependence and authority
value system	ordering of what is held to matter
recognition network	pattern of who is acknowledged as a subject

No embedding of these into a common vector space is available, and the ones that have been proposed are precisely the objects of critique: utility, price, and the composite index each purchase comparability at the cost of the differences they were meant to preserve.

It is worth being exact about the sense in which this heterogeneity is *ontological* and not merely practical, since the two are easily confused and only the former has consequences for the form of a theory. Practical heterogeneity would mean that a common space exists but is hard to construct—that the data are poor, the scales incommensurate in practice, the measurement instruments crude. Such a difficulty is answered by better instruments, and it licenses the modeler to proceed as though the space were there, since in principle it is.

The heterogeneity at issue is not of that kind. It is not that a common space is hard to find but that the objects to be placed in it are not of a kind that admits a common placement. A rule and a dependence are not two values of one variable measured badly; they are not two values of one variable. A pattern of recognition is not a coarse rendering of a distribution of authority. These are distinct modes of being, and the question of how far one lies from another is not a hard question but a malformed one. It is in this sense that the demand for a common state space is not a technical inconvenience but a substantive commitment—indeed an ontological one, asserted in the guise of a modeling convention—and it should not be made by default.

2.2 Order presumes commensurability, metric presumes symmetry, zero presumes magnitude

Order. A partial order on $\mathcal{S}$ furnishes suprema, and a supremum of two value states is a common measure of them. To assume a lattice is to have assumed commensurability.

Metric. A metric d on $\mathcal{S}$ satisfies $d(x, y) = d(y, x)$. Symmetry cannot represent a directed act. Under a metric, a mechanism and its reception are the same distance apart, and the asymmetry of the relational act has been erased before any question about it can be posed.

Zero. An additive structure with a zero element makes the residue of a transformation a quantity that may or may not vanish. This is a determinate philosophical position—the position on which what is lost is a magnitude, and so, in principle, restorable. The rival position holds that what is lost has no place in the new structure at all. The metamodel must be able to host both, and therefore may assume neither.

2.3 Fixing the mechanisms leaves the carrier free

The path taken here inverts the usual order of construction. Rather than fixing states and deriving the transformations that act upon them, we fix the transformations and leave the states

unstructured. This is not new; it is the one by which the algebraic approach to dynamics proceeds. Its warrant is that the structure a theory requires can be carried by the acting objects, leaving the carrier as a set on which they act.

3 Change, Structure, Constraint, and Difference Are Definable without a Structured Carrier

3.1 The carrier is a bare set; the mechanisms carry the structure

Definition 1 (Primitives). A *social dynamical metamodel* is a triple $(\mathcal{S}, \mathcal{M}, \sim)$ where

- $\mathcal{S}$ is a set, the *carrier*. It is assumed to have no further structure: no order, no metric, no algebraic operation, no distinguished element.
- $\mathcal{M}$ is a set, the *mechanisms*.
- $\sim$ is an equivalence relation on $\mathcal{S}$.

Elements of $\mathcal{S}$ are states, in the weakest sense the word can bear: whatever a given domain takes a configuration to be. Elements of $\mathcal{M}$ are mechanisms: whatever, in that domain, acts upon a configuration and yields another. Nothing is presumed about what either is made of.

3.2 The mechanisms form a semigroup, and Δ is derived from α and $\sim$

Axiom 1 (Change). There is a map

$$\alpha : \mathcal{M} \times \mathcal{S} \longrightarrow \mathcal{S}, \qquad (m, x) \longmapsto m(x).$$

A mechanism acts on a state and returns a state. This is all that change is required to be.

Axiom 2 (Structure). $\mathcal{M}$ carries an associative composition

$$\mathcal{M} \times \mathcal{M} \to \mathcal{M}, \qquad (m_1, m_2) \mapsto m_1 m_2, \qquad (m_1 m_2) m_3 = m_1 (m_2 m_3),$$

and α is an action of it:

$$\alpha(m_1 m_2,\, x) = \alpha(m_1,\, \alpha(m_2, x))\,.$$

$\mathcal{M}$ is a semigroup. It is *not* assumed to have an identity, and it is *not* assumed to have inverses.

Associativity is free: it says only that doing m_1 then m_2, and then m_3, is the same as doing m_1, and then m_2 followed by m_3. The two omissions are not free, and they are the substantive content of the axiom. Their consequences are drawn in §4.

Axiom 3 (Constraint). $\sim$ is a congruence for the action:

$$x \sim y \implies \alpha(m, x) \sim \alpha(m, y) \qquad \text{for all } m \in \mathcal{M}.$$

Read: whatever the system preserves, no mechanism may destroy. The axiom does not say what $\sim$ is. It says that a mechanism which fails to respect it is not a mechanism of this system

at all. $\sim$ is the system's law of admissibility, and its content is supplied by the domain.

Axiom 4 (Difference). For each $m \in \mathcal{M}$, the *collapse* of m is

$$\Delta(m) \;=\; \big\{\, (x,y) \in \mathcal{S} \times \mathcal{S} \;:\; x \not\sim y \;\wedge\; \alpha(m,x) \sim \alpha(m,y) \,\big\}.$$

Read: $\Delta(m)$ is the set of distinctions that m destroys. Two states that the system could tell apart become, after m has acted, states it cannot tell apart.

3.3 Difference is a lost discrimination, not a leftover element

Three familiar formalizations of difference are rejected, each because it requires structure on $\mathcal{S}$ that the metamodel declines to assume.

Not a residuum. The residuated-lattice operator, $x\backslash m(x) = \max\{c : x \cdot c \leq m(x)\}$, requires that $\mathcal{S}$ carry both a multiplication and an order. It therefore requires that states be comparable, which is what the ontological heterogeneity of social states denies.

Not a distance. The metric-induced form, $d(x, m(x))$, requires a metric, and a metric is symmetric. It cannot represent a directed act, and the acts at issue are directed.

Not a kernel. The form $\ker \pi = \{x : \pi(x) = 0\}$ requires a zero, hence an algebraic structure on $\mathcal{S}$. In a semigroup the kernel of a morphism is not a subset at all: it is a congruence. Axiom 4 takes that fact as its cue and defines difference as a relation rather than an element.

> Difference, at this layer, is not a thing that is left over. It is a discrimination that has been lost.

The three rejections share a form. Each of the discarded operators returns an *element*, and in doing so commits the metamodel to a determinate view of what a remainder is—a view on which the traditions that have thought longest about remainders do not agree. What is at stake in this is taken up in §5.
Δ is a derived object. It is not a fifth primitive: it is defined entirely from α and $\sim$, which is to say from Axioms 1 and 3.

4 Irreversibility Follows from Associativity and the Congruence Alone

The axioms are weak. They nevertheless entail results that were not stipulated. This section gives them.

4.1 Collapse is irreversible

Proposition 1 (Irreversibility of Collapse). Let $(x,y) \in \Delta(m)$. Then for every $m' \in \mathcal{M}$,

$$\alpha(m'm,\, x) \;\sim\; \alpha(m'm,\, y).$$

That is: no mechanism applied after m can restore the distinction m destroyed.

Proof. By definition of Δ, $\alpha(m, x) \sim \alpha(m, y)$. By Axiom 3, applying m' to congruent states yields congruent states, so $\alpha(m', \alpha(m, x)) \sim \alpha(m', \alpha(m, y))$. By Axiom 2, the left side is $\alpha(m'm, x)$ and the right side is $\alpha(m'm, y)$. □

The proof uses only Axioms 2 and 3. Irreversibility is therefore not an extra postulate about the social world, appended because we know from experience that some things cannot be undone. It is what the associativity of mechanisms and the preservation of the congruence, taken together, already say.

4.2 Inverses annihilate difference

Proposition 2 (Groups have no history). Suppose $\mathcal{M}$ is a group acting on $\mathcal{S}$ and $\sim$ is a congruence. Then $\Delta(m) = \emptyset$ for every $m \in \mathcal{M}$.

Proof. Suppose $(x, y) \in \Delta(m)$, so $\alpha(m, x) \sim \alpha(m, y)$ and $x \not\sim y$. Applying m^{-1} and using Axiom 3, $\alpha(m^{-1}m, x) \sim \alpha(m^{-1}m, y)$, that is $x \sim y$, a contradiction. □

The absence of inverses is not a technical weakening. It is the condition under which a system can have a history at all. Where every mechanism can be undone, nothing is destroyed, nothing is preserved against destruction, and the question of what a transformation has cost does not arise. A group of mechanisms is a world without loss.

The two propositions stand in a definite relation. Proposition 1 says that what is collapsed stays collapsed. Proposition 2 says that this is possible only because mechanisms are not invertible. Taken together they locate the exact structural commitment on which everything else in this framework depends: Axiom 2's refusal of inverses.

4.3 A mechanism destroys nothing iff it is injective modulo $\sim$

Proposition 3. $\Delta(m) = \emptyset$ if and only if the induced map $\bar{m} : \mathcal{S}/\!\sim \to \mathcal{S}/\!\sim$ is injective.

Proof. Axiom 3 guarantees that $\bar{m}$ is well defined on the quotient. $\bar{m}$ fails to be injective exactly when there are classes $[x] \neq [y]$ with $\bar{m}[x] = \bar{m}[y]$, that is, when there are states $x \not\sim y$ with $\alpha(m, x) \sim \alpha(m, y)$, that is, when $\Delta(m) \neq \emptyset$. □

The proposition supplies a criterion. A mechanism destroys nothing if and only if it is injective modulo the congruence, so it is not necessary to inspect a mechanism's effects case by case in order to know whether it is destructive. It suffices to ask whether it separates what the system could already separate.

4.4 Composition accumulates

Proposition 4 (Monotonicity of Collapse). For all $m, m' \in \mathcal{M}$,

$$\Delta(m) \subseteq \Delta(m'm).$$

Proof. Let $(x, y) \in \Delta(m)$. Then $x \not\sim y$, and by Proposition 1, $\alpha(m'm, x) \sim \alpha(m'm, y)$. Hence $(x, y) \in \Delta(m'm)$. □

Collapse, once incurred, is carried forward by every subsequent mechanism. The history of a system is thus a monotone accumulation of lost discriminations, and no mechanism in the semigroup can reduce it. This is the formal sense in which a social system does not return to a prior condition.

5 Loss Is a Magnitude Only If the Carrier Has an Arithmetic

Axiom 4 defines difference as a relation. The natural alternative would define it as an element: a residue, a remainder, a something left over when a mechanism has acted. The alternative was declined, and the reason is that the two traditions with the strongest claim on the notion of a remainder—political economy and psychoanalysis—disagree about what a remainder is. An operator that returns an element settles their disagreement, and settles it by stipulation. What follows sets out the disagreement, shows where the notation would decide it, and shows what a relation-valued Δ leaves open instead.

5.1 Surplus value is restorable; the *objet a* has no place to be restored to

The economic residue. In the analysis of value, what a mechanism leaves over is a *magnitude*. Surplus value is the difference between the value a labourer produces and the value returned to him [12]; it is a quantity, it can in principle be computed, and—this is the point on which the whole normative force of the analysis rests—it could have been returned. That it was not is the injustice. The residue is thus an element of the same order as what was given: it has a location in the value system, it is expressible in the system's terms, and its restitution is intelligible even where it is not forthcoming. A theory of exploitation requires a residue of this kind, for otherwise it could not say what was taken.

The psychoanalytic residue. In Lacan the remainder is of a different kind altogether [14, 15]. The *objet petit a* is not a quantity of satisfaction withheld; it is what falls out of symbolization itself, the residue produced by the subject's entry into the symbolic order and precisely not representable within it. It is not that the object is scarce, or that it has been taken and might be given back. It has *no place* in the order that produced it. Its whole theoretical function depends on this: were it locatable, were it a magnitude, it could in principle be supplied, and the structure of desire that it sustains would collapse [16].

> The economic residue is a magnitude that was not returned. The psychoanalytic residue is not a magnitude at all. The first can be restored. The second cannot, and the obstacle is not that restoration is difficult but that there is nothing of the right kind to restore.

5.2 An element-valued operator decides between them by notation

Suppose difference were defined, as it commonly is, by an operator returning an element:

$$\Delta(m,x) \;=\; x \backslash m(x) \qquad \text{or} \qquad \Delta(m,x) \;=\; d(x, m(x)) \qquad \text{or} \qquad \Delta(m) \;=\; \ker \pi_m = \{x : \pi_m(x) = 0\}.$$

Each of these requires structure on $\mathcal{S}$: the first an order and a multiplication, the second a metric, the third a zero. And each, in requiring it, has already chosen. An operator that returns an element of $\mathcal{S}$, or of some $\mathcal{D}$ possessing a zero, has said that what is lost is a *something*—a magnitude that may be null, that has a place, that could conceivably be supplied. It has

decided for the economic residue and against the psychoanalytic one, and it has done so not by argument but by notation.

This is the kind of commitment the highest layer exists to hold open. Whether the remainder of a social mechanism is a restorable magnitude or an unrepresentable void is a substantive question, and one on which the traditions divide. A metamodel is arguably not the place to answer it, and one that answers it in its choice of symbols has answered it without argument.

5.3 A relation-valued Δ leaves both readings open

$$\Delta(m) \;=\; \{\, (x, y) \;:\; x \not\sim y \;\wedge\; \alpha(m, x) \sim \alpha(m, y) \,\}$$

Δ returns a relation, not an element. It says which discriminations a mechanism destroyed. It does not say what, if anything, was left behind, and it requires no order, no metric, no arithmetic, and no zero in order to say what it says.

The two traditions are thereby left open, and each is recovered at instantiation rather than assumed at the outset:

- Where an instantiation supplies $\mathcal{S}$ with an additive structure, a magnitude can be associated with each collapsed pair, and the residue becomes a quantity—the economic reading. Restitution is then well posed, and one may ask whether it has been made.
- Where an instantiation supplies no such structure, $\Delta(m)$ remains a set of pairs and nothing more. Two states have become indiscernible, and nothing of the right type exists to be returned—the psychoanalytic reading. Restitution is not withheld here; it is not *formulable*.

> The metamodel is not neutral because it is empty. It is neutral because it locates the disagreement: the question of whether loss is a magnitude is the question of whether the carrier has an arithmetic. That is a decision about a particular social order, to be made and defended in the modeling of that order. It is not, so far as this paper can see, a decision about the form of social dynamics as such, and it should not be made by notation alone.

5.4 The two readings license different demands

It should be said, though it exceeds the scope of this part, that the choice is consequential. A theory of justice built on the economic residue can demand restitution: something was taken, it is of a determinate size, and it can be given back. A theory built on the psychoanalytic residue cannot make this demand, and must ask instead for a different order—one whose congruence separates what the present one has conflated.

The metamodel does not adjudicate between them. It does establish that they are different demands, that they follow from different structural assumptions about the carrier, and that a theory which has not said which assumption it makes has not yet said what it is asking for.

6 Instantiation Supplies the Structure the Axioms Withhold

The metamodel is deliberately too weak to compute with. It has no order, so it cannot rank. It has no metric, so it cannot measure. It has no arithmetic, so it cannot aggregate. Each of these is supplied only at instantiation, and each supply is a commitment. The purpose of separating the layers is to make the commitments visible, so that of any concrete model it may be asked: at which line did it assume comparability, and with what warrant.

6.1 Every instantiation is a semiflow, and its congruence carries the normative weight

To instantiate is to supply four things: a carrier $\mathcal{S}$, a semigroup $\mathcal{M}$, an action α, and a congruence $\sim$. The axioms then constrain what the instantiation may do, and the propositions of §4 hold in it automatically, without reproof.

Two constraints on instantiation follow directly from §4 and are worth stating here, since they hold for every instantiation and therefore belong to the highest layer rather than to any particular one.

Semiflows, not flows. A continuous-time flow with $t \in \mathbb{R}$ is a group action, and by Proposition 2 it has $\Delta \equiv \emptyset$. Reversible dynamics has no collapse. This is the classical fact that a Hamiltonian system loses no information, and it is here a corollary rather than an observation. Any instantiation that is to model a system with a history must therefore be a semiflow, $t \geq 0$. The restriction is not a modeling convenience; it is forced.

The congruence carries the normative weight. In any instantiation, $\sim$ is not a technical choice. It is the system's statement of what it is obliged to preserve, and it is the sole point at which normative content enters the formalism. Two configurations that a theory of justice would not have conflated are configurations that $\sim$ is required to separate. Choosing $\sim$ is therefore a substantive theoretical act, and one to be defended as such. The metamodel supplies the *form* of the obligation and none of its content.

6.2 Instantiation, application, and generativity are deferred

Three things are outside the scope of Part I, and are named so that their absence is not mistaken for an oversight.

No instantiation. No carrier, semigroup, action, or congruence is exhibited for any concrete domain. The metamodel is presented as a set of conditions on models, not as a model.

No application. The framework is not read against any substantive problem in social or political theory. Where such readings are possible—and the author holds that they are, and that they alter the description of the phenomena—they require a determinate $\sim$, and hence an instantiation, and hence a later part.

No account of generativity. The axioms describe how mechanisms act on a fixed carrier. Nothing in them produces a state that was not already in $\mathcal{S}$, nor a distinction that $\sim$ did not already admit. Collapse has been given a formal home; emergence has not. This is a genuine limitation and is returned to in §6.

> Part I establishes what a social dynamical system must be able to say. It does not say it.

7 The Axioms Cannot Judge a Collapse, Generate the New, or Evolve Their Own Congruence

The framework should be judged by what it cannot do, and four things it cannot do are named here.

It cannot say that a collapse was wrong. $\Delta(m)$ records which distinctions a mechanism destroyed. It does not say they ought to have been kept. Some collapses are innocuous, and some are necessary: a system that could distinguish every state from every other would be a system incapable of generalization. The normative weight falls entirely on $\sim$, that is, on the prior determination of what a system is obliged to preserve. The metamodel supplies the form of that determination and nothing of its content.

It cannot generate the new. The axioms describe how mechanisms act on a fixed carrier. Nothing in them produces a state that was not already in $\mathcal{S}$, and nothing produces a distinction that $\sim$ did not already admit. This is a genuine limitation for a programme whose central term is generativity. Collapse has been given a formal home; emergence has not. A candidate exists—the passage of a system into an inequivalent representation of the same algebra, where the new is not a rearrangement of the old but an accession to a sector formerly unreachable—but it requires more structure than four axioms provide, and it is not developed here.

The congruence is exogenous. Axiom 3 posits $\sim$ and does not derive it. Yet in any actual system, what counts as a preserved distinction is itself an outcome of the system's history. A sharper framework would let $\sim$ evolve, so that a mechanism could alter not only the states but the system's very capacity to discriminate among them. The immediate obstacle is that Δ is defined in terms of $\sim$, and a moving $\sim$ makes the definition circular. Resolving this is, in the author's view, the most important open problem in the framework, and it is the problem to which the next part is addressed.

It is not, by itself, a theory. A metamodel of this kind constrains the class of admissible models; it does not select among them, and it makes no prediction. Its use is diagnostic. It permits one to ask of any social model: what does it take a state to be, what does it take a mechanism to be, what does it oblige a mechanism to preserve, and what, therefore, does it permit a mechanism to destroy. A model that cannot answer the fourth question has not thereby avoided destruction. It has only declined to record it.

8 Conclusion

Four axioms have been given. A carrier without structure; a semigroup of mechanisms acting upon it, associative and without inverses; a congruence recording what the system is obliged to preserve; and a difference operator defined as the set of distinctions a mechanism collapses. From these, four propositions follow: that collapse is irreversible; that it is possible only in the absence of inverses; that a mechanism is non-destructive exactly when it is injective modulo the congruence; and that collapse accumulates monotonically under composition.

The propositions are not deep. They are three lines each. What is worth noticing is that they were not put in. The framework was constructed to be as weak as it could be made—no order, no metric, no arithmetic, no zero—and by assuming so little, it was able to obtain irreversibility as a theorem rather than posit it.

A system has a history because its mechanisms cannot be undone. It can lose what it was obliged to keep because its mechanisms can collapse distinctions the congruence required it to hold apart. These are the same fact, stated once algebraically and once normatively, and it is the burden of a formal social theory to show that they are the same.

That burden is not discharged here. This paper has established only the highest layer: what a social dynamical system must be able to say, and what it costs to say it. It has exhibited no instantiation, made no application, and given no account of the term—generativity—for the sake of which the wider programme exists.

The order of exposition, however, follows the order of dependence. A framework that cannot say what a mechanism destroys cannot say what it would mean to generate, since generation is intelligible only against the possibility of loss. Loss has now been given a form. It is a relation, not a magnitude: not a quantity that has diminished, but a discrimination the system can no longer make. What follows from that—and in particular whether a congruence can be made to evolve without circularity, so that a system might recover a distinction it had lost—is the subject of the next part.

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A Metamodel for Ontologically Heterogeneous Social Dynamics

Part II: Modeling Six Categories of Social Facts

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Abstract

Social inquiry uses entities, relations, events, attributes, states, and processes to articulate different questions about a common situation. This paper develops their representations within the abstract action framework introduced in Part I, with ontological questions suspended. Each category receives a separate construction, derivation, critique, and philosophical interpretation. Indexed appearances support declared entity-reidentification criteria; incidence relations require invariance under participant identification; occurrence records preserve distinctions lost by idempotent effects; partial attributes require both value and definedness consistency; state descriptions depend on retained observation and memory; and process histories retain ordering, intermediate conditions, and segmentation beyond their composite effect. Established continuation semantics supplies a common state-consistency construction. Further conditional results concern the exact composition of collapse sets, coordination among category records, classification-mediated updates, changes of descriptive regime, finite probabilistic aggregation, and finite-horizon approximation error. A cooperative-agreement model is developed through its complete twelve-map transformation family. A graph model derives collective units and shows how a component description can support edge additions while failing under deletion. The philosophical analysis separates formation, description, and social uptake; predictive sufficiency and historical warrant; and behavioral equivalence and entity identity. A proposed case-study design states the evidence and revision conditions for each representation. The contribution is a coordinated architecture of explicit modeling commitments, with empirical adequacy and broader ontological interpretation remaining open.

Keywords: social facts; analytical categories; generative relational modeling; semigroup action; continuation equivalence

Research Paper Note

This paper continues the metamodel inquiry through a specified task: modeling six categories used in discussing social facts. The full series title retains the identity of Part I. The present argument concerns representational conditions, with ontological questions held open.

The term *social fact* identifies the subject matter of inquiry at a deliberately modest level. A description can concern an organization, a relation, an occurrence, a property, a situation, or a course of activity. The paper asks what information each description needs and how its representation interacts with the others. Establishing that a modeled description is warranted requires evidence appropriate to the inquiry.

The six categories constitute a selected analytical repertoire. Their uses can overlap within one investigation. A theory of their exhaustiveness, exclusivity, or metaphysical priority remains a separate undertaking.

The mathematical argument distinguishes conditional results from proposed interpretations. The finite example is constructed to expose assumptions and countercases. Its social labels are stipulated for illustration. A subsequent application would have to establish the relevant operations, observations, histories, and identity criteria from its own material.

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Notices

This page records the draft's status, inherited licence, and preparation disclosure.

Status. This expanded working draft is being developed for author review. Its formal propositions are conditional on the displayed assumptions. Category representations and the cooperative-agreement example remain revisable modeling proposals. Empirical validation, a broader originality review, and publication sequencing remain open.

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Statement on the use of language models. The author selected the research direction, clarified the six-category scope, required ontological suspension, and authorized drafting. Language-model assistance supported organization of the source discussion, mathematical reconstruction, counterexamples, website verification, and preparation in LaTeX. Agent-added constructions and source provenance are recorded in the accompanying research files. This version awaits the author's review of its formulations, arguments, and references. Authorship and decisions about circulation remain with the human author.

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1 Introduction

This paper develops a common framework for representing six categories used in discussing social facts: entity, relation, event, attribute, state, and process. Its objective is to make the modeling requirements of each category explicit and to examine their connections within a shared dynamics. The method combines conditional constructions, stepwise derivations, counterexamples, philosophical analysis, and two finite illustrations. Ontological questions remain suspended throughout.

Consider an inquiry into a cooperative agreement. Investigators may ask which organizations participate, what obligations connect them, when authorization was recorded, which resources are available, whether the agreement is operative, and how implementation developed. These questions select different aspects of the inquiry. A record of implementation may help establish an event, describe a stage of a process, and change an attributed state. The usefulness of these distinctions depends on the work they enable an account to perform.

The questions become more demanding when the records diverge. An organization can change its membership while retaining an institutional identity. An authorization can be repeated without changing the current condition. Two histories can establish the same present status through different procedures. Two arrangements can look alike under a current observation while responding differently to a later request. A completed outcome can conceal different intermediate costs or failed attempts. A common mathematical language should make these differences available for analysis.

Part I supplied an abstract framework for change and composition relative to a declared regime of distinction [3]. The continuation considered here asks how the six-category vocabulary can be represented over that framework. Its scope is intermediate between an abstract action and an empirically warranted account. It develops representational possibilities and identifies the information needed to use them.

Three levels organize the argument. A *base definition* uses the symbols and explicitly declared parameters of the underlying model. An *induced construction* builds a mathematical object, such as a quotient or a set of finite paths, from specified data. An *enrichment* supplies further information, such as an actual history, an observation rule, or a criterion for following an organization through change. Keeping these levels visible makes the commitments of a category representation available for assessment.

The distinction matters because a formalism can conceal its inputs. Writing an entity as a set of related configurations can leave the relation's justification unexamined. Writing a process as a product can conceal the history omitted by that product. Writing an attribute as a function can leave its subject, definedness, and interpretation unresolved. The paper develops each construction far enough to expose these choices and to derive the conditions under which the representation performs its intended task.

The proposed contribution is a coordinated architecture for the six categories. It includes limited positive results and discriminating counterexamples. A preserved equivalence supports quotient dynamics; a coarse current observation can fail to support them. A mechanism product determines a composite effect while omitting distinctions between possible histories. Reachability can connect configurations while leaving entity identity underdetermined. These differences matter when an inquiry moves from a mathematically possible description to a claim about a particular social situation.

The entity treatment begins with indexed appearances and a criterion of reidentification. It examines invariant descriptors, directed lineage, fission, merger, and behavioral comparison. The relation treatment distinguishes incidence among participants from historical formation and potential effects under continuations. The event treatment separates occurrence tokens from transformation types and derives the loss of occurrence counts under idempotent compression.

The attribute treatment develops predicates, value maps, and partial descriptions, including the conditions for their descent to a quotient. The state treatment examines retained memory, observation tasks, and predictive sufficiency. The process treatment follows words through their trajectories and compares the information retained by products, maps, and endpoints. Each treatment includes its own interpretation, counterconditions, and evidence requirements.

A common construction compares configurations through the observations available under all finite continuations. The resulting equivalence is preserved by the declared operations. This construction be-

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longs to established behavioral semantics [7]; its function here is to show how a consistent state description can be derived once its inputs are declared. The six-category question retains further requirements, especially occurrence, historical warrant, attribute interpretation, and reidentification.

Two examples connect the abstract results to inspectable models. The cooperative-agreement example has eight configurations and three primitive operations. Its complete transformation family can be derived, allowing comparison of mechanism effects, occurrence histories, and observations. The relational-unit example forms collective units from connected components of finite graphs. Comparing edge addition with edge deletion shows how the adequacy of a reduced description depends on the operation repertoire.

The philosophical discussion asks what these constructions commit an investigator to. It separates formation of a social arrangement, description of that arrangement, and uptake of a classification into subsequent action. It also distinguishes predictive sufficiency from historical explanation and entity identity from behavioral equivalence. These distinctions permit substantive criticism while the ontological status of the categories remains open.

The extensions examine partial operations, transitions among declared descriptive regimes, and finite probabilistic updates. Each introduces additional inputs and a corresponding preservation obligation. A change of description can require information omitted by an earlier record. A probabilistic quotient requires equal transition mass into each target class. These results provide precise limits on transferring the deterministic construction to richer settings.

The paper's social claims remain conditional modeling proposals. The finite examples establish consequences of their displayed assumptions and supply counterexamples to broader identifications. Empirical adequacy requires evidence about operation meanings, histories, observations, identity criteria, and availability conditions. The research-design section specifies how a bounded application could examine those requirements and identify revisions.

Section 2 locates the method and verified antecedents. Section 3 states the abstract framework, and Section 4 develops its generative and relational interpretation. Section 5 introduces the category architecture. Section 6 establishes the common continuation construction before Sections 7–12 develop the six category representations separately.

Section 13 develops the cooperative-agreement model. The subsequent relational-unit and coordination sections examine collective formation and compatibility among category records. Section 16 develops the philosophical interpretation, Section 17 examines changes to the dynamics, Section 18 derives finite-horizon approximation bounds and their limits, and Section 19 specifies the research design and revision conditions. The conclusion draws together the construction's results and its remaining evidential obligations.

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2 Methodological Commitments and Verified Antecedents

This section locates the inquiry's contribution and explains how its arguments should be evaluated. It distinguishes the supplied abstract framework, established mathematical constructions, and the proposed coordination of the six categories. It then states the role of counterexamples, finite calculations, and philosophical interpretation in the paper's method.

2.1 The Inherited Framework and the Present Construction Task

Part I supplies the abstract carrier, mechanism composition, action, and regime of distinction from which the present development begins [3]. The use of that framework creates a definite dependency: results established here assume the relevant action and preservation conditions. Their social interpretation requires an account of what the carrier, mechanisms, and distinctions represent.

The present task concerns the additional work needed to model entities, relations, events, attributes, states, and processes. A vocabulary naming these categories can suggest a unified account, yet the formal requirements differ. An event occurrence needs a way to distinguish individual happenings. An attribute

needs a subject and interpretation. An entity record needs a reidentification criterion. The argument evaluates the data required for each role.

This dependency also fixes the scope of the series continuation. The paper develops an intermediate modeling layer over Part I. It leaves the categories' ultimate ontological status suspended. A successful construction establishes that declared data support a specified representation. Further philosophical and empirical arguments would be needed to determine the broader status of that representation.

The distinction among a base definition, an induced construction, and an enrichment serves this purpose. A quotient can be constructed from an equivalence already supplied. A historically actual occurrence requires an actuality claim and relevant evidence. Both can enter one account, while their sources of warrant remain different.

2.2 Behavioral Constructions and Their Local Use

The continuation construction draws on established behavioral semantics. Rutten's account of systems and behavioral equivalence provides a verified mathematical antecedent for comparing states through their observable responses to continuations [7]. The present paper uses that machinery to derive a state description relative to declared observations and operations.

The local result is valuable because it identifies the exact information retained by the construction. Two states belong to one behavioral class when the selected continuations and readouts fail to distinguish them. Changing the observations or available operations changes the relevant comparison. Thus the quotient's meaning includes its inputs.

The six-category architecture adds questions that behavioral equivalence alone leaves open. Historically distinct occurrences can produce the same response profile. Two different organizations can occupy behaviorally equivalent positions. A formation history can answer a provenance question that a predictive state omits. These are repository applications and distinctions developed in the present argument.

The division of intellectual work should remain explicit. The mathematical existence and preservation results for behavioral descriptions have established antecedents. The proposed contribution concerns their coordination with other representational requirements in this metamodel. A broad claim of novelty for quotient-based state comparison would exceed that contribution.

2.3 Provenance Models and Historical Evidence

The W3C PROV-DM recommendation distinguishes entities, activities, agents, and relations used to represent provenance [6]. Its treatment of derivation gives an established reference point for structured historical records. The present paper uses this connection narrowly: provenance representation can organize dependence and activity records whose interpretation requires evidence.

The six categories in this paper have a different organizing purpose from the categories of that recommendation. Shared terms therefore need local definitions. An entity appearance in the present construction is an indexed subject of a proposed reidentification criterion. An occurrence is a token recorded within a declared event domain. Their relation to a provenance schema would need an explicit mapping.

This distinction helps separate documentary organization from historical warrant. A well-formed provenance record can state that one item was derived through an activity involving another. Assessing the statement requires evidence concerning the activity and its dependencies. The graph or relation structure organizes the claim; the inquiry remains responsible for establishing its application to the case.

The paper's historical examples follow the same discipline. They construct candidate histories and ask which questions a retained record can answer. A proof that several histories share a record establishes an information limit. It leaves the actual history to be identified through evidence.

2.4 Pattern Interpretation and Selective Description

Dennett's discussion of real patterns connects questions of description with compression and predictive usefulness [1]. It offers a philosophical comparison for the selection of informative descriptions. The

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present paper retains its own analytic formulation and suspends the ontological conclusion that might be drawn from that comparison.

A selective description can gain explanatory value by preserving distinctions relevant to an inquiry while omitting others. The continuation quotient formalizes one such task under exact assumptions. An entity criterion, however, may also preserve historical continuity that has little effect on the selected predictions. A useful description therefore needs a stated purpose before its compression can be assessed.

The coexistence of several purposes gives the six-category architecture a philosophical role. Predictive economy, historical accountability, occurrence counting, and participant reidentification can demand different records. Their coordination makes those demands visible within one account. It also exposes tensions when a single compression is asked to serve incompatible tasks.

The position defended here is consequently methodological. An explicit representation can clarify what an account retains, what it omits, and which further claims require support. Its usefulness is assessed through the work it performs in a bounded inquiry. Ontological interpretation remains an additional question.

2.5 Conditional Proof and Interpretation

A conditional proof establishes a consequence of stated assumptions. The quotient action proof, for example, begins with an equivalence preserved by every mechanism and derives a representative-independent action on its classes. The proof can be complete while the empirical applicability of the preservation assumption remains open.

Interpretation supplies the connection between that mathematical result and a social question. If equivalence means equality of a proposed institutional status, the application must explain why equivalent cases respond equivalently to the declared operations. A counterexample to that empirical interpretation can reveal a missing variable or a poor choice of operations without affecting the abstract theorem.

The paper therefore places symbols and domains before definitions, assumptions before conclusions, and interpretation after the relevant formal construction. This order allows a reader to identify where a disagreement arises. The disagreement may concern a proof step, the meaning of a variable, the adequacy of a classification, or the evidence supporting an input.

An original formulation also carries a distinct research status. A proposed enrichment can be mathematically coherent and philosophically suggestive while awaiting empirical evaluation. The status of the construction should travel with it when it is used in another paper or applied to a case.

2.6 Counterexamples and the Repair of Tempting Identifications

Counterexamples perform a central part of the argument. They test claims that can appear plausible when expressed only in general language. A reachable configuration may seem to belong to the same entity's development. Overlapping forward closures show why that association requires an additional identity criterion. A mechanism product may seem to preserve a process. Repeated idempotent operations show how it can omit occurrence multiplicity.

Each counterexample has a specified target. The idempotence example refutes recovery of a positive occurrence count from the compressed product under the stated assumptions. It leaves open the use of a larger state or a richer record. The graph example shows that connected components can support addition-only updates while failing under a deletion operation. It leaves intact the component description for the restricted repertoire.

A good repair preserves the useful part of the original insight. An entity can remain a continuing unit through change, provided the continuity criterion is declared. A process product can summarize a composite effect, provided the historical information it omits is retained when required. The counterexample identifies the boundary of the formulation and the data needed to cross it.

This method also guards against excessive formalization. If a proposed symbol merely renames a social term, its contribution is limited. A useful formulation should define a comparison, expose an

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assumption, derive a consequence, or distinguish models that would otherwise be conflated. The category sections evaluate their formulas by these functions.

2.7 Finite Calculations and Mathematical Coverage

Finite illustrations make the constructions inspectable. The cooperative-agreement model has a small carrier, a declared primitive repertoire, and a transformation family that can be derived explicitly. The relational-unit example permits comparison of component descriptions under different operation repertoires.

Enumeration checks are used to examine the finite claims and to compare independently specified constructions. Such checks can detect an omitted transformation, a mistaken partition count, or an incorrect example. The accompanying proofs explain why the claimed result follows from its assumptions.

Finite verification has a defined scope. Exhausting an eight-state example verifies claims about that example. It supplies a counterexample to a universal assertion when the assertion fails there. It supplies an illustration of a general theorem when the theorem has been proved separately. It leaves empirical correspondence to the case-study stage.

The examples are therefore analytic models. Their social labels help state the intended questions, while their transition rules are declared hypotheses of the illustration. An empirical investigation may need different states, operations, and observations.

2.8 Philosophical Discussion within the Modeling Scope

The philosophical discussion concerns the commitments made by the representations. Identity requires a rule for following a subject through change. Historical explanation requires a relation between present records and candidate histories. Potential effects require a comparison under continuations. Classification can remain descriptive or enter a response rule through actual uptake.

These questions can be developed while ontology remains suspended. Suspension sets the scope of the present argument; it leaves room for substantive claims about the adequacy, consequences, and limits of a representation. A model can be criticized for erasing a relevant history or for hiding an assumption even when its categories receive an agnostic ontological interpretation.

The same discipline governs evaluation. A greater number of reachable outcomes can serve a stated aim while making other outcomes possible as well. A more persistent relation can sustain cooperation or maintain an unwanted dependence. The mathematics identifies structural properties. Evaluation requires the aims, affected subjects, and standards relevant to the inquiry.

The paper's philosophical contribution is to articulate these commitments together with the mathematical constructions. Their coordination supports a form of criticism in which a reader can identify both the formal step and the interpretive premise on which a conclusion depends.

3 Abstract Framework for Category Modeling

This section develops the base on which the category representations depend. It explains the carrier, mechanism algebra, action, and equivalence separately; derives the quotient and the behavior of collapse under composition; and examines which additional descriptions can be defined from the base. The discussion also tests identity, reversibility, order effects, and semantic interpretation through countermodels. Its purpose is to make the assumptions perform visible work in each later derivation.

3.1 Configurations and the Scope of the Carrier

The carrier S is a nonempty set of represented configurations. A configuration can include several participants and conditions together. It can also be an abstract description whose internal structure is left unspecified. The metamodel uses this flexibility to compare forms of representation without requiring every application to begin with the same inventory of objects.

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The choice of carrier determines which differences a model can express before any quotient is applied. A carrier containing only an activity flag cannot directly distinguish permission from resources. A carrier containing both conditions can represent their different roles. A history-enriched carrier can preserve formation information that a present-condition carrier omits. These are different models even if they share a verbal description of the case.

The distinction between a point of S and an entity is therefore essential. One point can describe an entire arrangement involving several organizations. The entity category later introduces appearance records to track individual subjects within and across such configurations. A state space whose points already stand for individuals makes another legitimate but stronger interpretation.

The carrier can include possible configurations that are unreachable from a selected seed. Their inclusion can support comparisons, counterfactual tests, or alternative initial conditions. A particular application should state whether S is intended to cover every relevant possibility or only a declared subset. A theorem over all of S inherits that choice of scope.

Changing the carrier changes the available questions. A richer carrier can distinguish histories or internal relations previously merged into one point. A smaller carrier can simplify calculation at the cost of information. Comparisons between such models need explicit maps or correspondences. The mere use of the symbol S in both models supplies no alignment.

3.2 Mechanisms and Associative Composition

The mechanism domain M is equipped with an associative multiplication. Its elements represent operations at the chosen level, including composites when the model treats them as mechanisms.

Assumption 3.1 (Mechanism semigroup)**.** The nonempty set M has a product satisfying

$$\ell(nm) = (\ell n)m \qquad (\ell, n, m \in M).$$

The product nm is read as applying m first and n second.

Associativity permits a finite sequence to have a composite independent of how its parentheses are placed. It leaves execution order intact. The equation equates two groupings of the same ordered sequence; commutativity would equate different orders and is a separate property.

Closure under composition also has a specific meaning. If m and n belong to the mechanism domain, their product belongs to it. This is an algebraic closure claim. Whether a particular execution is available in a social situation requires an admissibility rule. The later feasible-path construction retains that distinction at every intermediate step.

Mechanism labels can preserve distinctions that their visible effects omit. Two procedures can have the same action on the chosen variables while differing in their formation, purpose, or provenance. An abstract mechanism algebra can retain their labels, whereas a semigroup of transformations identifies them whenever their maps agree. The appropriate choice depends on the questions the model needs to answer.

The algebra also leaves temporal duration open. A product records composition, not how much time its enactment takes. Repeated applications can collapse to one algebraic element under an idempotent equation even when their durations or occurrence counts differ. The process category derives this information loss explicitly.

3.3 The Action and Its Interpretation

The action connects mechanisms to configurations. This subsection states its consistency condition and explains what that condition establishes.

Let $\alpha : M \times S \to S$ be total, and write $mx = \alpha(m, x)$.

Assumption 3.2 (Action law)**.** For all $m, n \in M$ and $x \in S$,

$$(nm)x = n(mx).$$

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The law equates the effect of the composite mechanism with successive evaluation of its factors. It makes the algebra and dynamics consistent. Once a finite word and initial configuration are selected, repeated use of the law identifies the word's endpoint with the action of its product.

Totality states that each mechanism has a modeled output at each carrier point. An application can use total maps for attempted operations, including self-loops under unmet conditions. It can instead supply an admissibility rule or use partial maps for successful executability. Those interpretations require explicit definitions because they disagree about what happens outside an operation's effective domain.

The action can be nonfaithful. Distinct $m, n \in M$ can satisfy $mx = nx$ for every $x \in S$. Their algebraic identity then retains information beyond the selected dynamics. If the action is faithful, equality of maps implies equality of mechanisms. Faithfulness is an additional assumption and is unneeded for the quotient results.

An effect can also be local. Distinct maps can agree at one initial configuration while differing elsewhere. An endpoint observation at that seed therefore gives weaker information than knowledge of the entire map. The history and process constructions will distinguish these successive reductions carefully.

3.4 Equivalence and Preserved Distinctions

The base equivalence declares which configurations the model treats alike at a selected level. This subsection explains its logical and dynamic requirements.

Let $\sim$ be an equivalence relation on S. Reflexivity, symmetry, and transitivity make its classes a partition. The additional action condition is

$$x \sim y \quad \Longrightarrow \quad mx \sim my \qquad (m \in M). \tag{1}$$

The full base assumptions are summarized as follows.

Assumption 3.3 (Base action and distinction)**.** Let M be a semigroup acting totally on nonempty S, with $(nm)x = n(mx)$. Let $\sim$ be an equivalence preserved by every mechanism as in Equation (1). Identities and inverses are permitted without being required.

The condition concerns configurations already treated as equivalent. They must remain equivalent after the same action. Initially distinct configurations may become equivalent. The model therefore permits collapse of a represented distinction while preserving established equivalence.

The intended meaning of $\sim$ needs a domain argument. It can record a selected observational resolution, a theoretically relevant classification, or another declared equivalence. An observation-induced relation $\ker o$ qualifies only if the operations preserve it. A current measurement can fail that condition when it omits a future-relevant variable.

The equality relation always satisfies preservation under a function. The universal relation also satisfies it, because every pair is already equivalent. These extremes show that preservation alone does not select a useful descriptive level. A finer relation retains more distinctions; a coarser relation can simplify the description. The inquiry must justify which distinctions its task requires.

A value judgment about preserving a social distinction adds another requirement. The base permits some initially distinct cases to collapse. If an application needs to protect a particular difference, it must restrict the mechanisms or strengthen its conditions. Mathematical preservation of equivalence should not be conflated with a normative requirement to preserve all differences.

3.5 Symbols and the Four Analytical Roles

The base coordinates several roles in one formal structure. This subsection relates them without treating the verbal roles as interchangeable with every symbol.

Table 1 collects the notation used in the category constructions. The abstract framework continues Part I's treatment of change and composition [3], while stating the precise assumptions required for the present results.

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Table 1: Symbols for the action framework and its declared enrichments

Symbol	Domain and analytical role
S	Nonempty carrier of represented configurations
$M, \cdot$	Mechanism domain with associative composition
α	Total action, written $mx = \alpha(m, x)$
$\sim$	Equivalence preserved by the action
Q, q	Quotient $S/\sim$ and projection $q : S \to Q$
B, T_b	Operation labels and their declared maps
$A(x)$	Admissible mechanisms or labels at x, with the domain specified
o, ρ	Observation and retained-description maps
I, E	Appearance indices and a declared identity equivalence

Change appears through the action. Structure appears through the composition law and any further structure supplied to the carrier. Constraint includes the requirement that equivalent configurations remain equivalent under common action. Difference appears through the selected distinction regime and the changes that operations can make to it.

These are analytical roles, not four independently measured quantities. The same mathematical component can contribute to more than one role. For example, the action both implements change and expresses a compositional consistency constraint. The collapse set defined below depends on both the action and equivalence.

Resources, permissions, values, and physical time are additional application data. They can be encoded in configurations or attached through explicit maps. Their appearance in a model requires a construction or interpretation; it does not follow merely from assigning them one of the four verbal roles.

3.6 Quotient Dynamics and Representative Independence

The quotient construction makes the preserved equivalence operational. This subsection gives both directions of its adequacy condition and derives the induced action.

Let $Q = S/\sim$ and $q(x) = [x]$. The proposed quotient update is

$$\bar{\alpha}(m, [x]) = [mx]. \tag{2}$$

The expression uses a representative x, so its value must be independent of that choice.

Proposition 3.4 (Induced quotient action)**.** *Equation* (2) *is well-defined exactly when $\sim$ is preserved by every mechanism. Under Assumption 3.3, it defines an action of M on Q.*

Proof. Suppose preservation holds. If $[x] = [y]$, then $x \sim y$, so $mx \sim my$ and $[mx] = [my]$. The quotient update is therefore representative-independent.

Conversely, if the update is well-defined and $x \sim y$, the equal inputs $[x] = [y]$ give equal outputs $[mx] = [my]$. This is preservation.

For the action law, evaluate the two proposed composite updates:

$$\bar{\alpha}(nm, [x]) = [(nm)x] = [n(mx)] = \bar{\alpha}(n, \bar{\alpha}(m, [x])).$$

The middle equality follows from the base action law. Thus the quotient maps form an action. □

The quotient can be viewed as a reduction of the configuration description. The projection commutes with each operation: $q(mx) = \bar{\alpha}(m, q(x))$. This equation is the precise relationship between the full and reduced dynamics.

If preservation fails, the same quotient class would need different outputs under one mechanism. An application can then refine the equivalence, retain additional state information, or adopt another type

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of reduced model. The failure is informative because it identifies a specific incompatibility between description and dynamics.

Representative independence is a recurring theme in the six categories. Entity descriptors, relational incidence, attributes, and historical queries each need an analogous constancy condition when transferred to a reduced domain. The quotient proof supplies the basic pattern, while each later application has its own input and interpretive commitments.

3.7 Identity Elements and Zero-Step Continuations

An algebraic identity and an identity action are different assumptions. This subsection explains that distinction and constructs a uniform zero-step convention.

If M has an identity element e, the semigroup action law gives $\alpha(e, \alpha(e, x)) = \alpha(e, x)$. It forces the map $\alpha(e, -)$ to be idempotent. Without a unitality requirement, it need not equal id_S.

For example, take the one-element monoid $M = \{e\}$ and a carrier with at least two points. Let $\alpha(e, -)$ be a constant map. The action law holds because a constant map is idempotent, while the map differs from the identity on S. The example isolates the missing assumption.

Finite words can represent zero steps by defining $T_\epsilon = \mathrm{id}_S$ directly. This convention does not require an identity mechanism in the original semigroup. It also avoids identifying the empty word with an old algebraic identity whose action has not been checked.

A uniform algebraic repair adjoins a fresh unit 1 disjoint from M, even if M already contains an identity. Set $1m = m1 = m$ and $1 \cdot 1 = 1$, retain all original products, and define $1x = x$. Associativity in cases involving 1 follows by deleting the unit; other cases use associativity in M.

The extended action law holds for the same reason. If a factor is 1, both sides reduce to the unchanged action. If both factors belong to M, the original law applies. The extension therefore retains the earlier model while adding a valid zero-step action.

This distinction matters when a word is compressed to a product. A product representation that includes the empty word must specify which element or map represents it. Checking that convention prevents a zero-step history from acquiring an unintended effect.

3.8 Collapse of a Declared Distinction

An operation can identify configurations that the base initially distinguishes. This subsection defines that collapse and derives its persistence under common subsequent action.

For $m \in M$, define

$$\Delta_-(m) = \{(x, y) \in S^2 : x \not\sim y,\ mx \sim my\}. \tag{3}$$

The set records ordered pairs that lose their distinction under m. It is relative to the declared equivalence.

Proposition 3.5 (Persistence of common-action collapse)**.** *Under Assumption 3.3,*

$$\Delta_-(m) \subseteq \Delta_-(nm) \qquad (m, n \in M).$$

Proof. Take $(x, y) \in \Delta_-(m)$. Then $x \not\sim y$ and $mx \sim my$. Preservation under n yields $n(mx) \sim n(my)$. The action law identifies these outputs with $(nm)x$ and $(nm)y$. The initial distinction therefore also collapses under nm. □

The proof holds the equivalence fixed and applies the same subsequent mechanism to both configurations. Changing either condition changes the comparison. Different later actions can give different outputs, and a finer observation can reveal differences previously identified by $\sim$.

The result also concerns represented distinctions. A collapse relative to one quotient can leave many differences intact at a finer level. Interpreting it as physical erasure, epistemic loss, or institutional homogenization requires a domain mapping and evidence. The set formula alone leaves those meanings open.

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The original role of difference in the metamodel is therefore retained with a precise boundary. It identifies how an operation transforms a declared regime of distinction. It supplies no automatic measure of social importance or loss.

3.9 Exact Composition of Collapse Sets

The inclusion can be sharpened into an exact identity. This subsection derives the decomposition and explains its counting implications.

Write $\alpha_m(x) = mx$.

Proposition 3.6 (Two-stage collapse decomposition)**.** *Under the base assumptions,*

$$\Delta_-(nm) = \Delta_-(m) \,\dot\cup\, (\alpha_m \times \alpha_m)^{-1}\big(\Delta_-(n)\big), \tag{4}$$

where the union is disjoint.

Proof. Take a pair in $\Delta_-(nm)$. Its inputs are initially inequivalent and its final outputs are equivalent. There are two cases.

If $mx \sim my$, the pair belongs to $\Delta_-(m)$. If $mx \not\sim my$, the intermediate pair (mx, my) belongs to $\Delta_-(n)$, so the input pair lies in the displayed inverse image.

Conversely, a pair in $\Delta_-(m)$ belongs to $\Delta_-(nm)$ by Proposition 3.5. A pair in the inverse image has $mx \not\sim my$ and $n(mx) \sim n(my)$. Its inputs must be inequivalent: $x \sim y$ would imply $mx \sim my$ by preservation. Thus it also belongs to $\Delta_-(nm)$.

The first branch requires $mx \sim my$; the second requires $mx \not\sim my$. They are disjoint, completing the proof. □

The identity separates distinctions already collapsed by the first step from those surviving it and collapsing at the second. It therefore preserves the sequence of reasoning behind the final collapse set.

For finite S, cardinalities of the two branches add. The second term is the size of an inverse image, which need not equal $|\Delta_-(n)|$. Several initial pairs can map to one intermediate pair. A simple sum of the two mechanisms' raw collapse counts can therefore misrepresent the composition.

An interpreted measure would need further choices about which pairs matter and how they are weighted. The exact set identity precedes that choice and keeps its dependence on the action visible.

3.10 Order, Reversibility, and Independent Properties

Several intuitive properties of dynamics are logically distinct. This subsection uses countermodels to prevent their meanings from being merged.

On the nonnegative integers, the shift $s(k) = k + 1$ is injective and lacks an inverse within the semigroup of positive shifts. With equality as the distinction regime, its collapse set is empty. Absence of an inverse therefore does not by itself imply collapse.

On $\{1, 2, 3\}$, let a swap 1 and 2, and let b swap 2 and 3. Both are bijective and preserve every distinction. Yet $ba(1) = 3$ and $ab(1) = 2$. Order sensitivity can occur without collapse.

On $\{0, 1\}^2$, let r_1 reset the first coordinate to zero and let r_2 reset the second. They commute, because each leaves the other's coordinate unchanged. Each also collapses pairs differing only in its reset coordinate. Collapse can therefore occur without an order effect between these operations.

These examples distinguish three questions: whether an operation can be reversed within the chosen algebra, whether it identifies a represented pair, and whether its order with another operation changes an outcome. A historical interpretation can involve any combination of the three.

History itself is another question. A sequence can have a history record even when its composite is bijective or returns a seed to its initial point. The record of what occurred belongs to the event and process representation. It is not determined by the presence of a collapse set.

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3.11 Definitions, Constructions, and Enrichments

The category account uses several forms of mathematical development. This subsection states their differences so that a representation's contribution can be assessed.

The two-sorted base language is

$$L_0 = \{S, M, \cdot, \alpha, \sim\}.$$

An explicitly defined predicate uses a stated formula in that language, with every parameter disclosed. The order-effect predicate is one example because it refers only to mechanism products, actions, and equivalence.

A quotient is an induced set construction from a specified equivalence. A word space is constructed from a specified alphabet. These constructions are available in the mathematical setting, but treating their elements as objects of the original first-order language requires an encoding or additional sorts.

An enrichment supplies further information. An actual history, observation map, availability set, or identity criterion can be supplied in this way. The enrichment can be justified and useful while remaining distinct from a consequence of the bare base data.

An underdetermination test holds the entire base fixed and varies the proposed addition. If two permitted enrichments disagree, the fixed base does not uniquely determine that addition. This does not exclude a particular definition under stronger premises. It identifies the information that those premises must supply.

The distinction also clarifies philosophical claims of emergence. A mathematical construction can derive a pattern from specified relational data. Whether that construction explains the emergence of a social category depends on the interpretation and evidence for those data. Calling the construction generative cannot replace that argument.

3.12 Symmetry and Parameter-Free Definability

A symmetry test can expose omitted distinctions. This subsection gives the logical reasoning and its interpretive boundary.

A base automorphism consists of bijections on the two sorts that preserve multiplication, action, and equivalence. Every parameter-free first-order predicate defined in L_0 has the same truth value on a tuple and its image under such an automorphism.

The proof proceeds by induction on expressions. Variables transform by the assigned bijections. Preservation of function symbols makes term evaluation commute with the automorphism. Atomic equalities and the relation $\sim$ therefore preserve truth. Boolean connectives retain that invariance.

For an existential quantifier, a witness is sent to a witness by the automorphism. Its inverse gives the converse. Universal quantification follows by the same bijective correspondence. The induction establishes truth invariance for every formula.

Consider a carrier $\{0, 1\}$ with only identity action and ordinary equality. Swapping the two states preserves the whole base. A parameter-free unary predicate therefore cannot select just one state. A named parameter or supplied subset can make that selection, adding information that breaks the symmetry.

The symmetry test is necessary, not a general converse. Passing it does not display a defining formula. It is useful because a failed test shows that a proposed semantic distinction requires additional structure or parameters.

The same point applies to social meanings. If two interpreted cases receive identical base representations, a base-only calculation cannot recover the omitted difference. The appropriate response is an explicit encoding and justification, not a stronger verbal claim about the unchanged formula.

3.13 The Base and the Category Construction Task

The preceding results establish a common formal discipline for the rest of the paper. This subsection states how that discipline guides the six categories.

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The base provides configurations, composition, action, and a preserved distinction regime. It supports quotient dynamics, order comparisons, and collapse calculations. The category constructions use those resources while declaring their additional domains and criteria.

Entities require reidentification across appearances. Relations require participant incidence, formation records, and potential-effect comparisons. Events require occurrence indices. Attributes require coding rules at a declared level. States require sufficient retained information for the chosen task. Processes require words, trajectories, and any grouping or time records.

The contribution is therefore a coordinated development under explicit assumptions. Some components are derived from the base, some are induced constructions, and some are justified enrichments. Each can be examined through proofs, counterexamples, and evidence without turning the category repertoire into an asserted ontology.

4 Interpretation of Generative Relational Dynamics

This section explains the generative and relational vocabulary through historical formation, future possibilities, and the conditions of realization. It constructs mechanism fibres, derives the relation between support and outcome images, and examines prefix feasibility and reachability. The philosophical discussion identifies which comparison can justify a claim of generation, expansion, or reproduction. The aim is to connect the abstract action to a research question without assigning more meaning to the algebra than its inputs support.

4.1 Historical Formation and Further Activity

A working relational interpretation concerns a relatively reidentifiable dependence with a formation history and possible effects on later activity. A relation can arise historically and participate in producing further history. The two directions connect provenance with prospective dynamics while retaining distinct information requirements.

The first direction asks how a pattern came to obtain. Its answer can involve a sequence of events, a negotiation, a maintained practice, or another specified process. The second direction asks what later activity depends on that pattern. Its answer can involve an available operation, a changed outcome, or a route whose feasibility requires the pattern to persist.

A current state can encode enough information for a selected future prediction while omitting the formation sequence. That sufficiency leaves the historical question open. Conversely, a detailed history can remain insufficient for prediction when the model lacks the relevant transition rules or current conditions. Retaining records and specifying dynamics are complementary tasks.

The potential effect can remain unrealized. An authorization can make a continuation possible even during a period in which it is never used. The model must specify the conditions and test under which the effect would appear. An observed sequence that bypasses the continuation supplies different information from a complete test of the proposed possibility.

The terms *generative* and *relational* therefore orient an inquiry. They motivate questions about formation and dependence. Their use in a title or variable name does not supply the missing history, interpretation, or evidence. Those components must be developed in the model and argument.

4.2 A Base-Definable Interaction Witness

Order sensitivity gives one interaction predicate within the abstract language. This subsection states its use before the broader relation category develops its limits.

Define

$$R_{\mathrm{ord}}(m, n, x) \quad \Longleftrightarrow \quad (nm)x \not\sim (mn)x. \tag{5}$$

The predicate compares the two orders from one seed under the same distinction regime. It requires no additional relation symbol because every component belongs to the base.

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The calculation can reveal that one operation changes the conditions under which another operates. In the cooperative example, authorization followed by attempted activation has a different effect from the reverse order. The interpretation depends on the specified maps and conditions.

Commuting operations can also contribute jointly to an outcome. Two operations that set separate prerequisite bits commute, yet a later activity can require both bits. An order predicate therefore captures one kind of interaction and leaves other forms of dependence open.

The distinction matters to the ambition of deriving relations. A base-definable predicate establishes that one structural pattern is available in the language. A social relation requires an account of its participants, formation, and meaning. The later relation section keeps those additional commitments explicit.

4.3 Mechanism Fibres and Possible Outcomes

The generative interpretation needs a way to describe possibilities before their realization. This subsection constructs their witnesses and separates them from the image of outcomes.

Let $A(x) \subseteq M$ be a declared set of admissible composite mechanisms at x. For a quotient outcome $v \in Q$, define

$$\Pi_A(x, v) = \{m \in A(x) : q(mx) = v\}, \tag{6}$$

$$P_A(x) = \{v \in Q : \Pi_A(x, v) \neq \varnothing\}, \tag{7}$$

$$G_A(x) = P_A(x) \setminus \{q(x)\}. \tag{8}$$

Definition 4.1 (Support of a possible outcome)**.** The fibre $\Pi_A(x, v)$ retains the admissible mechanism witnesses for outcome v. Its nonemptiness establishes possibility in the declared model. The image $P_A(x)$ retains outcomes with witnesses, and $G_A(x)$ restricts that image to changed quotient outcomes.

The fibre and image answer different questions. The image states which outcomes are possible. The fibre states which admissible mechanisms support one outcome. Several witnesses can share an outcome while differing in cost, history, duration, or enabling conditions.

The definition of $G_A(x)$ makes another selection. It excludes the present quotient state. This is appropriate when the research question concerns a changed outcome at that resolution. An activity that reproduces the current state can still require effort, sustain a relation, or have historical significance. Those roles remain visible through the fibre or occurrence record.

The set $A(x)$ is additional information unless a definition derives it from represented conditions. A semigroup action alone does not determine which mechanisms are available at a particular situation. The same action can be paired with different availability rules, producing different support sets.

4.4 Support Enlargement and Outcome Enlargement

Adding mechanisms can increase routes without adding outcomes. This subsection derives the exact condition for strict image expansion.

Fix the seed and quotient, and suppose $A_1(x) \subseteq A_2(x)$. Every mechanism in $\Pi_{A_1}(x, v)$ then belongs to $\Pi_{A_2}(x, v)$. Consequently

$$P_{A_1}(x) \subseteq P_{A_2}(x).$$

Proposition 4.2 (Strict outcome expansion)**.** *The inclusion of outcome images is strict exactly when some $m \in A_2(x)$ satisfies $q(mx) \notin P_{A_1}(x)$.*

Proof. If such a mechanism exists, its image belongs to the larger outcome set and lies outside the smaller one, proving strictness.

Conversely, a member of $P_{A_2}(x) \setminus P_{A_1}(x)$ has a witnessing mechanism in $A_2(x)$ by definition. That mechanism satisfies the stated condition. □

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An added witness for an old outcome leaves the image unchanged. It can nevertheless matter if its enabling conditions differ from those of earlier witnesses. The outcome may become available under circumstances that previously blocked every route. To analyze that change, the model must retain the route conditions.

Duplicating a label can also enlarge a syntactic catalog while adding neither an effect nor a distinct enabling structure. Raw mechanism counts therefore depend on representation. A substantive claim about expanded opportunity needs a comparison that identifies what the new witness actually changes.

For infinite sets, strict inclusion need not increase cardinality. Even in a finite model, cardinality alone omits the meaning of outcomes and the relations among routes. Set-based comparison is therefore the starting point; a numerical summary requires further choices.

The result keeps several possible claims separate: more labels, more mechanism witnesses, more feasible paths, more supported outcomes, and more valued opportunities. Each transition between them requires its own premises.

4.5 Primitive Words and Prefix Feasibility

A composite mechanism can conceal the stages needed for its enactment. This subsection retains those stages and states the feasibility condition.

Choose an operation alphabet B whose labels specify mechanisms and their maps. A word $w = b_1 \cdots b_k$ gives

$$x_0 = x, \qquad x_i = T_{b_i} x_{i-1}.$$

Let $A_{\text{prim}}(x) \subseteq B$ be the admissible primitive labels at x.

Definition 4.3 (Prefix-feasible word)**.** The word is feasible from x when

$$b_i \in A_{\text{prim}}(x_{i-1}) \qquad (1 \le i \le k). \tag{9}$$

The empty word is feasible and leaves the seed unchanged.

Every test is performed at the configuration reached by the earlier prefix. The total action can calculate the hypothetical endpoint of a word whose intermediate execution is unavailable. Prefix feasibility identifies that difference.

Primitive admissibility and composite admissibility have different domains. The former concerns the next label. The latter concerns a whole mechanism. A composite can be called feasible when at least one of its factorizations is prefix-feasible. Retaining the witness matters when the process must actually be followed.

Other factorizations of the same product can remain infeasible. An existential composite feasibility claim therefore does not establish that every word with that product can be executed. The feasible-path paper develops this factorization issue through an exact descent criterion.

The distinction is especially important when prerequisites can be consumed, withdrawn, or changed by an earlier step. An endpoint image does not record those intermediate conditions. A resource or permission model must specify their update rules.

4.6 Partial Maps and Domain-Sensitive Composition

Partial operations provide an alternative representation of availability. This subsection explains the domain law and its relation to the base algebra.

Suppose m is executable on D_m and n on D_n. Their partial composition is defined on

$$D_{n \circ m} = \{x \in D_m : mx \in D_n\}.$$

The first condition permits the initial step; the second permits the next step at its result.

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Three successive partial maps have the same prefix conditions under either parenthesization. This establishes associativity of partial-map composition. The domain and effect together determine the partial transformation.

Arbitrary domains attached to elements of an existing total semigroup can fail to preserve its equations. A total flip can satisfy $f^2 = \mathrm{id}$, while restricting its domain to one state makes its two-step partial composition empty. The restricted product has changed meaning.

An application can retain free words until their domain compatibility is established. It can instead use the semigroup of partial transformations. Either approach records the additional structure openly and avoids silently transferring identities that no longer hold.

A blocked-state totalization offers another convention. It can make failed execution observable, but the marker and its later behavior require interpretation. The state and event sections distinguish modeled unavailability from an actual failed attempt.

4.7 Realization, Selection, and Valuation

A possible route and an actual occurrence have different statuses. This subsection separates the additional commitments needed for realization and appraisal.

Nonempty support means that a witness exists under the model's rules. It leaves open whether anyone selects the witness, whether execution occurs, and whether the modeled outcome is observed. Each claim needs an occurrence or selection account.

A probability distribution is another enrichment. The set of witnesses does not supply a canonical measure, and a uniform distribution over labels can change when labels are duplicated. A probability model must identify its sample space and justify its weights.

Intention and reasons remain distinct from a selection law. A statistical account of which route is chosen can omit the participant's understanding of the choice. A philosophical account of agency may need those reasons and the conditions under which they are formed.

Valuation adds further structure. A larger outcome set can include undesirable possibilities. Greater route robustness can sustain an arrangement that participants wish to change. A generative or reproductive effect therefore has no fixed evaluative sign in the formalism.

The model can accommodate values, preferences, or constraints when they are supplied explicitly. It should then distinguish the formal consequence of those inputs from an argument that the inputs are justified. This preserves the open relation between generation, reproduction, and evaluation.

4.8 Unrestricted Reachability in a Fixed Semigroup

A fixed semigroup already contains every finite composite of its mechanisms. This subsection derives the consequence for unrestricted future reachability.

Define the reflexive reachable set

$$\mathrm{Reach}^*(x) = \{x\} \cup \{mx : m \in M\}.$$

Proposition 4.4 (Reachability after a represented action)**.** *For every $c \in M$,*

$$\mathrm{Reach}^*(cx) \subseteq \mathrm{Reach}^*(x). \tag{10}$$

Proof. A member of the left side is either cx or $m(cx)$ for some $m \in M$. The first is reachable from x by c. The second equals $(mc)x$, and closure puts mc in M. Both therefore belong to the right side. □

The result can appear to conflict with a claim that an operation opens possibilities. Its scope resolves the apparent tension. The reachable set already includes all composites, without a finite horizon, resource budget, or changed availability rule.

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An enabling action can make a later primitive locally effective while its composite route was already included in the unrestricted set. The cooperative example illustrates that distinction. Recording authorization changes what an immediate activation can do, even though the authorization-plus-activation word was already a represented composite.

The inclusion also leaves strict contraction possible. After an irreversible action, some earlier alternatives may no longer be reachable. Equality requires additional conditions, such as a suitable route back. The theorem itself guarantees only inclusion.

A claim of generative expansion therefore needs to identify a comparison different from this unrestricted fixed-semigroup one, or explain how the model's carrier or repertoire changes.

4.9 Horizon, Availability, and Comparison Design

Finite resources and time horizons produce different possibility comparisons. This subsection explains their relation to the unrestricted theorem.

Let $\mathrm{Reach}_h^A(x)$ contain endpoints of prefix-feasible words of length at most h under a fixed primitive admissibility rule. If c is feasible at x, then

$$\mathrm{Reach}_h^A(T_c x) \subseteq \mathrm{Reach}_{h+1}^A(x).$$

A witness word from $T_c x$ can be prefixed by c, adding one feasible step and preserving its later prefix conditions.

Comparing the same remaining horizon h before and after the enabling step resets the budget. It is therefore different from comparing two plans under one fixed total budget. A statement that more outcomes are available after the step can depend on which comparison is used.

Changing admissibility while holding the seed fixed is another comparison. If a rule makes additional primitive operations available, new feasible words can appear. Their endpoint images may or may not expand, depending on whether the new words reach new outcomes.

Changing the operation repertoire or carrier is stronger still. The old and new models need an alignment before their possibility sets can be compared. A novel label alone supplies no evidence of a novel effect.

These distinctions make the generative claim more precise. A researcher can state whether an intervention changes immediate activity, bounded routes, availability scenarios, represented outcomes, or the model's own vocabulary. The proof obligations follow that choice.

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4.10 Interpretive Role within the Category Architecture

The generative-relational interpretation connects the base to the six categories. This subsection states that connection and the remaining philosophical task.

Entities can be formed or reidentified through changing relations. Relations can condition later activity. Events record actual applications. Attributes describe conditions and outcomes. States retain the distinctions relevant to the selected task. Processes preserve ordered formation and enactment.

The formalism supplies routes, images, and compatibility tests. Historical and social meaning enters through declared records, comparisons, and interpretations. A useful model makes those additions inspectable and demonstrates why they serve the inquiry.

This preserves the central insight that history can form the conditions of further history. It also exposes the separate questions that a comprehensive account must answer: what was formed, how it was formed, which possibilities depend on it, and what evidence warrants the interpretation.

5 Representations of Six Social-Fact Categories

This section gives entity, relation, event, attribute, state, and process distinct representational jobs within a single inquiry. After the common consistency construction, six category sections develop each con-

Table 2: Representational roles and additional commitments for six categories

Category	Representational role	Additional commitment
Entity	Reidentification across indexed appearances	Identity criterion or directed lineage
Relation	A dependence pattern with formation and possible effects	Relata, history, comparison, and domain meaning
Event	An indexed occurrence of a transition or attempt	Occurrence evidence and relevant circumstances
Attribute	A predicate or value assigned at a declared descriptive level	Coding rule, scale, and evidential interpretation
State	A configuration class under a selected distinction regime	Coverage and observation adequacy
Process	An ordered history with a trajectory	Step records, grouping, duration where relevant

struction, its derivation, and the information needed to interpret it. Table 2 summarizes these dependencies. The repertoire is a working selection for this research program; its completeness remains an open question.

Sections 7–12 treat the categories individually. Each develops its mathematical representation alongside the philosophical question that motivates it. Their formal roles overlap in one inquiry, while the evidence needed for a particular claim remains specific to the category and question.

The distinction between a representation and its interpretation governs this architecture. An equivalence class can support an entity label, but its identity criterion needs justification. A transition map can support an event description, but occurrence requires a record and warrant. An attribute can be mathematically well-defined while its classification rule remains debatable. These are explicit dependencies to investigate through the detailed constructions.

6 Consistency of State Descriptions under Continuation

This section establishes a common construction used by the category treatments that follow. Given operations and an observation, it derives the coarsest equivalence that retains the observation and supports deterministic updates. The discussion gives the full proof, examines the relation to an inherited distinction regime, derives finite refinement, and treats blocked operations. It then identifies the construction's interpretive and computational limits.

6.1 The State-Description Problem

A current observation can merge configurations that respond differently to a later operation. This subsection states the resulting problem and the information needed to repair it.

Let $o : S \to Y$ report an aspect of a configuration. Equality of o values defines an equivalence on S. That relation is sufficient for reporting the current observation. It can fail to support an update rule on observation values.

If $o(x) = o(y)$ while $o(T_b x) \neq o(T_b y)$, the same current observation would need two different successor observations under b. A deterministic update using only $o(x)$ is therefore impossible. The failure identifies information omitted by the observation.

A repair can retain the original configuration, but a smaller record may suffice. The desired relation should merge configurations only when every declared continuation leaves their observations equal. That criterion retains exactly the distinctions needed for the selected task.

The mathematical construction has an established antecedent in deterministic behavior semantics. Rutten's final-system example uses observations indexed by finite input words [7, p. 44, Example 10.2(5)]. The present application uses that construction to audit state descriptions within the six-category framework.

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6.2 Symbols and Continuation Signatures

The construction requires explicit operations and an observation. This subsection fixes their domains and the execution convention before stating the theorem.

Assumption 6.1 (Declared observation system)**.** Let S be nonempty, let B be an operation alphabet, and let $T_b : S \to S$ be a total deterministic map for every $b \in B$. Let $o : S \to Y$ be an observation. Words execute left to right, with $T_\epsilon = \mathrm{id}_S$ and $T_{bw} = T_w \circ T_b$.

Definition 6.2 (Continuation signature)**.** For $x \in S$, define

$$\sigma_x : B^* \to Y, \qquad \sigma_x(w) = o(T_w x), \qquad x \equiv_o y \iff \sigma_x = \sigma_y. \tag{11}$$

An equivalence E is compatible with the task when $E \subseteq \ker o$ and xEy implies $T_b x \, E \, T_b y$ for every $b \in B$.

The signature includes the empty word, so it retains the current observation. Positive words record possible later observations. Equality of signatures concerns the declared test system, rather than actual execution of every test.

The alphabet is also an input. Different labels can share a map, while an omitted operation can reveal a difference that the selected repertoire leaves invisible. The scope of the resulting equivalence must therefore name the operations used.

6.3 The Greatest Compatible Equivalence

The theorem derives the desired relation through four separate properties. This subsection includes the quotient maps so that the construction's dynamic use is explicit.

Proposition 6.3 (Greatest compatible equivalence)**.** *The relation $\equiv_o$ is the greatest compatible equivalence under inclusion. Its quotient supports well-defined updates $[x] \mapsto [T_b x]$ and observation $[x] \mapsto o(x)$.*

Proof. First, equality of functions is reflexive, symmetric, and transitive, so $\equiv_o$ is an equivalence. Taking the empty word in signature equality gives $o(x) = o(y)$ whenever $x \equiv_o y$. Thus $\equiv_o \subseteq \ker o$.

Second, suppose $x \equiv_o y$ and fix $b \in B$. For every word w,

$$o(T_w T_b x) = o(T_{bw} x) = o(T_{bw} y) = o(T_w T_b y).$$

Hence $T_b x \equiv_o T_b y$, proving update preservation.

Third, let E be any compatible equivalence and suppose xEy. Induction on word length gives $T_w x \, E \, T_w y$ for every word. The empty case is the assumed pair. The induction step uses preservation by the next operation. Since $E \subseteq \ker o$, the updated observations agree. Therefore $x \equiv_o y$, proving $E \subseteq \equiv_o$.

Finally, define the quotient update by $[x] \mapsto [T_b x]$. Preservation makes its value independent of the representative. Define the quotient observation by $[x] \mapsto o(x)$. Containment in $\ker o$ makes that value representative-independent as well. □

Greatest under inclusion means coarsest as a partition. The theorem merges the largest set of pairs consistent with the specified responsibilities. It does not seek the most informative possible description.

A finer equivalence can retain additional history or identity information. A coarser one must lose either the current observation or compatibility with some declared continuation. The theorem identifies that precise boundary.

The result also supplies a positive response to underdetermination. The base alone leaves the observation and repertoire open, but once they are declared, the compatible quotient is determined by them. Its interpretive adequacy remains a separate question.

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6.4 Inherited Distinctions and Generator Scope

A new observation task can coexist with an earlier distinction regime. This subsection derives the appropriate intersection and limits the scope of generator-based preservation.

Suppose the original equivalence $\sim$ is preserved by the same operations on the same carrier. Define

$$E^\dagger = \sim \cap \equiv_o . \tag{12}$$

The intersection is an equivalence because both factors are. Each operation preserves both factors and therefore their intersection. The relation also retains the current observation.

Any compatible equivalence contained in $\sim$ lies in $\equiv_o$ by Proposition 6.3. It therefore lies in the intersection. Thus $E^\dagger$ is the greatest compatible equivalence that also respects the inherited distinctions.

The construction uses the same carrier and operation system. An earlier equivalence need not remain preserved after new availability restrictions or new operations are introduced. Its compatibility must be checked in the revised model.

Preservation under B extends by induction to every word over B. To claim preservation under all of an ambient semigroup M, the declared maps must generate its action, or the remaining maps must be checked separately.

For a counterexample, take $S = \{0, 1, 2\}$ with $o(0) = o(1) = 0$ and $o(2) = 1$. If B contains only the identity, the continuation classes are $\{0, 1\}$ and $\{2\}$. An added map sending zero to zero and one and two to two splits the first class. The old quotient was valid for its old repertoire.

6.5 Finite Horizons and the Refinement Recursion

A finite horizon gives a bounded approximation to full continuation equality. This subsection derives its recursive form and the relation between horizons.

For $h \geq 0$, define

$$x \equiv_o^{(h)} y \quad \Longleftrightarrow \quad o(T_w x) = o(T_w y) \text{ for every } |w| \leq h. \tag{13}$$

At horizon zero, this is $\ker o$. At the next horizon,

$$x \equiv_o^{(h+1)} y \quad \Longleftrightarrow \quad o(x) = o(y) \text{ and } T_b x \equiv_o^{(h)} T_b y \text{ for every } b \in B. \tag{14}$$

To derive the recursion, separate the empty word from a nonempty word bw. The empty word tests current observation. The suffix w has length at most h after the first update. These conditions cover exactly the words of length at most $h + 1$.

The relations decrease under inclusion because a longer horizon imposes all the shorter horizon's tests. Their intersection over all finite horizons equals $\equiv_o$, since every finite word belongs to some bounded horizon.

A bounded relation need not itself be update-preserved. One initial operation can expose a distinction requiring the full remaining horizon. The stable relation, rather than an arbitrary bounded one, supplies the exact unbounded state quotient.

6.6 Finite Stabilization and Its Certificate

On a finite carrier, the refinement process reaches the full relation after a bounded number of strict splits. This subsection proves the bound and distinguishes attainment from certification.

Proposition 6.4 (Finite refinement bound)**.** *If $|S| = n < \infty$ and $\ker o$ has r_0 classes, some $h \leq n - r_0$ satisfies $\equiv_o^{(h)} = \equiv_o$. Equality of consecutive refinement relations certifies stabilization.*

Proof. Every strict refinement of an equivalence on S splits at least one class. It therefore increases the number of classes by at least one. Starting from r_0 classes, at most $n - r_0$ strict increases are possible.

If consecutive relations agree, Equation (14) applies the same operator to the same input, so every later relation also agrees. The stable relation equals the intersection of all horizons, which is $\equiv_o$. A stable value must therefore be attained by the stated depth. □

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An implementation may compare the attained partition with one further stage to certify that it has stopped changing. The bound concerns the depth of attainment, while the additional comparison supplies the certificate.

A finite alphabet makes each refinement directly enumerable. The mathematical class-count bound can hold with an infinite alphabet, but an effective computation then needs a way to check the operation family.

The result concerns a specified model. Observing a finite number of traces from an unknown social system does not establish that its unmodeled transitions agree with the assumed maps. Model identification requires additional evidence.

6.7 Blocked Operations and Totalization

Partial availability can be represented through a fresh blocked state and observation. This subsection states that convention and examines the information it preserves.

Let T_b initially be partial with domain $D_b \subseteq S$. Adjoin a fresh state † and define

$$\widehat{T}_b(x) = \begin{cases} T_b(x), & x \in D_b, \\ \dagger, & x \in S \setminus D_b, \end{cases} \qquad \widehat{T}_b(\dagger) = \dagger.$$

Extend the observation by $\widehat{o}(\dagger) = \bot$, where $\bot$ is outside the ordinary observation range.

The totalized system satisfies the theorem's map assumptions. A word executable from one configuration and blocked from another can now distinguish them through the fresh observation. Availability becomes part of the test output.

The absorbing convention records failure of the modeled execution. It need not describe a physical state from which recovery is impossible. A repairable failure requires a different transition or a richer failure record.

The construction uses free operation words. Equations between products in an earlier total semigroup may fail after domains are restricted. Their validity must be checked before the totalized word action is compressed through that presentation.

Observable blockage, silent failure, and an unattempted operation also carry different meanings. The observation should reflect the distinctions the inquiry can justify. A convenient marker is an explicit modeling choice.

6.8 Interpretive Limits and Category Use

The continuation quotient supplies a consistent state description for a selected task. This final subsection identifies how the six categories can use it and where their requirements remain independent.

An entity can persist while its continuation profile changes. Different entities can have the same profile under a coarse observation. The quotient therefore cannot replace a separate reidentification criterion.

Event occurrences and process histories can also be merged by behavioral equality. A repeated idempotent operation can leave the same future state while adding an occurrence. A historical query can require that distinction even when the predictive task does not.

Attributes can supply the observation or contribute to a family of observations. The quotient must preserve their values if those values belong to the task. Partial attributes also require a definedness criterion, developed in the attribute section.

The construction thus provides one shared tool within the category architecture. It derives dynamic consistency from declared observations and operations, while leaving identity, occurrence, history, evidence, and evaluation visible as additional commitments. The following sections develop those commitments for each category.

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7 Entity Reidentification and Historical Continuity

This section develops the entity category through the problem of reidentifying a participant, organization, agreement, document, or other focal object across changing appearances. It begins with configurations and appearances, constructs an identity quotient under a declared criterion, and derives consequences for attributes and lineage. It then examines orbit-based alternatives, branching, behavioral similarity, relational individuation, and evidential warrant. The objective is an entity representation whose mathematical conditions and philosophical commitments remain separately assessable.

7.1 The Reidentification Problem

An entity description lets an inquiry connect claims made at different moments or in different settings. A researcher may ask whether the group that entered an agreement is the group that later exercised its permission, whether a revised document continues an earlier document, or whether a newly configured organization carries forward an earlier commitment. These questions require a way to join appearances while allowing some of their properties to change. A catalogue of currently visible features cannot settle the question by itself, because the significance of a changed feature depends on the criterion of continuity being used.

Consider a stipulated association that changes its meeting place, replaces several participants, and modifies its procedures. A study of its historical activity might follow it through all three changes. A study of the membership cohort could treat replacement of participants as a change of its focal object. A study of the meeting practice might group several otherwise different associations together because they enact the same procedure. These descriptions can be internally coherent while answering different questions. The inquiry needs to state what is being tracked and what a claim of sameness is intended to preserve.

The word *entity* marks a representational role in this paper. It provides a subject to which claims across appearances can be attached. This role is compatible with several positions about the metaphysical status of the represented subject. Ontological suspension keeps those positions available for later argument. It also prevents a mathematical equivalence class from receiving more philosophical authority than its construction supplies.

The distinction matters for the carrier S, which represents configurations of an inquiry. A configuration can describe many participants and conditions together. Conversely, one participant can appear in many configurations. Taking every $x \in S$ to be an individual would identify the overall situation with each object discussed within it. Taking every trajectory to be an individual would import another assumption about continuity. The appearance construction provides a separate domain on which the entity question can be stated explicitly.

7.2 Appearances, Contexts, and Identification

The construction introduces the records needed for the question before assigning identity classes. This order makes additional commitments visible and permits comparison between competing criteria.

Let I be a set of indexed appearances. An appearance is a position in the representation at which a focal object is presented or referred to. It can include a time, context, document reference, or observation source when the inquiry requires those data. The index distinguishes records that would otherwise have the same description. A map

$$p : I \longrightarrow S$$

associates an appearance with a represented configuration. Its mathematical role is modest: it connects entity records to the action framework. Several appearances may have the same image, and the image may contain information about several focal objects.

The appearance domain is itself a modeling choice. It can be constructed from positions in a documented history, versions in a repository, or a declared set of possible manifestations. Each source has a different epistemic status. A possible appearance supplies a place in a model; a recorded appearance

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supplies documentary material; an evidentially warranted appearance supports a claim about the case. The mathematics can represent each, provided the interpretation of I remains clear.

Definition 7.1 (Declared entity criterion)**.** Let E be an equivalence relation on I. The represented entity domain is $\mathcal{E} = I/E$, with projection $e : I \to \mathcal{E}$. The assertion iEj records that the inquiry reidentifies appearances i and j under its stated criterion.

Reflexivity assigns an appearance to its own class. Symmetry permits the same identification to be read from either appearance. Transitivity lets a chain of warranted identifications support a single class. These properties make a partition possible: classes either coincide or are disjoint. They also constrain interpretation. A weaker relation of influence or succession may fail symmetry or allow branching that the partition would obscure.

An equivalence can be supplied in several ways. A specified identifier may induce iEj when identifiers agree. A documentary reconstruction may establish pairwise links and assess whether they justify an equivalence closure. A formal model may stipulate classes for an illustration. The resulting partitions can have the same abstract form even when their evidential bases differ. Writing the relation as E records the criterion; its justification belongs to the accompanying argument.

A possible circularity becomes visible at this point. If the input is defined to contain all appearances of an already identified entity, identity has already been used to select the domain. The construction can organize those appearances, but presupposes their initial identification. A stronger reconstruction begins with indexed records whose grouping remains open, states admissible evidence for joining them, and examines the consequences. The framework accommodates either use and requires disclosure of which one is intended.

7.3 Invariant Descriptors and Changing Properties

The quotient provides a subject for invariant descriptions. The following result identifies the appearance-level values that can be assigned to it without dependence on the chosen representative.

Proposition 7.2 (Descent of an entity descriptor)**.** *Let $d : I \to V$ be a descriptor. A map $\bar{d} : \mathcal{E} \to V$ satisfying $d = \bar{d} \circ e$ exists exactly when*

$$iEj \quad \Longrightarrow \quad d(i) = d(j). \tag{15}$$

When it exists, it is unique.

Proof. Suppose first that $d = \bar{d} \circ e$. If iEj, then $e(i) = e(j)$. Applying $\bar{d}$ to the equal arguments gives $d(i) = d(j)$.

Conversely, suppose Equation (15) holds. For $C \in \mathcal{E}$, define $\bar{d}(C)$ to be the common d-value of its members. The class is nonempty, and the condition ensures that any two members give the same value. This proves existence and representative independence. Since $e(i)$ contains i, $\bar{d}(e(i)) = d(i)$.

Every class is the image of an appearance. Any map satisfying the factorization must send that class to its members' descriptor value. Two such maps therefore agree on all of $\mathcal{E}$, proving uniqueness. □

A descriptor that changes within an identity class cannot be an invariant function of the class alone. It can remain an appropriate attribute of the entity at a specified time or context. A change of membership, location, or resources therefore need not defeat an entity criterion. It may show that the attribute's domain needs an extra coordinate.

Let $c : I \to C$ record context and consider $(e, c) : I \to \mathcal{E} \times C$. An attribute $a : I \to V$ factors through the image of this joint map precisely when

$$e(i) = e(j) \text{ and } c(i) = c(j) \quad \Longrightarrow \quad a(i) = a(j).$$

The proof repeats the two directions above with (e, c) in place of e. The resulting value is assigned on represented entity/context pairs. Extending it to every conceivable pair requires further information. If

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records disagree even at one such pair, the model can retain conflicting evidence, uncertainty, or a need for finer context.

This distinction blocks an indiscriminate inference from changed properties to changed identity. Such an inference needs a premise making the property identity constitutive. Conversely, an invariant identifier can continue while the object relevant to another inquiry has changed substantially. Identity and descriptive attributes constrain one another through explicit decisions. A convenient database key settles only the identity question built into that database.

Structural type and entity token also differ. A descriptor may assign the same procedural form to several entity classes. Equality of its value groups similar entities. Recovering token identity from the descriptor would require injectivity of $\bar{d}$, which the proposition never assumes. A classification can describe many objects efficiently while remaining insufficient to reidentify an individual object.

7.4 Forward Reachability and Orbit Proposals

The action framework supplies a natural family of reachable configurations. This subsection examines its contribution to continuity and the additional conditions needed for identity.

For a declared subsemigroup $N \subseteq M$, write

$$\mathrm{Orb}_N(x) = \{nx : n \in N\}, \qquad \mathrm{Orb}_N^*(x) = \{x\} \cup \mathrm{Orb}_N(x).$$

The first set collects results of at least one mechanism in N. The second retains the seed. If an identity action is available, the seed may already belong to the first set; otherwise its inclusion requires an explicit convention.

The associated reflexive reachability relation is a preorder. A zero-step continuation gives reflexivity. If $y = mx$ and $z = ny$, then $z = (nm)x$, so composition gives transitivity. These properties track where a configuration can lead. Symmetry requires a path back, which a semigroup action need not supply.

Example 7.3 (Overlapping forward closures)**.** Let $S = \{u, v, w\}$ and let k send every point to v. Then $k^2 = k$, but

$$\mathrm{Orb}_{\{k\}}^*(u) = \{u, v\}, \qquad \mathrm{Orb}_{\{k\}}^*(w) = \{w, v\}.$$

The closures intersect at v while remaining distinct.

Applying k once to either seed reaches v. Further applications stay there. The reflexive closures therefore contain their respective seeds and the common destination. Since u belongs only to the first and w only to the second, the closures differ. Equivalence classes, by contrast, coincide whenever they intersect. These forward closures fail to provide an identity partition.

Two organizations can be represented as reaching a common later configuration because the model retains only a shared outcome. Their common destination leaves several interpretations open: a merger, a coarse observation that discarded their distinction, or an actual identity claim supported by other evidence. The reachability pattern alone leaves the choice unresolved. An entity criterion needs information appropriate to its intended interpretation.

Calling N identity preserving can make the orbit a useful description of transformations undergone by an already identified entity. That description presupposes the identity judgment it might appear to derive. The construction is conditional: given a criterion and mechanisms that respect it, the orbit records reachable configurations. It can contribute to persistence analysis while leaving the criterion's justification visible.

Absence of inverses also leaves the identity question open. An injective forward shift can lack an inverse in the selected semigroup while retaining every difference between starting points. An idempotent operation can collapse distinct beginnings immediately. An entity's history can involve either behavior. Historical continuity, injectivity, reversibility, and identity preservation require separate conditions.

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7.5 Directed Lineage, Fission, and Merger

Lineage records directional continuation between appearances and permits branching to remain visible. This subsection derives the constraints that arise when such continuity is identified with equivalence.

Let $L \subseteq I \times I$ record immediate continuation. Its reflexive transitive closure L^* connects appearances by finite lineage paths. An edge may represent organizational succession, document derivation, or another declared continuation. Its meaning remains narrower than a general identity claim unless identity is independently justified.

Proposition 7.4 (Branching consequence of equivalence)**.** *If an equivalence E satisfies iEj and iEk, then jEk. Consequently, keeping two successors in distinct identity classes prevents both from belonging to the predecessor's identity class.*

Proof. Symmetry gives jEi. Transitivity with iEk yields jEk. If the successors occupy distinct classes, at least one proposed identification with the predecessor must be revised. □

The result imposes a structural choice without prescribing a philosophical resolution of fission. An inquiry can treat a predecessor as ending and both successors as new. It can identify one successor as continuing under a privileged criterion. It can preserve shared descent in a lineage description while leaving identity undecided. Its statements must agree with the relation type chosen to represent them.

For example, take

$$I = \{r, u, v, u', v'\}, \qquad L = \{(r, u), (r, v), (u, u'), (v, v')\}.$$

The partition $\{\{r\}, \{u, u'\}, \{v, v'\}\}$ treats the predecessor as ending and two successors as continuing separately. The partition $\{\{r, u, u'\}, \{v, v'\}\}$ privileges one continuing branch. Both accompany the same lineage. Choosing between them requires a criterion beyond the directed graph.

Automatic closure operations supply further alternatives. Mutual reachability under L^* is an equivalence: reflexivity and symmetry are immediate, and concatenating forward and reverse paths proves transitivity. In this acyclic example, however, distinct appearances lack paths back to one another, so the equivalence has five singleton classes. Symmetrizing the edges and taking transitive closure gives one connected component containing all five appearances. The first construction can be too fine for continuity, the second too coarse for distinguishing branches. Mathematical availability alone leaves their adequacy unsettled.

Merger produces a corresponding issue. If two earlier entities are both identified with a common successor, equivalence identifies them with each other. An inquiry that distinguishes them before merger needs to differentiate lineage from identity. It can record the successor's multiple origins without erasing the earlier distinction. The substantive question is what continues: organization, membership, resources, commitments, or a declared combination.

Temporal indexing makes the disagreement articulable. Investigators can agree that a successor inherits something from both predecessors while disagreeing about whether either predecessor continues numerically. Lineage records inheritance directions. Identity records the stronger claim of sameness. Their coordination preserves the disagreement for argument and evidence.

7.6 Behavioral Equivalence and Entity Tokens

Continuation signatures characterize agreement under specified tests. This subsection separates that result from reidentification across appearances and explains how the two tasks can be coordinated.

Section 6 identifies configurations when every declared continuation produces the same observation. Equal signatures justify shared treatment for that prospective observation task. They can support a behavioral type or compressed predictive state. Whether the records concern one entity remains an additional question.

Two stipulated devices can have identical update rules and conditions while remaining separately indexed. Two document copies can have matching content and editing possibilities. Two associations

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can occupy the same position in a coarse procedural model. A token-sensitive inquiry can preserve their differences through appearance or provenance records. Behavioral agreement supplies no rule for discarding those records.

The converse is equally significant. An entity can continue under a criterion while its signature changes. An association can gain permission, acquire resources, or lose facility access. If these alterations affect a continuation observation, the signature changes, even when the chosen identity criterion permits the changes. Requiring signature invariance would impose a special persistence criterion under which such changes terminate the entity.

Use separate maps to coordinate the questions. The identity projection e groups appearances by continuity. A behavior map β sends an appearance to the signature of its configuration $p(i)$. The pair (e, β) retains the entity label and behavior at each appearance. It can represent a continuing entity with changed behavior, or different entities with matching behavior, without requiring one map to determine the other.

Dennett's discussion of patterns connects descriptive usefulness with compression and prediction [1]. This comparison motivates attention to what a representation preserves. The present construction adds an independent reidentification task and leaves the metaphysical conclusions of that discussion open.

A stable pattern can contribute evidence for continuity. Making it sufficient requires explaining why this pattern, at this resolution and over this interval, settles the entity question. An account must also address equally predictive descriptions that support different token groupings. The distinction between identity and behavior exposes that obligation while allowing pattern-based theories to supply a further argument.

7.7 Relational Individuation and Boundaries

An entity can be tracked through relations to other objects and conditions. This subsection evaluates that strategy without concealing its dependence on jointly specified records.

A relational description can identify an appearance through participation, commitment, dependence, or derivation. A document's relation to an earlier version can distinguish it from a matching document with another history. An association's commitments and recognition by participants can support continuity. These are proposed forms of evidence whose relevance depends on the target.

Such descriptions encounter mutual dependence. Identifying an entity through its relations requires identifying the relations and their other participants. Identifying a relation through its participants requires tracking those participants. A joint representation can constrain these components together. The distinction is between a coherent joint specification and a claim that one component is uniquely derived from data that already presuppose it.

One approach begins with provisional appearance indices and relational records, then assesses candidate assignments of identity classes and incidence relations. A candidate fails when a required predicate becomes representative-dependent or when its grouping collapses evidentially required distinctions. Several candidates may remain. The result is then a family of admissible reconstructions. Later evidence can narrow the family without pretending that the initial formulation already settled identity.

Boundary selection changes the task. The focal object can be a participant, a group, a working arrangement, or a system including resources and procedures. An alteration internal to one boundary becomes an interaction across another. The action model can represent either choice through a suitable carrier and update maps. Explanatory relevance and evidence must supply reasons for preferring a boundary.

This permits a disciplined plurality of descriptions. Different questions can use different boundaries while each description states what its identity claims preserve. Grounds for criticism remain concrete: descriptor inconsistency, unsupported continuity links, loss of a required distinction, or failure to represent the subject of the inquiry. The availability of several representations therefore leaves substantial room for disagreement and correction.

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7.8 Continuity, Potential Efficacy, and Explanation

The motivating intuition combines reidentifiable continuity with the capacity to matter in subsequent activity. This subsection evaluates these components separately before discussing their conjunction.

Continuity relates appearances. Potential efficacy concerns a difference under a continuation or comparison. A stable identity record can be irrelevant to the chosen future observations. A configuration difference can affect those observations while giving little guidance about which entity persisted. The two conditions therefore need distinct representations and warrants.

For a proposed efficacy test, take a defensible comparison (x, y) and a nonempty continuation w. The inequality $o(T_w x) \neq o(T_w y)$ shows that the model distinguishes the configurations under that test. Attributing the contrast to an entity requires an account of how the comparison isolates that entity or a relevant condition. Other differences in resources, rules, or participants leave the source of the effect underdetermined.

Dormant efficacy remains meaningful under an existential test. A permission-bearing organization can have a modeled route to activity that is never exercised. Its absence from an observed sequence leaves the untested potential unresolved. An interpretation depends on admissible continuations, persistence of enabling conditions, and the comparison's empirical warrant. The relation category and the companion historical paper develop those requirements in more detail.

The source intuition also links continuing appearance with withholding a commitment to independent self-subsistence. Here it functions as a research proposal. Its mathematical content concerns tracking continuity and effects through explicit records. A conclusion about the ultimate constitution of the object requires a philosophical argument beyond those records and their algebraic properties.

Historical explanation introduces further information. Explaining a present capacity requires evidence about its formation and transformation. A current identity label or signature can omit those histories. Two organizations with the same present model may have acquired capacity through different sequences. The difference can matter to a historical, causal, or normative question. Keeping current efficacy separate from formation history preserves the possibility of asking those questions.

7.9 Evidence, Revision, and Disagreement

A usable entity representation includes a way to assess its identification claims. This subsection identifies evidence problems left open by the formal construction.

An appearance record can accurately report a local feature while misidentifying its subject. Matching names need not identify one organization; different names can belong to a continuing organization. The evidence task therefore concerns both record reliability and the inference linking records. A naming convention can support that inference when its reliability is justified in the case.

Conflicting records illustrate the distinction between identifier and warrant. Attach sources to appearances and preserve competing identity assignments. The inquiry can then distinguish conclusions shared by all admissible assignments from conclusions dependent on one reconstruction. A definitive identifier assigned too early can conceal disagreement and make downstream calculations appear more certain than their premises.

Revision also differentiates a claim from a record of that claim. Evidence may justify regrouping appearances while the fact that a different grouping was previously accepted remains historically relevant. Preserving both supports inquiry into changing recognition without asserting that the earlier appearances were rewritten. Occurrence, recording, and later interpretation retain their separate roles.

An operational assessment can ask what would justify joining two classes, what would require splitting one, how the criterion handles a changed name or a gap in records, and whether it distinguishes succession from continuation when needed. It should also ask whether the criterion forces attributes to remain invariant that the inquiry needs to examine as changing. Each answer requires domain-specific decisions and a way to retain unresolved cases.

Disagreement then becomes more precise. An investigator can challenge the evidence, the criterion, the appearance domain, or the fit between the criterion and the explanatory purpose. These objections call

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for different revisions. An unqualified claim to have derived entity identity would collapse distinctions that the formal result leaves open.

7.10 Coordination with the Other Categories

The entity construction supplies one part of the six-category framework. This subsection states how that part connects to the others and what a successful application would establish.

Entity classes can support context-sensitive attribute descriptions. Appearances can participate in relational incidence records. Event tokens can index occurrences involving those appearances. Process histories can connect successive configurations, while a state description retains conditions relevant to a declared prediction. These links let an inquiry ask several questions about a continuing subject without forcing every answer to follow from one quotient.

The formal tasks remain distinguishable. Equivalence supplies a partition. Descriptor descent identifies invariant class-level information. Lineage preserves direction and branching. Signatures retain agreement under chosen tests. Evidence supports or challenges their interpretation. A successful application coordinates those tasks and demonstrates why its criterion serves a concrete question.

Stronger philosophical theories of identity, persistence, and selfhood can propose privileged criteria or criticize this separation. Their conclusions enter through argument. The present constructions expose their consequences and countercases while keeping the original inquiry visible.

8 Historically Formed Relations and Potential Effects

This section develops the relation category through three connected questions: how participants are represented, how a dependence is historically formed, and how it can matter for later activity. It first constructs contextual incidence, then examines the base-definable order predicate and a comparative potential-effect test. The philosophical discussion concerns relational individuation, dormancy, persistence, and the evidence needed for causal interpretation. The proposed account remains a focal research criterion rather than a definition of every mathematical or social relation.

8.1 The Focal Relational Question

A mathematical relation can be any subset of a product of domains. That broad usage permits precise representation of many patterns, including similarity, order, participation, and dependence. The research question here is narrower. It concerns a relatively reidentifiable dependence that has a formation history and can affect subsequent activity.

The motivating insight joins two directions of inquiry. Relations are historically formed, and they can participate in further historical formation. The first direction asks how an arrangement came to obtain. The second asks which later possibilities depend on its presence, alteration, or removal. The two directions can interact while requiring different evidence and formal records.

A stipulated agreement illustrates the distinction. Its participants can be represented through appearance indices. Its formation can be represented by a history of proposals and authorization. Its present role can be represented by a permission condition. Its potential effect can be tested through a continuation whose availability or result depends on that condition. None of these components alone supplies the entire relational account.

The category also leaves evaluation open. A dependence can enable cooperation, sustain an unwanted arrangement, constrain a participant, or preserve an existing practice. Potential efficacy identifies a role in the declared dynamics. An appraisal requires further premises about purposes, interests, and justification. Generative and reproductive roles can each have several evaluations depending on the case.

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8.2 Participants and Contextual Incidence

A social relation needs a representation of its participants or conditions. This subsection constructs incidence and derives the requirement for describing it at an entity level.

Let I be the appearance domain and let E be a declared identity equivalence, with projection $e : I \to \mathcal{E}$. For a fixed finite arity n, let

$$R \subseteq I^n$$

record an incidence predicate. The tuple positions can have different roles, such as issuer, recipient, or object of an authorization. Binary notation is a special case; the framework imposes no requirement that every relation have two participants.

Suppose the inquiry wants a predicate on entity classes, $\bar{R} \subseteq \mathcal{E}^n$. The intended exact descent condition is

$$R = (e^n)^{-1}(\bar{R}).$$

This says that the appearance predicate can be recovered from the entity-level predicate without losing its truth conditions.

Proposition 8.1 (Incidence descent)**.** *Such a predicate $\bar{R}$ exists exactly when coordinatewise replacement by E-equivalent appearances preserves membership in R.*

Proof. If R is the displayed inverse image, coordinatewise equivalent tuples have equal e^n projections and therefore equal membership truth.

Conversely, assume replacement invariance. Define $\bar{R}$ on a tuple of entity classes by the R-value of any representative tuple. The assumption makes the value independent of representatives. Pulling the predicate back then recovers R. □

The condition can fail for historically changing participation. One appearance of an entity may belong to an agreement and a later appearance may follow its withdrawal. An entity-only predicate would assign one value to both appearances. Retaining a time or context argument permits the relation to change while the entity criterion remains fixed.

Existential projection is another option: an entity tuple is related when some representative tuple belongs to R. This always supplies a quotient-level predicate, but its pullback can be larger than R. It changes the statement from participation at this appearance to participation at some appearance. The difference matters to claims about present authorization or historical membership.

Incidence therefore performs one clear task: it identifies participation at a declared level. Historical formation and potential effect require additional structures. An incidence table can record who stands in a relation while leaving how it arose and what it enables unresolved.

8.3 Relation Tokens and Relational Types

A relation can persist, be renewed, or recur between the same participants. This subsection distinguishes a general relational type from a particular historically tracked arrangement.

A predicate such as participation in an agreement can classify many arrangements. Two agreements between the same parties may have different formation histories, scopes, or durations. Conversely, one continuing arrangement may change some terms while remaining reidentified under a chosen criterion.

An occurrence or relation-record index can retain those distinctions. Let Λ index proposed relational arrangements and attach participant, context, and formation records to each index. A classification map can send several indices to the same relational type. The map's image retains the type while its domain retains the separate arrangements.

The indexing does not establish their identity by itself. Reidentifying one arrangement through renewal requires a criterion, just as reidentifying an entity does. The criterion might concern continuing commitments, a declared institutional record, or another warranted feature. The model can represent the criterion and test its consequences without treating it as self-evident.

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A relation can also change arity or participant roles in an extended model. Fixed-arity incidence then captures only one stage or one selected description. A more general record can retain a role-indexed participant assignment. That extension adds flexibility while introducing new questions about comparison across stages.

These distinctions prevent a relational type from absorbing its historical tokens. Two arrangements can share an extensional participant pattern and differ in provenance. A present type description can support one prediction while leaving a historical question unanswered. The historical-relations paper develops that record-sufficiency problem directly.

8.4 Order Effects in the Abstract Base

The base action supplies an exact predicate for order-sensitive effects. This subsection derives its scope and tests a broader relational reading.

For $m, n \in M$ and $x \in S$, define

$$R_{\text{ord}}(m, n, x) \quad \Longleftrightarrow \quad (nm)x \not\sim (mn)x. \tag{16}$$

The predicate compares two orders from one seed under the same equivalence. Its symbols belong to the base language, so it is explicitly definable there.

A simple numerical example uses $a(x) = x + 1$ and $b(x) = 2x$ with ordinary equality. Then $ba(x) = 2x + 2$ and $ab(x) = 2x + 1$. The order predicate holds at every input. The calculation establishes order dependence without assigning a particular social meaning to either map.

Commuting operations give a complementary countercondition. The translations $a(x) = x + 1$ and $c(x) = x + 2$ both affect the same coordinate, yet $ca(x) = ac(x) = x + 3$. A shared target of action therefore need not produce noncommutativity. Likewise, two prerequisite-setting operations can commute while jointly enabling a later activity.

The predicate is thus neither a necessary nor a sufficient criterion for a particular social relation. It can be a useful witness when the interpretation of the maps and outcome distinction is independently supplied. It leaves friendship, authorization, dependence, or another substantive meaning open.

The locality in x also matters. Two operations can commute at one configuration and differ at another. A global statement quantifies over the carrier; a local witness concerns one selected seed. An empirical comparison must identify which configurations are relevant and accessible rather than treat a local result as a universal law.

8.5 Historical Formation and Present Representation

A relation's formation history can be compressed into present conditions for some tasks. This subsection explains why that possibility preserves the historical question rather than settling it.

Let a word $w = b_1 \cdots b_k$ represent a candidate formation sequence from a seed. Its endpoint can contain a record that the relation currently obtains. Another word can produce the same endpoint. The present state can therefore be sufficient for a future operational prediction while failing to recover which formation sequence occurred.

Consider two labels n and i with identical maps that set an authorization coordinate to 1. They can be interpreted in a stipulated example as negotiated and imposed formation. Their effects agree on the chosen carrier while the labels retain different histories. A calculation using only the common endpoint cannot recover the label.

This is an underdetermination argument. Keep the base data and endpoint fixed while varying the formation record. Any function of the fixed data returns the same value in both cases. A target query that distinguishes the histories therefore requires richer input. The result identifies a representational limit; it does not claim that formation history is always inaccessible.

Historical formation also differs from dependence on information omitted by the present state. A sufficiently rich current state can encode every condition needed for the selected future task. The ar-

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rangement still has a history. A statement that it was historically formed therefore does not imply failure of a present state description.

The distinction supports two legitimate research directions. One can ask which historical information must be retained for future updates. One can ask what happened in the formation of an arrangement even when that information is redundant for the selected prediction. A comprehensive relational model keeps both directions available.

8.6 Potential Effects under Declared Continuations

Potential efficacy concerns a comparison of possible futures. This subsection states the relevant domains and explains the positive-length condition.

Fix total operation maps T_b, an observation $o : S \to Y$, and a set $\mathcal{C} \subseteq S^2$ of admissible comparison pairs. For a word w, write $\sigma_x(w) = o(T_w x)$.

Definition 8.2 (Comparative future-effect witness)**.** For $(x, y) \in \mathcal{C}$, a nonempty word $w \in B^+$ is a future-effect witness when

$$o(T_w x) \neq o(T_w y). \tag{17}$$

Potential efficacy under the declared tests requires at least one such witness.

The positive-length requirement separates a present distinction from a future effect. Let the observation distinguish two current states, while the only operation resets both to one common state. The present observations differ, but every nonempty continuation agrees. A definition using only current inequality would count a different property.

The condition is existential. It leaves open whether the witness is ever enacted. It also permits other continuations to erase or bypass the distinction. Requiring different outcomes under every continuation would impose a stronger criterion and exclude many dependence patterns that can matter under some relevant circumstances.

The comparison set $\mathcal{C}$ carries substantive information. It identifies which alternative configurations can be compared meaningfully. A pair that differs in many respects can witness a predictive difference without isolating the relation under study. A causal interpretation needs a justified design for the contrast.

The operation repertoire and observation likewise constrain the result. A test can fail to reveal a difference because its observation is too coarse, its repertoire omits the relevant continuation, or the relation has no effect under those declared conditions. The formal witness separates these possibilities only when the model retains the relevant distinctions.

8.7 Dormancy, Erasure, and Availability

A relation can affect access to a route or remain unused throughout an observed history. This subsection examines those cases through the declared comparison.

A permission can be represented by a condition that enables an activity. Comparing otherwise specified configurations with and without that condition can yield a distinguishing continuation. The permission's effect remains potential if the activity is never attempted. The absence of an observed enactment leaves that potential unresolved.

An erasing operation can remove the condition before the distinguishing test. The resulting actual sequence may therefore show no difference. This is compatible with an earlier potential witness. The interpretation must specify the time at which the comparison is made and the conditions that persist during the test.

Availability can itself be the relevant difference. For partial operations, let $W(x)$ contain the words whose every prefix is executable from x. Use a fresh marker $\perp$ and define

$$\widehat{\sigma}_x(w) = \begin{cases} o(T_w x), & w \in W(x), \\ \perp, & w \notin W(x). \end{cases}$$

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A word executable in one configuration and blocked in another gives a signature difference even when every commonly executable word has matching observations.

The marker records a testing convention. It can represent modeled unavailability, not an ordinary social outcome. A physical failed attempt or observable refusal requires the corresponding transition or occurrence record. Comparing these interpretations is part of the model's adequacy audit.

An inquiry that considers only the intersection $W(x) \cap W(y)$ omits availability differences. That restriction can be appropriate for comparing outcomes under shared opportunities, but it changes the question. A relational account of access needs to preserve the difference between available and unavailable continuations explicitly.

8.8 Relational Persistence and Change

A historically formed relation can persist while some of its participants, terms, or effects change. This subsection identifies the criteria needed to describe that continuity.

Persistence is a reidentification claim. It asks whether appearances of an arrangement belong to the same tracked relation under a declared criterion. Repeating an incidence pattern can support that claim while leaving open whether the arrangement was renewed, replaced, or independently recreated.

A relation's current extension can also change while its institutional or practical continuity is retained. A group can admit a new participant or revise a permission. Whether the result is the same relation, a modified relation, or a new arrangement depends on the criterion of tracking.

The model can keep these decisions visible through relation-record indices, contextual incidence, and histories. A single invariant predicate may be too coarse when the inquiry needs changing terms. A fresh relation index after every update may be too fine when continuity is central. The appropriate representation needs an argument about the kind of persistence at issue.

Potential effects can persist, vanish, or become observable under a changed repertoire. These are different claims from relation identity. One continuing agreement can lose an operational effect; two distinct agreements can have matching effects. A comprehensive account therefore tracks relation continuity and prospective behavior through separate components.

8.9 Causal Interpretation and Evidence

An observational difference is a formal witness. This subsection explains the further work needed to interpret it causally or historically.

The comparison in Equation (17) shows that the model distinguishes two configurations after the same word. Attributing the difference to one relation requires assumptions that isolate its role. Other differences between the configurations can account for the observation.

The historical question likewise needs evidence. A present authorization record may be compatible with several formation histories. Naming a history in the model makes it available for analysis, but the claim that it occurred depends on records, testimony, or other appropriate sources.

These obligations can interact. A formation history may explain why a present condition has the efficacy assigned to it. A present effect can motivate investigation of the history. Neither direction licenses an automatic inference. The account must state which premises support the transition between historical and prospective claims.

Counterfactual tests can also depend on the stability of other conditions. Removing one relation may alter participants, rules, or resources rather than leave everything else fixed. A proposed comparison must explain why its alternative configurations are admissible for the causal question. The set $\mathcal{C}$ records the choice; evidence and theory justify it.

The formalism remains useful under this restraint because it exposes the required comparison. It distinguishes a mathematical difference, a historical reconstruction, and a causal attribution. An application can then identify which parts are established and which remain hypotheses.

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8.10 Relational Explanation and Philosophical Scope

The relational category gives dependence a central explanatory role while retaining the conditions of that explanation. This subsection examines its philosophical implications.

A relation can help explain why a participant has a capacity in one context and lacks it in another. The explanation locates the difference in a structured arrangement rather than treating the capacity as an invariant isolated attribute. The model supports that move when its variables and comparisons represent the arrangement adequately.

The explanatory direction need not deny that participants have other properties. The same configuration can include individual conditions and relational conditions, with their interaction specified by the update rules. The question is which distinctions are required for the phenomenon being studied.

Relational individuation can also shape entity descriptions. An organization's commitments and dependencies can contribute to its reidentification. The entity and relation criteria may then be jointly specified. Coherence of the joint specification is a mathematical and conceptual requirement; uniqueness and empirical warrant require further argument.

The present account suspends the claim that relations are metaphysically prior to all relata. It permits a research program to investigate how represented units emerge or become identifiable through activity and dependence. Such an investigation must show its constructions and evidence rather than assume the desired priority in its choice of primitives.

The distinction preserves the original insight about historical formation while making it testable. A relation can be investigated through its formation record, continuity, incidence, and possible effects. Each component can be challenged, refined, or found inadequate without forcing a decision about the entire ontology.

8.11 Relation Use in the Coordinated Framework

The relation category connects participants and conditions across historical and prospective questions. This subsection states what a successful application needs to coordinate.

Entity appearances provide participant references. Events identify formation, exercise, renewal, or withdrawal occurrences. Attributes describe terms and conditions. State descriptions retain present dependencies. Process histories record how the arrangement developed. The relation account joins these records to a declared potential-effect comparison.

A successful model must specify its incidence domain, relation identity criterion, formation query, observations, operation repertoire, and admissible comparisons. It must explain which parts are given, which are constructed, and which are evidenced. Where current effects and historical identity diverge, it must preserve both questions.

This makes the relational account comprehensive at the level of its intended task. It combines a formation question with a future dependence question while retaining their distinct formal and evidential requirements.

9 Event Occurrences and Transition Descriptions

This section develops the event category by distinguishing a possible transition, an occurrence, and a record of that occurrence. It constructs the required maps, derives the loss of multiplicity under effect compression, and examines how exact counting changes an idempotent model. The later discussion concerns attempts, event boundaries, temporal resolution, and evidential revision. The objective is to represent a happening without allowing a formula for its possible effect to substitute for the claim that it occurred.

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9.1 Happenings within an Action Framework

An action model states what a mechanism would do at a represented configuration. Given $x \in S$ and a mechanism $m \in M$, the expression mx identifies the modeled result. The triple (x, m, mx) therefore describes a candidate transition. The same base is compatible with different occurrence histories: the mechanism may be applied once, repeatedly, or remain unused. The distinction between those histories requires information beyond the action map.

Social inquiry often needs precisely that additional information. A permission may be issued, renewed, refused, or merely proposed. Several meetings may enact the same procedure. Two attempts may have matching outcomes while differing in timing, participants, and significance. A model that retains only the input and final condition can answer an effect question while leaving those occurrence questions open.

The occurrence distinction remains relevant even in a wholly stipulated example. A simulation can declare a sequence of executed labels and count its positions. A counterfactual analysis can declare several possible sequences while selecting none as actual. An empirical study can reconstruct a sequence from records. The same word notation can appear in all three settings, so its epistemic role must be stated.

An event category accordingly requires a criterion of occurrence and a criterion of individuation. The first concerns whether the happening belongs to the selected history. The second concerns whether two descriptions refer to one happening or to separate happenings. A transition formula contributes a consistency condition for the modeled effect. It leaves occurrence and individuation available for their own evidence and argument.

9.2 Occurrence Indices and Record Maps

The following construction places occurrence information alongside the base dynamics. Its domain carries token distinctions while its image records the transition description.

Fix an operation alphabet B with maps $T_b : S \to S$. Let Ω be an index set of represented occurrences. Write

$$d : \Omega \longrightarrow S \times B \times S, \qquad d(\omega) = (x_\omega, b_\omega, x'_\omega).$$

The middle coordinate identifies the represented operation. The first and third identify the initial and resulting configurations.

Definition 9.1 (Consistent execution record)**.** An occurrence record d is execution-consistent with the declared total maps when

$$x'_\omega = T_{b_\omega} x_\omega \qquad (\omega \in \Omega). \tag{18}$$

An occurrence criterion separately specifies what membership in Ω means for the inquiry.

Equation (18) can be checked by substitution. It says that the recorded transition agrees with the action model. Agreement establishes internal consistency. Establishing an actual event requires a warranted interpretation of the occurrence index and its source records. A model can consistently describe a sequence that was never enacted.

The map d need not be injective. Distinct occurrence indices can map to the same triple. This allows repeated executions to remain distinct even when their recorded conditions and effects match. Conversely, one occurrence can have several records. To represent that distinction, introduce a record domain $\mathcal{R}$ and, when warranted, a map

$$r : \mathcal{R} \longrightarrow \Omega.$$

Several documents can then refer to one occurrence. Their multiplicity belongs to $\mathcal{R}$; event multiplicity belongs to Ω.

The map r may itself be uncertain. A practical inquiry can retain candidate assignments or a relation between records and possible occurrences. Forcing a total definitive assignment would assert that each record has already been identified with a particular happening. A representation of uncertain evidence should expose that assumption or use a suitably partial or set-valued relation.

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Times, participants, locations, and source references can be attached to ω through further maps. Each supplies a possible basis for distinguishing occurrences, but none is universally sufficient. Matching timestamps can accompany simultaneous distinct events. Different timestamps can record different stages or reports of one event. A participant list can remain unchanged across repeated enactments. The occurrence index provides a formal place to retain the intended distinction; evidence must justify its use.

9.3 Transition Types and Event Multiplicity

The image of the occurrence map classifies represented transitions. This subsection derives the information lost when only that image is retained.

Suppose a finite occurrence domain contains two distinct indices ω_1, ω_2 with

$$d(\omega_1) = d(\omega_2) = (x, b, x').$$

The image contains one transition description, while the domain contains two occurrences. A second record system containing only ω_1 has the same image. The two systems therefore agree about which transition types are represented and disagree about how often the transition occurred.

Proposition 9.2 (Multiplicity loss under image reduction)**.** *The set $d(\Omega)$ alone generally fails to determine the cardinality of a finite occurrence domain Ω or the multiplicity of a transition description within it.*

Proof. Choose any consistent transition triple t. A one-element domain and a two-element domain can each map constantly to t. Both images equal $\{t\}$, whereas their domain cardinalities and the multiplicity of t differ. Any function of the image alone would have to assign the same answer to both systems. It therefore cannot recover both counts. □

A multiset representation can preserve more information than an ordinary set image. For a finite domain, define

$$n(t) = |\{\omega \in \Omega : d(\omega) = t\}|.$$

The multiplicity function retains the count of each represented type, while still discarding the identity and other attributes of its individual occurrences. If timing or responsibility matters, the occurrence records remain necessary. There is consequently a sequence of increasingly coarse descriptions: indexed records, type multiplicities, and the set of represented types.

These reductions suit different questions. A catalogue may need only which procedures have ever been used. A workload study may need how often each procedure was used. A historical analysis may need who participated in particular enactments and in what order. The appropriate representation follows from the question. Calling each of them an event description without specifying its retained information would make their answers appear interchangeable.

The proof also shows why an elaborate notation can conceal a simple loss. Adding a symbol for the set of events to an endpoint model does little if the symbol is defined only as a set of transition types. The occurrence domain has to carry the distinctions that later questions require. Those distinctions may be supplied through recorded sequence positions, independent identifiers, or another justified indexing rule.

9.4 Repeated Applications of an Idempotent Operation

Idempotence provides a particularly sharp test because it identifies repeated effects while leaving repeated applications conceptually available. This subsection derives the incompatibility and constructs an explicit repair.

Suppose $T_b^2 = T_b$. Applying b twice has the same final effect as applying it once. A flag-setting operation is a simple example: $T_b(z) = 1$ on a Boolean carrier. One application and two applications both leave the flag at 1.

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Let words retain application positions, with b^k denoting k applications. The count $c(b^k) = k$ distinguishes b and bb. Their effect representation identifies them:

$$T_b = T_{bb}, \qquad c(b) = 1, \quad c(bb) = 2.$$

A count function of the total effect alone would therefore receive equal arguments and need to return different values.

Proposition 9.3 (Counting and idempotent compression)**.** *If a product or effect representation identifies b with bb, exact application count fails to factor through that representation. On $S \times \mathbb{N}$, the update*

$$\widetilde{T}_b(x, n) = (T_b x, n + 1) \tag{19}$$

retains application count and projects to the old effect, but it fails the idempotent equation.

Proof. For the first statement, a factorization $c = \bar{c} \circ e$ would imply $c(b) = c(bb)$ whenever $e(b) = e(bb)$. The counts 1 and 2 contradict that implication.

For the extension, apply Equation (19) twice:

$$\widetilde{T}_b^2(x, n) = (T_b^2 x, n + 2) = (T_b x, n + 2).$$

One application gives $(T_b x, n + 1)$. The natural-number coordinates differ, so $\widetilde{T}_b^2 \neq \widetilde{T}_b$. Finally, projection pr_S satisfies

$$\mathrm{pr}_S \circ \widetilde{T}_b = T_b \circ \mathrm{pr}_S,$$

showing that the visible effect on S is preserved. □

The repair changes the information and the algebra together. Freely composed words act consistently on the enlarged carrier because each application increments the counter. Imposing the old equation $b^2 = b$ on the enlarged transformations would erase that count. The model therefore needs to distinguish an effect semigroup from a history-sensitive action. Each is coherent, and their connection is the projection that forgets count.

This example gives a general methodological lesson about enrichment. Adding a variable is mathematically consequential when the variable records distinctions previously identified by an algebraic law. A proposed enrichment should be checked against the old equations, rather than assumed to preserve them automatically. The same issue arises for duration and intermediate-state records in the process category.

The counter also remains interpretation-relative. It can count attempts, successful completions, or documented reports, depending on which updates increment it. An attempt counter and a completion counter need different update rules when an action can fail. Repeated reports can inflate a documentary counter without changing an occurrence counter. The equation records exactly what the increment rule specifies and leaves its empirical warrant open.

9.5 Quotient-Silent Events

A state description can treat an occurrence as silent when it leaves the selected observation unchanged. This subsection explains why that classification is a property of the description and event criterion.

For a quotient map $q : S \to Q$, a transition is silent at that resolution when $q(T_b x) = q(x)$. Silence means that this quotient records the same class before and after the operation. Another observation can distinguish the configurations, and an occurrence index can distinguish the application even when the carrier point itself remains fixed.

A stipulated renewal illustrates the issue. Let a Boolean flag indicate whether a permission is currently recorded. A renewal applied while the flag is 1 leaves it at 1. If the inquiry concerns current permission alone, the transition is silent. If it concerns how often the agreement was renewed, who endorsed the renewal, or when its evidential record was updated, the occurrence can be central. Those questions require additional observations or occurrence records.

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A failed attempt can likewise matter despite an unchanged outcome. The model may record that a participant tried to activate a mechanism, that a prerequisite was absent, and that the selected outcome remained unchanged. The attempt, refusal, and unchanged state have distinct descriptive roles. A definition that counts only changed quotient outcomes selects a narrower event category. It should state that selection explicitly.

The converse also holds: a change in recorded state can reflect a revised observation rather than a newly occurring event in the target history. If an investigator corrects an earlier record, the research database changes. The target event may have occurred earlier. A model of the investigation and a model of its subject then have different carriers and update meanings. Their alignment requires explicit maps or provenance relations.

This distinction is philosophically important because event significance often depends on the question under which a happening is described. The mathematics can show that an update is silent relative to a map. It cannot establish that the occurrence is insignificant in every respect. Equally, adding a counter can make every application visible, but visibility alone supplies no criterion of social importance.

9.6 Attempts, Blocking, and Completion

An event representation needs a clear convention when an operation is unavailable or its attempt fails to achieve the target. This subsection compares three modeling choices.

A total map can encode a failed attempt by leaving the configuration unchanged. This is appropriate when the intended rule specifies a self-loop under unmet prerequisites. The self-loop remains an executed application in the model, even though the selected state is unchanged. An occurrence record or attempt counter can retain it.

A partial map can encode successful executability through its domain. For x outside that domain, the operation has no modeled result. This convention expresses unavailability, and it leaves the effect of attempting the unavailable operation unspecified. An application that needs to discuss refusal, discovery of blockage, or sanctions for an attempt must supply an additional transition or record type.

A totalized partial map introduces a special blocked marker. That marker can distinguish availability failure from an ordinary outcome. Its interpretation requires care: it may record a failed test, a terminal analysis state, or an observable refusal. Each meaning places different demands on subsequent dynamics. An absorbing marker, for example, says that later modeled operations remain blocked after the failure. That is a substantive testing convention whose adequacy must be justified for the question.

These representations can agree about successful routes while differing about failed attempts. A comparison between models should therefore identify which event class is being compared. Counting successful applications in a partial model and counting every attempted label in a totalized model can produce different totals without any mathematical inconsistency. The counts answer different questions.

A comprehensive event record can declare an outcome type such as completion, refusal, interruption, or unresolved attempt. These labels remain proposed coding choices. Their relation to observed evidence, institutional categories, and the modeled state transition must be specified separately. Adding a label for success does not prove that the intended target was achieved.

9.7 Event Boundaries and Temporal Resolution

The beginning, end, and granularity of an event determine its occurrence domain. This subsection examines how changing those boundaries affects counting and interpretation.

A meeting can be represented as one event, a sequence of agenda events, or a process containing many individual contributions. The choice depends on what the inquiry needs to distinguish. A process model retains intermediate states; an event-level compression may retain only its overall transition. The two can be coordinated by a segmentation map that groups finer occurrences into coarser units.

Such grouping adds information. An ordered sequence alone can have several segmentations, each with the same total effect. A grouping criterion might concern a common purpose, an institutional procedure, a temporal interval, or a continuous activity. Each criterion can be debated. Associativity

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guarantees consistency of composite effects when grouping changes, while leaving the intended event boundaries undetermined.

Temporal resolution can also alter the appearance of simultaneity. Events that receive one coarse timestamp may be sequential at a finer resolution. Events known to overlap may resist a faithful representation by a single total order. A word model can impose an order for analysis, but its empirical significance requires justification when operations fail to commute.

For two operations a, b, equality $T_b T_a = T_a T_b$ can make the endpoint insensitive to their ordering. It leaves the occurrence order unresolved. The same final effect can arise from two different sequences, and the difference may matter to a historical explanation. When the operations fail to commute, uncertainty about order can imply uncertainty about the predicted endpoint as well.

A partial-order event record offers another possible extension. It can preserve known precedence constraints while leaving unrelated events unordered. To derive an endpoint from it, the model must explain how linear orders consistent with those constraints are evaluated and whether they agree. Agreement can follow from suitable commutation assumptions, but those assumptions need proof for the specified maps. This paper retains the sequential base and records the partial-order extension as an explicit modeling obligation.

9.8 Occurrence Evidence and Reconstruction

An event formula becomes part of an empirical inquiry through evidence. This subsection identifies the gap between internal consistency and warranted reconstruction.

A log entry can support the claim that a system recorded an operation. Its relation to a real-world completion depends on how the log is generated. A proposal document can support an intention without proving execution. A retrospective account can describe an event while requiring corroboration about timing or participants. These are generic evidence problems; an application must examine the particular source mechanism.

One can formalize the reconstruction task without pretending to have solved it. Let H be a declared space of candidate histories and let $\rho : H \to Z$ record the information retained by the investigation. An event-count query $g : H \to \mathbb{N}$ is exactly recoverable from ρ when it is constant on each record fibre. Different histories with the same record and different counts witness failure of exact recovery. The condition identifies the information requirement while leaving evidence about the actual history open.

A reconstruction can remain useful when exact recovery fails. The set of counts compatible with a record expresses the unresolved alternatives. Additional independent records can narrow that set when their interpretation is justified. Assigning probabilities would add another layer of assumptions; the set of alternatives alone supplies no frequency or likelihood.

The same distinction applies to event identity. Two reports may be compatible with either one jointly reported event or two matching events. A model that retains both possibilities makes the uncertainty visible. A single merged event index suppresses it. The appropriate choice depends on the evidence and the inferential purpose, not on the convenience of a compact event table.

Revision of an event reconstruction should preserve the earlier record when that record has historical relevance. Correcting a count or participant assignment changes the current representation. It also creates a new occurrence in the inquiry's own history: a correction was made on the basis of particular evidence. Keeping those levels separate supports a clear account of what changed and why.

9.9 Philosophical Role of the Event Category

The formal distinctions support a philosophical account of occurrence without settling a general metaphysics of events. This subsection states what the construction contributes and where further argument would be required.

The event category permits reference to a happening that has a place in a history. Its identity can depend on a declared boundary, a continuity criterion, and a relevant description. The action framework specifies the transformations associated with a possible happening; the occurrence domain speci-

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fies which tokens the inquiry considers. Their combination supports claims about repetition, order, and participation that an endpoint alone cannot express.

A single occurrence can receive several descriptions. An enactment may be described through its physical procedure, its authorization role, or its effect on a record. The model can attach several attributes to one occurrence index while retaining the possibility that some descriptions refer to distinct subevents. Whether they should be joined or separated depends on the event criterion and evidence.

This creates a relation between event and process categories. An event can be analyzed internally as a process. A process can be compressed into one event for a coarser inquiry. The mathematical consistency of the compression concerns its retained effects and records. Its philosophical adequacy concerns which changes, reasons, and meanings the inquiry needs to explain. A useful event boundary is justified through those purposes and can remain revisable.

The category also clarifies the status of actuality. A possible transition, an intended action, a documented attempt, and a completed occurrence occupy different places in an argument. Moving between them requires premises. The framework exposes these transitions by giving each a distinct representational component and avoiding an automatic inference from a map's existence to its enactment.

9.10 Event Use in the Coordinated Framework

The event category contributes indexed happenings to the six-category account. This subsection connects that contribution to the rest of the model and identifies the required adequacy checks.

Entities can participate in occurrences through appearance indices. Relations can be formed, exercised, or modified through recorded events. Attributes can classify event types or report conditions at their occurrence. State descriptions specify before-and-after distinctions. Processes preserve sequences and intermediate configurations. The event domain supplies the token distinctions needed to coordinate these uses.

A successful application must declare what counts as an event, how occurrence indices are warranted, which repeated applications remain distinct, and how blocked or silent attempts are treated. It must check that any enriched variables respect the algebra it continues to use. It must also explain what information is lost when records are reduced to types, counts, or effects.

These requirements make the event category more than a transition triple. The triple remains essential for the action model, while occurrence, individuation, and evidence determine how that possible transition enters an account of social history.

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10 Attribute Descriptions and Classification Commitments

This section develops attributes through the mathematical question of assigning a predicate or value at a declared descriptive level. It derives the condition under which an attribute descends to a quotient, extends the result to partial information, and examines overlapping classifications and numerical scales. The philosophical discussion concerns the difference between a coding rule, the constitution of a status, and the evidence for an assignment. The objective is to make the information supplied by an attribute explicit rather than conceal it in the notation.

10.1 Subjects and Descriptive Levels

An attribute says something about a subject under a description. That subject can be a configuration, an entity at a time, an event occurrence, or a process record. Its domain is therefore the first modeling decision. A value assigned to a current configuration can change while an entity continues. A value assigned to an event can remain historically fixed while later evidence about it changes. A value assigned to a process can depend on intermediate steps that its endpoint omits.

The carrier S supplies one available domain. A quotient $Q = S/\sim$ supplies a coarser domain when the inquiry treats equivalent configurations alike. An appearance domain supplies context-sensitive sub-

jects. The choice matters because a well-defined function must assign one value to each input. If the input merges cases that require distinct values, the attribute needs a finer domain or a different representation.

Consider a stipulated permission classification. A configuration may include whether a permission is recorded. A current-state attribute can read that coordinate. An entity-only attribute would additionally require the permission value to remain invariant across all appearances of the entity. An entity/time attribute can retain its variation. These representations can use similar verbal labels while making different claims about their subjects.

The six-category framework therefore treats an attribute's domain as part of its meaning. A statement that a group is authorized differs from a statement that a particular record classifies the group as authorized. The two can coincide under appropriate rules and evidence. Their coincidence is a further claim, and a model should retain enough structure to state it rather than assume it through a shared variable name.

10.2 Boolean Predicates and Value Maps

The first construction represents a declared classification on the quotient. Its simplicity makes the added information particularly clear.

For $U \subseteq Q$, define

$$a_U : S \longrightarrow \{0,1\}, \qquad a_U(x) = \mathbf{1}_U(q(x)). \tag{20}$$

The map assigns 1 to configurations whose quotient class belongs to U, and 0 to the others. It is constant on every $\sim$-class because equivalent inputs have the same quotient image.

A value-valued attribute uses a map $f : Q \to V$ and defines $a = f \circ q$. The codomain can contain names, categories, numbers, or structured values. Calling the values numbers adds arithmetic notation, but the meaningful operations on them depend on the intended scale. A set of numbered categories can still carry only a nominal distinction.

The subset U and the map f supply information. The quotient alone does not select which of its classes count as authorized, isolated, resilient, or relevant to another substantive property. A particular classification may be defined through the base language and declared parameters. A freely supplied classification is a legitimate enrichment when its origin and interpretation are stated.

This distinction affects claims of derivation. Showing that an attribute can be represented by an indicator proves a representational possibility. It leaves the membership criterion for U open. Deriving a substantive attribute requires an argument that determines its membership from specified data or rules. The indicator formula then expresses that criterion's result; it cannot replace the argument selecting the criterion.

10.3 Descent from Configurations to Quotient Classes

A proposed attribute may initially be defined on the full carrier. This subsection derives the exact condition for retaining it at the quotient level.

Proposition 10.1 (Attribute factorization)**.** *Let $a : S \to V$. There exists a map $\bar{a} : Q \to V$ satisfying $a = \bar{a} \circ q$ exactly when*

$$x \sim y \quad \Longrightarrow \quad a(x) = a(y). \tag{21}$$

The map $\bar{a}$ is unique when it exists.

Proof. If $a = \bar{a} \circ q$ and $x \sim y$, then $q(x) = q(y)$. Applying $\bar{a}$ gives $a(x) = a(y)$, proving necessity.

For sufficiency, define $\bar{a}([x]) = a(x)$. If $[x] = [y]$, Equation (21) gives $a(x) = a(y)$. The definition therefore does not depend on the representative and satisfies $\bar{a}(q(x)) = a(x)$.

Every quotient class has a representative. Any factorization must take that class to its representative's a-value. This determines $\bar{a}$ uniquely. □

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For a Boolean attribute represented on S by a subset A, the condition says that A is a union of $\sim$-classes. If one member of a class belongs to A, every equivalent member must belong. This saturation requirement makes explicit what a quotient classification assumes.

Failure of the condition has several possible responses. The inquiry can refine the equivalence so that distinct attribute values remain separate. It can change the attribute's target, perhaps by reporting a set of possible values for a coarse class. It can retain the attribute on the full carrier alongside a coarser state description. These choices preserve different information and should be assessed against the research question.

A set-valued report can describe uncertainty introduced by aggregation:

$$A([x]) = \{a(y) : y \sim x\}.$$

The definition is representative-independent because equivalent inputs have the same class. A singleton set permits exact recovery of the attribute at that class. Several values expose the ambiguity. Replacing the set by one selected value requires an additional selection or approximation rule. The construction is useful precisely because it displays what the coarse representation leaves unresolved.

The quotient condition also disciplines changes of scale. A finer state description can support an attribute that the coarser description cannot recover. Calling both descriptions states does not make their attribute languages interchangeable. When an inquiry moves between them, it should identify which values are preserved, lost, or newly supplied.

10.4 Partial Attributes and Definedness

A classification can be incomplete. This subsection extends the descent argument to show that its domain of definedness carries information alongside its reported values.

Let $a : D \to V$ be a partial attribute, where $D \subseteq S$. An input outside D lacks a value under the declared coding. The reason may be missing evidence, an unresolved classification, or inapplicability. Those reasons can require different representations, even when a preliminary formal treatment uses one partial domain.

Proposition 10.2 (Partial-attribute descent)**.** *A partial map $\bar{a} : \bar{D} \to V$ on Q can satisfy*

$$D = q^{-1}(\bar{D}), \qquad a = \bar{a} \circ q \text{ on } D$$

exactly when D is a union of $\sim$-classes and a is constant on each class contained in D.

Proof. Suppose the partial factorization exists. If $x \sim y$, then $q(x) = q(y)$. Membership of that image in $\bar{D}$ is the same for both, so $x \in D$ exactly when $y \in D$. Thus D is saturated. For members of D, applying $\bar{a}$ to equal projections gives equal values.

Conversely, assume both conditions. Set $\bar{D} = q(D)$. If $q(x) \in q(D)$, then some $y \in D$ satisfies $q(x) = q(y)$. Saturation puts x in D, so $q^{-1}(\bar{D}) = D$. Assign $\bar{a}([x])$ the common value of the class's members. Value constancy makes this well-defined and gives the required factorization. □

A two-point counterexample isolates the domain condition. Let $S = \{x, y\}$ with $x \sim y$, and let $D = \{x\}$. Even if a has only one reported value, it cannot preserve definedness on the one-point quotient. The single class would need to be both inside and outside $\bar{D}$. Checking only equality of reported values would miss this failure.

A fresh marker can totalize the partial map:

$$\widehat{a}(x) = \begin{cases} a(x), & x \in D, \\ \perp, & x \notin D, \end{cases}$$

where $\perp$ is distinct from every value in V. Constancy of $\widehat{a}$ on quotient classes combines the two requirements in the proposition. The marker makes missingness visible; its meaning remains an interpretive choice.

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For a Boolean attribute, the codes 0, 1, and $\perp$ can represent false, true, and unknown to the investigation. This coding does not by itself assert that the underlying proposition has three truth values. Unknown can concern evidence rather than the world's state. Likewise, inapplicability can differ from both falsehood and missing evidence. A careful application separates these meanings before aggregating or comparing observations.

10.5 Overlapping Attributes and Classification Partitions

Several attributes can apply to the same subject. This subsection distinguishes that possibility from the stronger structure of a partition.

For a family $(U_j)_{j \in J}$ of subsets of Q, the profile

$$a(x) = (\mathbf{1}_{U_j}(q(x)))_{j \in J}$$

records simultaneous Boolean classifications. A configuration may belong to several U_j, or to none. The formula imposes neither mutual exclusivity nor exhaustive coverage.

A partition requires both. Its cells must be pairwise disjoint and their union must cover Q. A single-valued map $f : Q \to V$ induces a partition by its nonempty fibres. Conversely, a partition supplies a single-valued cell assignment. The structure is suitable when the classification task explicitly requires one exhaustive alternative.

A cultural or institutional classification may need overlapping predicates. A participant can hold several roles. A practice can belong to several traditions under the inquiry's declared criteria. A configuration can be both authorized and resource-constrained. Turning these predicates into one list of mutually exclusive categories changes the task unless the list retains every relevant combination.

One can create a partition from the full Boolean profile, grouping subjects that agree on all attributes. This preserves overlap information at the cost of a potentially larger classification space. For a finite family of k Boolean attributes there are at most 2^k profiles, though some may be absent. The resulting cells represent combinations of predicates, not a discovery that the original predicates were exclusive.

The philosophical point concerns what the classification claims. Overlapping predicates organize several aspects of one subject. A partition organizes alternatives at a particular level. Both can be useful, but they impose different commitments about how descriptions fit together. The six social-fact categories are used here as overlapping analytical roles and therefore require no partition of all social facts into six disjoint kinds.

10.6 Coding Rules and Constitutive Conditions

A classification can record a pattern, implement a rule, or represent an investigator's judgment. This subsection separates those functions while permitting their interaction.

An observational coding rule maps available material to a reported value. A constitutive rule specifies conditions under which a status obtains within a stipulated practice. An interpretive judgment connects records to a substantive claim. These functions can coincide in a particular model, but their coincidence requires premises about how the practice and its records work.

For a hypothetical registry, let $c(x)$ be the current registered classification and let $g(x)$ be the substantive target of the inquiry. If the target is precisely the registry's classification, then $g = c$ by definition. If the target concerns an independently specified condition, equality is a further claim. The registry can be evidence for that condition while remaining fallible with respect to it. The formal distinction protects the investigator from changing the target silently when evidence is convenient.

A constitutive classification can also influence later dynamics. If access depends on $c(x)$, two otherwise similar configurations with different classifications may admit different operations. That effect is a modeled consequence of the rule. It leaves open whether the classification accurately describes another feature, whether its implementation is stable, and whether the rule is justified.

The formation of a category and the classification of an instance are therefore different research problems. A community may develop a classification practice, after which an investigator asks which

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instances satisfy it. A revision of the practice can change the classification rule itself. Modeling that revision requires a rule index or a dynamic state containing the relevant rule. A fixed subset U represents one selected rule at a time.

This distinction matters for philosophical accounts of social facts. Some attributes concern statuses constituted through practices; others concern patterns that an institution attempts to record. The same function notation can represent both. Their difference lies in the interpretation and the arguments connecting the code to the subject, not in the bare mathematical form of the map.

10.7 Numerical Values and Measurement Commitments

A numerical attribute invites arithmetic operations. This subsection shows why those operations require more structure than a numerical label alone.

A nominal classification can be recoded by a bijection of labels without changing its intended distinctions. An ordinal classification can be recoded by a strictly increasing function while preserving order. A quantitative scale may permit a narrower class of transformations when differences or ratios carry meaning. Which transformations are admissible is a modeling and measurement commitment.

For an ordinal attribute a and a strictly increasing ϕ,

$$a(x) < a(y) \quad \Longleftrightarrow \quad \phi(a(x)) < \phi(a(y)).$$

The equivalence follows directly from strict monotonicity on the scale. It establishes preservation of individual comparisons. It leaves aggregate operations such as addition open.

Consider two stipulated profiles $(0, 3)$ and $(2, 2)$. Their numerical sums satisfy $3 < 4$. The increasing recoding of $\{0, 1, 2, 3\}$ to $\{0, 1, 2, 100\}$ changes the sums to $100 > 4$. Individual rank information is preserved, while the aggregate ranking reverses. A sum-based comparison therefore uses more than the ordinal information.

This counterexample does not prescribe a social ranking. It identifies an assumption that a scalar model must justify. If a score represents authorization categories, degrees of recognition, or a researcher-defined index, meaningful addition cannot be inferred from its numerical appearance. The intended interpretation of the scale must explain the operation.

Aggregation can also conceal heterogeneity. Two configurations can have the same scalar score while differing in which conditions contribute to it. Those differences may affect feasible continuations. If they do, equality of the score can fail the state-preservation condition. A scalar summary can remain useful for reporting while being inadequate as the sole predictive state variable.

10.8 Aggregate Attributes and Predictive Closure

A scalar attribute can accurately summarize a configuration while leaving its later value unrecoverable from the scalar alone. This subsection derives a complete characterization for a simple aggregation model. The example gives the earlier warning about heterogeneity a precise mathematical content: the suitability of a summary depends jointly on the aggregation map and on the update family.

Let $S = \mathbb{R}^2$, where the two coordinates represent a stipulated pair of numerical attributes, and define

$$q(x, y) = \frac{x + y}{2}.$$

The map retains the arithmetic mean. Let $f : \mathbb{R} \to \mathbb{R}$ be continuous, and apply the same update independently to both coordinates:

$$T_f(x, y) = (f(x), f(y)).$$

A closed mean description requires a map $\bar{T} : \mathbb{R} \to \mathbb{R}$ satisfying $qT_f = \bar{T}q$. This is the action-preservation question for the equivalence relation induced by the mean.

The assumptions are deliberately narrow. The coordinate values lie on a scale supporting arithmetic means. Membership and weights stay fixed. Each component receives the same deterministic update,

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and the update depends only on that component's value. Interaction between components, changing membership, different local update rules, or a restricted carrier would change the problem. The narrow formulation allows the consequences of the chosen summary to be derived completely.

Proposition 10.3 (Mean closure for a continuous component update)**.** *Under the stated assumptions, a reduced map satisfying $qT_f = \bar{T}q$ exists exactly when f is affine: $f(t) = at + b$ for constants $a, b \in \mathbb{R}$. The reduced map then equals f.*

Proof. For each t, the diagonal point (t, t) has mean t, and its updated mean is $f(t)$. Any reduced map therefore satisfies $\bar{T}(t) = f(t)$.

For arbitrary x, y, put $m = (x+y)/2$. The points (x, y) and (m, m) have the same mean, so descent implies

$$\frac{f(x) + f(y)}{2} = f\left(\frac{x+y}{2}\right).$$

Define $g(t) = f(t) - f(0)$. Then $g(0) = 0$, and g satisfies the same midpoint equality. Substitution of $2t$ and 0 gives $g(2t) = 2g(t)$. Consequently,

$$g(x+y) = 2g\left(\frac{x+y}{2}\right) = g(x) + g(y).$$

Repeated addition yields $g(n) = ng(1)$ for nonnegative integers. Since $g(n) + g(-n) = g(0) = 0$, the same expression holds for negative integers. For an integer p and positive integer q,

$$qg(p/q) = g(p) = pg(1),$$

so $g(p/q) = (p/q)g(1)$.

Given a real number t, choose a sequence of rationals tending to t. Continuity of g implies $g(t) = tg(1)$. Thus $f(t) = at + b$, with $a = g(1)$ and $b = f(0)$.

Conversely, for $f(t) = at + b$,

$$qT_f(x, y) = \frac{ax + b + ay + b}{2} = a\,q(x, y) + b = f(q(x, y)).$$

Taking $\bar{T} = f$ supplies the required factorization. □

Continuity enters at a specific step: it transfers rational linearity to all real arguments. The proof should therefore preserve that assumption even when the substantive interpretation makes smooth changes seem natural. Its conclusion concerns the displayed carrier and update rule. A finite selected set of attribute pairs can permit additional reduced maps because fewer equal-mean pairs need to be compared.

For a direct failure, take $f(t) = t^2$. The configurations $(0, 2)$ and $(1, 1)$ both have mean 1. Their updated configurations are $(0, 4)$ and $(1, 1)$, whose means are 2 and 1. Any proposed mean-only update would need to assign two different next values to the same input 1. The disagreement establishes failed closure without relying on an estimation error or an imperfect observation.

The missing information in this example can be displayed by expanding the formula:

$$\frac{x^2 + y^2}{2} = \left(\frac{x+y}{2}\right)^2 + \frac{(x-y)^2}{4}.$$

The second term records heterogeneity omitted by the mean. It vanishes on the diagonal and is positive for unequal coordinates. Retaining the mean and this additional term would recover the next mean for the squaring update. Whether the enlarged record supports its own future updates requires another closure check.

That last qualification matters. Adding a variable that repairs one prediction can leave later predictions unresolved. The construction of an adequate state description therefore proceeds relative to an

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update family and an intended horizon. A reporting statistic answers a present descriptive question. A state variable used for repeated prediction must additionally support the continuation requirements of the inquiry.

The mathematical distinction remains useful even where an arithmetic mean has a clear interpretation. Average resources, average reported confidence, or an average numerical performance measure may summarize the selected subjects accurately. Interpreting the average as an autonomous dynamic subject requires evidence that the omitted distributional features are irrelevant to the modeled updates. Proposition 10.3 supplies one exact test in a restricted model and demonstrates why that additional requirement can be demanding.

The result also places a limit on claims that an aggregate creates a new entity. The map q defines equivalence classes of numerical configurations. Those classes can support a closed update under the proposition's conditions. Reidentifying a collective entity across time requires the appearance and continuity records developed in Section 7. A successful mean quotient establishes a descriptive and dynamic achievement, with entity identification remaining a separately stated task.

10.9 Changing Composition and Aggregate Direction

A second aggregation problem arises when the subjects entering a summary change their relative weight. This subsection derives an exact decomposition and a numerical counterexample. The objective is to separate a change within the classified groups from a change in how those groups contribute to the reported aggregate.

For a finite set of strata indexed by j, let r_j be an earlier rate and r'_j a later rate. Let w_j and w'_j be the corresponding nonnegative weights, each family summing to one. Write

$$A = \sum_j w_j r_j, \qquad A' = \sum_j w'_j r'_j.$$

The strata, rates, denominators, and weighting rule are declared components of the representation. A stratum can be a reporting category without being an entity, and membership in it can change between observations.

Proposition 10.4 (Rate and composition decomposition)**.** *The change in the aggregate satisfies*

$$A' - A = \sum_j w'_j (r'_j - r_j) + \sum_j (w'_j - w_j) r_j. \tag{22}$$

For fixed weights, weak improvement in every stratum gives weak improvement in the aggregate.

Proof. Add and subtract $\sum_j w'_j r_j$ in the expression for $A' - A$. The first difference is $\sum_j w'_j (r'_j - r_j)$; the second is $\sum_j (w'_j - w_j) r_j$. This proves the identity. When $w'_j = w_j$ for every j, the second sum vanishes. If every rate change is nonnegative, each term in the first sum is nonnegative, proving the direction statement. □

The first term evaluates within-stratum rate changes at the later composition. The second evaluates the weight change at the earlier rates. Reversing these baseline choices gives another exact decomposition. The allocation of an interaction between changing rates and weights depends on the stated convention. The total difference remains the same.

Table 3 gives stipulated counts that make the distinction visible. In the earlier observation the high-rate stratum records 90 successes out of 100 cases, while the low-rate stratum records 1 out of 10. In the later observation the high-rate stratum records 10 out of 10, and the low-rate stratum records 20 out of 100. These counts define a mathematical illustration; they report no empirical population.

Both subgroup rates rise by $1/10$. Yet the pooled rate falls from $91/110$ to $30/110$, a change of $-61/110$. The earlier weights are $(10/11, 1/11)$ and the later weights are $(1/11, 10/11)$. The within-stratum term in (22) is $1/10 = 11/110$. The composition term is

$$-\frac{9}{11}\frac{9}{10} + \frac{9}{11}\frac{1}{10} = -\frac{72}{110}.$$

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Table 3: Stipulated subgroup rates and changing composition in two observations. Each subgroup rate increases while the pooled rate falls.

Observation	High-rate stratum	Low-rate stratum	Pooled rate
Earlier	$90/100 = 0.9$	$1/10 = 0.1$	$91/110$
Later	$10/10 = 1$	$20/100 = 0.2$	$30/110$

Adding the terms gives $-61/110$, matching the pooled calculation.

The apparent directional conflict disappears once the two questions are stated explicitly. The subgroup comparison asks how each rate changed. The pooled comparison asks for the success fraction among the cases represented in each observation, under that observation's composition. The numerical answers can move in opposite directions because the later pool contains a much larger share of the lower-rate stratum.

A fixed-weight standardized comparison answers another declared question. Holding the weights constant removes the composition term. It can make the within-stratum change easier to compare across observations. The choice of standard weights still requires a reason: earlier composition, later composition, equal weights, and a separately chosen reference population can all answer different comparative questions. The formula cannot select the relevant population by itself.

The example also exposes a connection to entity and process records. If the research question concerns the same individuals over time, aggregate counts from changing pools are insufficient by themselves. An appearance-level link or another identification method is needed to establish which subjects persist, enter, or leave. If the question concerns a changing institution's current composition, the movement of subjects between categories may itself be part of the process under study. The required record depends on that distinction.

Interpreting a pooled decline as evidence of deteriorating practice would add a causal claim. The displayed example supplies one countercondition: a change of composition can outweigh improvement within every displayed stratum. Conversely, favorable standardized rates can coexist with a practically significant redistribution of cases toward difficult conditions. Choosing one statistic to settle the overall assessment requires an evaluative argument about which changes matter and to whom.

A comprehensive attribute record should consequently preserve the numerator, denominator, inclusion rule, stratum definitions, and weighting convention wherever those components affect interpretation. A scalar can remain the principal reported value while its construction remains recoverable. The retained detail permits criticism of the formula, comparison of alternative descriptions, and correction when the original question was expressed too coarsely.

10.10 Attribute Change and Explanatory Change

An attribute can change for several reasons. This subsection distinguishes a changed subject, a changed rule, and changed knowledge about the subject.

With a fixed map $a : S \to V$, a transition from x to mx can change the value because the represented configuration changes. With a fixed configuration, replacing a by a new map a' can change the reported value because the coding rule changes. A record can also be revised while both the target configuration and intended rule remain fixed, reflecting new evidence or correction.

These are different histories. A time-indexed report alone may combine them. To interpret the report, an inquiry can retain the configuration, rule version, and evidential record as separate components. A change in one component then has an explicit location in the model.

For example, a hypothetical practice can broaden its membership criterion. Some appearances receive a new category even when their previously recorded features remain fixed. A study of recognition may treat the reclassification itself as a social event. A study of changes in the underlying features would need to distinguish it from such changes. Both inquiries can use the same archive if its rule history is retained.

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The metamodel can accommodate rule change through an expanded carrier that includes the rule state. It can also compare separate models with an explicit alignment. In either case, a formula developed for one fixed quotient or classification needs renewed checking when the regime changes. Equality of labels across regimes supplies little evidence of equality of meaning.

10.11 Evidence and Interpretive Disagreement

Attribute assignments require evidence appropriate to their meaning. This subsection explains how formal consistency and substantive warrant can diverge.

A coding procedure can assign one value to every record consistently and still misrepresent the target. Internal consistency concerns whether the rule is applied as specified. Warrant concerns whether the rule, evidence, and interpretation justify the substantive claim. A reliable procedure for reading a database field does not establish that the field accurately represents an independently defined social condition.

Disagreement can concern different components. Investigators may agree on the records but disagree on the category. They may agree on the category but disagree on how the records support an assignment. They may disagree about the subject's identity or context, changing the domain to which the value belongs. A representation that retains these components permits a more precise diagnosis than a single disputed number.

Partial and set-valued classifications are useful when they express this unresolved state faithfully. They should not be adopted merely to avoid difficult decisions. A study can state which evidence would reduce uncertainty, which coding changes would alter the target, and which disagreements remain conceptual rather than empirical.

A further issue concerns reflexivity. Publicly assigning an attribute can affect the subject's later opportunities or behavior in a stipulated model. The reported classification then participates in the dynamics being studied. The investigator needs to distinguish evidence about an earlier condition from effects of the public classification. That distinction can be represented through separate event and state variables when the application warrants it.

10.12 Philosophical Role of Attribute Representation

The attribute construction clarifies how a description can be precise while remaining dependent on conceptual choices. This subsection develops that implication for the broader six-category account.

An attribute map is exact relative to its domain, codomain, and rule. Exactness does not make the rule inevitable. Different rules can classify the same carrier differently, and the appropriate comparison concerns their explanatory purpose, evidential basis, and consequences. Precision makes those choices inspectable; it leaves them available for criticism.

This also clarifies the difference between discovering a pattern and supplying a useful classification. A researcher can propose a category to organize inquiry, then investigate whether its instances share relevant dynamics. Conversely, a regularity may motivate a later coding scheme. The direction of inquiry matters to claims about emergence. A supplied subset becomes a representation of an observed regularity only through an argument linking it to evidence.

The framework leaves room for disagreement about which attributes matter. Formal compatibility can show that a classification survives a quotient or supports an update. It cannot establish that the classification deserves priority in every explanatory or normative inquiry. A social model therefore needs reasons for its attribute choices in addition to proofs of their internal consistency.

Within the six-category architecture, attributes supply descriptive predicates and values. Entities supply subjects across appearances; events and processes supply historical occurrences; relations supply dependencies; states supply the current descriptive level. An attribute can apply at each of these levels when its domain and rule are explicit. This flexibility is the construction's practical strength and the reason its commitments require careful disclosure.

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11 State Descriptions, Observation, and Retained Memory

This section develops the state category by separating a carrier configuration, an observation, and a description sufficient for a declared dynamical task. It derives the condition for deterministic updates on a reduced description, examines hidden memory and several observation tasks, and discusses actual occupancy and historical interpretation. Section 6 subsequently supplies the full continuation construction. The present section explains why that construction is needed and what its result means.

11.1 The Descriptive Role of a State

A state description records the conditions under which the model evaluates subsequent operations. In the abstract base, a point $x \in S$ has that role. The point can encode a large configuration containing participants, records, resources, and rules. It need not correspond to a single entity or to one directly observable snapshot.

The quotient point $q(x)$ supplies another descriptive level. It groups configurations according to the declared equivalence $\sim$. The action-preservation assumption ensures that equivalent configurations remain equivalent after the same mechanism, allowing the quotient to carry its own deterministic action. This is a mathematical condition on the description. Its empirical interpretation depends on what the carrier and quotient represent.

An observation map $o : S \to Y$ supplies a third object. It records the features visible or relevant to a chosen inquiry. Two configurations may have the same observation while producing different later observations under one operation. In that case, the present observation is insufficient to determine the next observation. Treating Y as a deterministic state space would require a repair or a different model.

These three objects can coincide in a simple application, but their roles remain distinct. The carrier supports the full declared dynamics. The quotient supports an agreed level of identification. The observation expresses a measurement or reporting task. A model should justify each identification between them rather than derive it from the shared word *state*.

11.2 Deterministic Updates on Reduced Descriptions

A reduced description is useful when its future values can be updated from its present value. This subsection derives the condition that makes such an update well-defined.

Let $\rho : S \to Z$ be a description and let $T_b : S \to S$ be a total operation. The question is whether a function $F_b : \rho(S) \to \rho(S)$ can satisfy

$$\rho(T_b x) = F_b(\rho(x)) \qquad (x \in S). \tag{23}$$

The function is defined on the image of ρ, because unrepresented values of Z need no arbitrary transition.

Proposition 11.1 (Reduced-update criterion)**.** *A function satisfying Equation* (23) *exists exactly when*

$$\rho(x) = \rho(y) \quad \Longrightarrow \quad \rho(T_b x) = \rho(T_b y). \tag{24}$$

If the condition holds for every operation label, the description supports the corresponding deterministic updates.

Proof. If F_b exists, equal current descriptions are equal arguments to the same function and give equal next descriptions. This proves necessity.

Conversely, assign to a represented value $z = \rho(x)$ the value $F_b(z) = \rho(T_b x)$. Whenever another representative y gives the same z, the stated condition gives the same proposed output. The assignment is therefore well-defined and satisfies the equation. □

The condition says that $\ker \rho$ is preserved by the operation. It is precisely the representative-independence needed for a quotient update. The argument applies to one operation at a time, so a repertoire of operations requires preservation under every member.

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The result distinguishes an accurate current report from a sufficient dynamic description. A report can correctly record the present value and still omit information needed for its next value. Accuracy at one moment therefore does not establish state sufficiency. Conversely, a mathematically sufficient description may be difficult to observe or may encode variables whose interpretation remains uncertain.

11.3 Hidden Memory and a Minimal Counterexample

A finite example makes the failure and repair explicit. Its purpose is to show why the omitted information matters under a specified operation.

Let $S = \{0, 1\}^2$, write $x = (v, h)$, and observe $o(v, h) = v$. Interpret v as a current reported flag and h as a retained condition. Define

$$T_r(v, h) = (h, h).$$

The configurations $(0, 0)$ and $(0, 1)$ have the same current observation, but

$$o(T_r(0, 0)) = 0, \qquad o(T_r(0, 1)) = 1.$$

Thus no deterministic function of the current flag alone can reproduce both next observations.

Retaining the pair (v, h) repairs this failure because the transition rule is already defined on that pair. The repair is sufficient for this stipulated system. Its adequacy in an application would require evidence that h represents an available condition and that the update captures the relevant dependence.

The variable can be called memory when its interpretation records a historically formed condition. The mathematical role, however, concerns future update dependence. A latent condition can perform that role without being a person's recollection. A document archive, an authorization record, or a retained resource state can each function as memory in a model if the interpretation and update rule justify the term.

The example also shows that a failed reduction does not uniquely identify the missing variable. Another sufficient encoding can be related to (v, h) by a change of coordinates, or a richer record can retain more detail. The failure proves that the chosen current observation is too coarse for the declared update. Identifying a particular hidden cause or historical mechanism requires additional evidence.

A stochastic reduced model offers a different response. It can assign a distribution to the next observation conditional on the current report. That move requires a probability model over the omitted distinctions or transitions. The deterministic failure alone supplies no canonical probabilities. Choosing a richer state and choosing a stochastic reduction are distinct modeling decisions.

11.4 Predictive Sufficiency and Historical Sufficiency

A description can be sufficient for one purpose and insufficient for another. This subsection distinguishes future observation from historical explanation.

Suppose two configurations have identical continuation signatures for the selected observations and operations. Their distinction can be omitted without affecting that predictive task. They may nevertheless correspond to different formation histories. If the historical question asks which sequence produced the present condition, the predictive quotient can discard the answer.

A stipulated permission illustrates the distinction. Two histories can produce the same current permission and all the same modeled future opportunities. One history may involve negotiation and another an imposed rule. If the current dynamics has no variable distinguishing those histories, prediction of the chosen outcome can remain identical. The historical query still differs, provided the formation labels have been meaningfully specified and evidenced.

The same issue appears in records of completed events. A state flag recording whether an activity has ever occurred can be sufficient for a future rule that depends only on that flag. It omits the count, timing, and participants of earlier occurrences. A historical inquiry needs those records even if they are redundant for the chosen transition rule.

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The appropriate repair is task-specific. A joint description can retain both predictive information and the historical query. If the query must remain updatable after future operations, preserving only its current value can be insufficient. The historical-relations paper develops the joint continuation construction in detail. Here the general lesson is that sufficiency belongs to a declared family of questions.

This limitation has philosophical force. A compressed state can be the right object for predicting a selected variable without being a complete account of the social situation. Explanations of formation, responsibility, recognition, and significance can require distinctions absent from that prediction. The model should state its task so that predictive success receives the appropriate evidential scope.

11.5 Coordination of Observation Tasks

A six-category inquiry can require several observations at once. This subsection derives their coordination and clarifies the meaning of the resulting refinement.

Let $o_j : S \to Y_j$ be observations indexed by $j \in J$. The product observation is

$$o_G(x) = (o_j(x))_{j \in J}.$$

For each j, let E_j identify configurations whose o_j observations agree after every finite word. Define

$$E_G = \bigcap_{j \in J} E_j. \tag{25}$$

Proposition 11.2 (Joint-task equivalence)**.** *The relation E_G is the continuation equivalence for o_G. It is the greatest update-preserved equivalence contained in every* ker o_j.

Proof. Equality of product observations under a word means equality of each coordinate under that word. Requiring this for every word gives precisely the intersection in Equation (25).

Each E_j is an update-preserved equivalence by the continuation construction proved in Section 6. Intersecting those relations retains equivalence and update preservation.

If another update-preserved equivalence retains every current observation, the greatest-property argument for each individual task places it inside each E_j. It therefore lies in their intersection. □

Adding an observation coordinate can only refine the relation, since it adds an equality requirement. Adding operation labels with the earlier maps unchanged can likewise expose more distinctions: every old word remains among the new tests. Neither change alone establishes that new underlying entities or configurations have appeared.

This distinction matters when a revised study reports more categories of state than an earlier one. The increase can reflect additional measurements or a richer repertoire of hypothetical tests. It can also reflect a changed underlying model, but that is another comparison requiring explicit alignment. A count of descriptive classes cannot distinguish the possibilities by itself.

The product construction can retain too much for a practical task. An infinite family can give an infinite record; even a finite family can be costly to measure. A researcher can therefore compare exact sufficiency, finite approximations, and selective omission. Each choice should state the errors or questions it leaves unresolved.

11.6 Actual Occupancy and Epistemic State

The action framework represents possible configurations. This subsection distinguishes those configurations from what an investigator knows about the current case.

An empirical occupancy assertion identifies the configuration or class occupied by the subject at a specified time. Such an assertion needs a mapping from evidence to the model. The existence of a state space and transition maps alone leaves the initial condition unspecified.

Incomplete evidence can be represented by a set $K \subseteq S$ of configurations compatible with the available information. This set is an epistemic record. Its elements are candidate world configurations.

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Confusing K with a single world configuration would combine uncertainty about the case with the case's own modeled conditions.

Under a known deterministic operation T_b, the predicted compatible set is

$$T_b(K) = \{T_b x : x \in K\}.$$

A subsequent observation y can restrict it to $T_b(K) \cap o^{-1}(\{y\})$, assuming the observation model is exact. This update follows by retaining precisely the candidates that satisfy both the dynamics and the observation. Noise or uncertain execution requires further rules.

The set update can be informative without selecting one actual state. If every surviving candidate gives the same answer to a query, that answer is identified relative to the model and evidence assumptions. If candidates disagree, uncertainty remains. Assigning a probability distribution would add a measure whose justification is separate from set compatibility.

A social inquiry can also include participants' beliefs or records inside S. Those variables belong to the modeled situation, whereas the investigator's compatible set concerns knowledge of that situation. Both are legitimate, and their relation can matter dynamically. A clear model distinguishes the participant's information, the public record, and the investigator's uncertainty before drawing conclusions.

11.7 State Revision and Changes of Description

A state report can change because the world changes, because evidence changes, or because the description changes. This subsection separates those transitions.

Under a fixed carrier, observation, and operation system, a transition $x \mapsto T_b x$ is a modeled change in the subject. Under a fixed subject configuration, revising a compatible set changes the inquiry's information. Replacing the observation or equivalence changes the descriptive regime. The resulting reports can look similar while having different meanings.

For equivalences $E' \subseteq E$ on the same carrier, the finer quotient S/E' maps to the coarser quotient S/E by $[x]_{E'} \mapsto [x]_E$. Representative independence follows from the inclusion. This map gives a precise alignment between the two descriptions. It permits questions about which distinctions the coarser quotient forgets.

Arbitrary quotients need not be ordered by refinement. Two observations can preserve different features. Their joint observation provides a common refinement, but recovering one from the other requires a factorization condition. Shared numerical labels or equal numbers of classes establish little about their semantic agreement.

A change of carrier introduces another level of difficulty. An enlarged model can include newly represented participants or mechanisms. Comparing states across the models then needs an explicit embedding, projection, correspondence, or other alignment. The original quotient theorem applies within its fixed domain and does not automatically settle that comparison.

These distinctions prevent an inference from greater descriptive detail to greater generative capacity. A new classification can reveal a possibility that the old description omitted. An intervention can also create or enable a new possibility. The model must identify which kind of change its before-and-after comparison represents.

11.8 Philosophical Interpretation of State Sufficiency

The state construction answers a precise question: which distinctions must a description retain for specified updates and observations? This subsection evaluates the philosophical scope of that answer.

A sufficient state is relative to the operations and observations that define the task. It can be minimal for that task while omitting information relevant to another. The relativity is disciplined by an exact criterion and a greatest-property theorem; it permits comparisons between candidate descriptions.

The result leaves open whether the selected task captures what matters about a social situation. A prediction of activity completion can omit the manner of agreement, the participants' reasons, or a dis-

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puted history. Those omissions can be acceptable for one calculation and serious for another inquiry. The philosophical argument must state why the chosen observations serve its purpose.

Deterministic state sufficiency also presumes that the operation repertoire captures the relevant way future developments are tested. A test set can exclude interventions that would expose an omitted distinction. Expanding the repertoire can therefore revise the equivalence. The theorem remains correct under either repertoire; the adequacy dispute concerns the choice between them.

This account gives state descriptions a constructive role without treating them as complete inventories of reality. A description organizes possible transitions, supports specified inferences, and exposes its dependence on retained information. Its philosophical value lies in making those commitments available for examination.

11.9 State Use in the Six-Category Framework

The state category coordinates current descriptions with the other analytical roles. This subsection states the connections that a complete application needs to preserve.

Entity identity can continue across changing states. Relations can be represented by conditions or incidence records that influence state transitions. Event tokens identify particular transitions or attempts. Attributes read values at the chosen level. Processes retain sequences and intermediate states. The roles are connected by maps and records, and each can preserve information that another omits.

A successful state model must declare its carrier, observations, operations, and retained equivalence. It must establish representative independence for reduced updates, identify how occupancy is warranted, and distinguish uncertainty from world configuration. Where historical or entity questions exceed predictive sufficiency, it must retain the corresponding records.

The continuation construction that follows provides one exact solution to the dynamic consistency problem. Its proof becomes philosophically useful when read together with these limits and choices, because it states both what the reduced state can do and which further questions remain outside that task.

12 Process Histories and Their Compositional Reductions

This section develops processes from ordered mechanism words and their trajectories. It derives endpoint composition, distinguishes several reductions of a history, and examines segmentation and duration. The philosophical discussion concerns what makes a sequence one process, how actual history differs from possible factorization, and how branching or overlapping activity challenges the sequential model. The aim is to preserve the reasoning carried by a process rather than retain only its final result.

12.1 Ordered Activity and Process Unity

A process description connects occurrences through an order and a criterion of unity. A sequence of operations can produce a result, sustain an arrangement, transform a relation, or end without completing a selected target. The action framework supplies an ordered composition calculus. The interpretation of the sequence as one socially meaningful process requires additional criteria.

A stipulated agreement can be formed through proposal, revision, authorization, and enactment. A record of the final authorization may leave the earlier negotiations invisible. An outcome-oriented calculation may need only the composite effect. A historical explanation may depend on the proposals that failed, the order of revisions, or the interruption of an earlier route. The representations serve different questions even when they concern the same eventual configuration.

A process also need not be goal-directed in its interpretation. An analyst can group a sequence by a recurring pattern, a causal chain, a maintained relation, or a declared interval. A participant's purpose is another possible organizing criterion, requiring its own evidence. The word representation captures order while leaving those interpretations open.

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This distinction prevents a sequence's formal availability from being mistaken for an established history. A factorization of a mechanism shows one way its effect can be composed. Evidence is needed to claim that the corresponding operations actually occurred in that order. The process category keeps factorization and occurrence linked through explicit records.

12.2 Words and Trajectories

The construction begins with labeled operations and a seed. This subsection specifies the conventions and derives the trajectory.

Let B be an operation alphabet, with total maps $T_b : S \to S$. A finite word $w = b_1 \cdots b_k$ is executed from left to right. For a starting configuration $x_0 = x$, define

$$x_i = T_{b_i} x_{i-1} \qquad (1 \le i \le k). \tag{26}$$

The process presentation retains

$$\mathsf{Proc}(x, w) = (x_0, b_1, x_1, \ldots, b_k, x_k).$$

The empty word ϵ has zero steps and leaves the seed unchanged.

Proposition 12.1 (Trajectory determination)**.** *A seed and a finite word determine a unique trajectory under the declared deterministic maps. Its endpoint is $T_w x$, where $T_w = T_{b_k} \circ \cdots \circ T_{b_1}$ and $T_\epsilon = \mathrm{id}_S$.*

Proof. For the empty word, the unique trajectory contains only x. Suppose the first $i-1$ states have been determined. The total function T_{b_i} assigns exactly one value to x_{i-1}, determining x_i uniquely. Induction constructs the entire finite trajectory.

Repeated substitution into Equation (26) gives $x_k = T_{b_k} \cdots T_{b_1} x$, which is the stated composite-map expression. □

The proof depends on determinism and totality. A partial map requires executability at every prefix. A stochastic transition requires a distribution over possible next states. A nondeterministic relation can yield several trajectories. Those extensions can be developed, but their path objects and claims of uniqueness differ from the present construction.

The labels matter independently of their maps. Two named operations can have the same action on the selected variables. A history of negotiation and a history of imposition can therefore be represented by distinct labels with identical maps when the model deliberately retains their formation names. Interpreting those names requires evidence or stipulation beyond the endpoint formula.

12.3 Words, Products, Maps, and Endpoints

Several reductions connect a process to its outcome. This subsection isolates their different information losses.

When labels specify elements of the base semigroup, a nonempty word has a product

$$e(w) = b_k \cdots b_1.$$

The action sends that product to a transformation of S. Evaluating the transformation at one seed gives an endpoint. The sequence of reductions is

$$w \longmapsto e(w) \longmapsto T_w \longmapsto T_w x \longmapsto q(T_w x). \tag{27}$$

Each arrow answers a narrower question about the process.

Distinct words can have the same product because the semigroup satisfies equations. If $b^2 = b$, one and two applications have the same product. Distinct semigroup elements can have the same map when

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the action is nonfaithful. Distinct maps can agree at the selected seed while differing elsewhere. Finally, distinct endpoints can belong to the same quotient class. These losses are logically independent.

A concrete seed-level example uses the identity map and a constant-zero map on $\{0, 1\}$. They agree at seed 0 and differ at seed 1. Knowing the endpoint from 0 therefore fails to identify which transformation was used. Recovering the map would require observations at enough inputs or another source of information.

Nonfaithfulness occurs at another level. A semigroup can contain distinct mechanism labels whose actions coincide on every configuration in the selected carrier. Observing all endpoints within that carrier still leaves the label distinction unrecoverable. The distinction may encode a provenance difference that the dynamics deliberately omits.

The quotient can discard still more. Two histories with different endpoints can agree on a selected outcome, such as whether a joint activity occurred. Their differences in authorization, resources, or recorded formation may remain outside the outcome class. An explanation that requires those differences must retain a richer stage of the reduction sequence.

12.4 Recovery of Process Queries

A process query can concern length, order, duration, participants, or another property of the retained history. This subsection derives a general test for recovering it after compression.

Let H be a declared set of process presentations, let $\rho : H \to Z$ be a retained record, and let $g : H \to V$ be a target query. A function $\bar{g} : \rho(H) \to V$ can recover the target exactly when

$$\rho(h) = \rho(h') \quad \Longrightarrow \quad g(h) = g(h'). \tag{28}$$

Necessity follows because equal records are equal arguments to $\bar{g}$. For sufficiency, assign each represented record the common query value of its fibre. The condition makes that value well-defined and gives $g = \bar{g} \circ \rho$. This elementary argument gives each proposed reduction a query-specific test.

The test can succeed for one query and fail for another. A composite effect determines the endpoint at a fixed seed. It can fail to determine application count under idempotence. A full word determines its ordered labels, but may fail to determine elapsed time when durations vary. A timestamped record can retain elapsed time while leaving a participant's intention open.

The result is useful because it locates a failed inference precisely. If two candidate histories share the retained record and differ in the target, exact recovery is impossible from that record alone. A richer record can repair the loss, or the inquiry can retain a set of compatible answers. A guessed answer would add information without identifying its source.

The criterion remains model-relative. It assumes that the history domain contains the relevant alternatives and that ρ correctly describes retained information. A query can be formally recoverable in an overly restrictive history domain while remaining empirically uncertain. Adequacy therefore requires scrutiny of both the compression and the candidate histories.

12.5 Segmentation and Composite Events

A process can be divided into stages or compressed into a single event. This subsection derives the endpoint consistency of segmentation and its limits.

For a nonempty word of length k, choose

$$0 = t_0 < t_1 < \cdots < t_r = k.$$

The jth block contains positions $t_{j-1}+1, \ldots, t_j$. Its subword acts on $x_{t_{j-1}}$ and yields x_{t_j} by the trajectory recursion. A segmentation therefore provides stage boundaries in addition to the underlying word.

Proposition 12.2 (Endpoint consistency of segmentation)**.** *Composing the block transformations of a segmented word gives the same transformation as the entire word. The total transformation generally leaves the segmentation unrecoverable.*

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Proof. Each block transformation is the composition of its consecutive operation maps. Composing the blocks concatenates those maps in their original order. Associativity removes the parentheses and yields T_w.

For failure of recovery, a two-letter word bb can be treated as one block or as two. Both segmentations yield T_b^2, while their boundary records differ. A function of the total transformation alone cannot recover both boundary choices. □

The proposition justifies stage-level calculation without proving that a stage boundary is socially appropriate. A group of operations can be one negotiation phase under one criterion and several events under another. The criteria can concern purpose, institutional procedure, temporal continuity, or a change in the relevant relation.

An event-level description often uses such compression. The overall transition of a meeting can be represented by one composite mechanism while an internal process record retains its steps. Their connection is mathematically clear when the event map is the composite of the process maps. The interpretive claim that these steps form one event remains additional.

Keeping both levels can be useful. The coarse event supports comparison across cases, while the detailed process explains how particular outcomes were reached. The model should identify which conclusions survive compression and which depend on the finer history.

12.6 Duration and the Limits of Algebraic Time

Order alone does not specify duration. This subsection constructs a simple time assignment and tests whether it can survive product compression.

Let $\delta : B \to \mathbb{R}_{\geq 0}$ assign a duration to each operation label. Under an additive sequential convention,

$$\tau(\epsilon) = 0, \qquad \tau(b_1 \cdots b_k) = \sum_{i=1}^{k} \delta(b_i). \tag{29}$$

The equation treats repeated applications as separate contributions to time.

For a product representation e, duration descends to a function on $e(H)$ exactly when equal products have equal τ-values. The necessity and sufficiency proof is the fibre-constancy argument in Equation (28).

If $e(b) = e(bb)$, descent requires

$$\delta(b) = 2\delta(b),$$

so $\delta(b) = 0$. A positive duration for each application therefore fails to descend through this idempotent product equation. The total effect can forget how long its enactment took.

The assumption of a fixed label duration is itself restrictive. An operation can take different times at different configurations or under different resources. A state-dependent duration map can retain that dependence along the trajectory. Interrupted or overlapping activity needs a schedule rather than a simple sum.

The mathematical distinction corresponds to several temporal questions. Sequence position records order. Duration records elapsed time under a convention. Calendar time locates an occurrence within another temporal frame. Historical periodization groups activities by an interpretive criterion. A natural-number word index supplies the first and leaves the others open.

This prevents the semigroup law from being read as a complete temporal theory. Associativity concerns the grouping of composition. It neither assigns duration nor establishes that every social process admits one fixed sequential time scale.

12.7 Feasibility at Intermediate Stages

A composite effect can be algebraically available while a particular route to it is infeasible. This subsection identifies the role of prefix conditions in the process category.

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Let $A(x) \subseteq B$ be the labels admissible at x. A word is feasible from seed x when

$$b_i \in A(x_{i-1}) \qquad (1 \le i \le k).$$

Every step is tested at the configuration produced by its earlier prefix. A final endpoint test alone can omit a blockage encountered earlier in the process.

For a two-state flip f with $f^2 = \mathrm{id}_S$, allow f only at state 0. From 0, the word ff would return to 0 under the total maps, but its second step is unavailable at state 1. The empty word and ff have the same total effect while differing in prefix feasibility.

The example shows why arbitrary availability domains need not respect equations among earlier total products. A process representation can preserve the words and their prefix tests. Another approach composes the partial maps themselves, so domain information participates in equality. Each approach states explicitly what the product means.

The social interpretation concerns realization conditions. A plan can specify an eventual result while requiring authorization, resources, or cooperation at intermediate stages. Those requirements are added data. The feasible-path paper develops their systematic representation and the consequences of shared conditions.

12.8 Branching, Interruption, and Open-Ended Histories

Finite words provide a clear starting point. This subsection examines cases that require a broader process representation.

Branching can represent several possible continuations from one history. A set of words retains alternative routes; a tree can make shared prefixes visible. Selecting one branch as actual requires occurrence information. A probability distribution or policy would add further assumptions about selection.

Interruption can be represented by a finite prefix that stops before the selected target. Whether it is an incomplete process, a completed attempt, or a separate event depends on the process criterion. The word alone records the performed or proposed prefix and leaves that classification to the inquiry.

Restarting can preserve some conditions while changing others. A new seed may encode retained resources, records, or commitments. Connecting the restarted activity to the earlier process requires a continuity criterion. Merely concatenating labels can conceal a gap whose significance matters historically or institutionally.

Open-ended activity requires a choice of representation. One may retain all finite prefixes, introduce infinite sequences, or use a changing process graph. Results proved for finite composition transfer only when the new structure and its limiting operations are defined. The existence of arbitrarily long finite words alone supplies no completed infinite historical object.

The possibility of generating new operation labels or units raises another issue. A fixed alphabet can encode a range of possible changes in advance. A model that changes its alphabet or carrier during execution needs an explicit comparison across stages. The base framework can motivate such an extension, while its fixed-domain theorems retain their stated scope.

12.9 Historical Actuality and Explanatory Relevance

A process record becomes an explanation through an interpretation of its steps and their evidence. This subsection distinguishes that achievement from a compositional calculation.

A factorization can show how an effect could arise. A historical explanation must support the claim that the relevant sequence occurred and that its steps have the meanings assigned to them. A sequence of labels named negotiation, agreement, and enactment does not establish those meanings without evidence or an explicit stipulated example.

Different histories can support the same final outcome and different explanations. One route may preserve participants' commitments; another may replace them. One may involve repeated failed attempts; another may reach the target immediately. The endpoint calculation can treat these routes alike for one purpose while the historical account distinguishes them.

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A process account also selects which intermediate differences matter. A complete physical or documentary record can contain more detail than the inquiry needs. Compression is therefore unavoidable in practice. The question is whether it preserves the distinctions required by the explanatory target, and whether its losses are stated.

The factorization criterion provides a formal version of that question. It can show that a particular query is unrecoverable after a chosen compression. It leaves the importance of the query to philosophical and empirical argument. This combination makes the mathematics useful without turning every retained distinction into an equally important feature.

12.10 Philosophical Role of Process Unity

A sequence becomes one process through a criterion of connection. This subsection considers the philosophical implications of making that criterion explicit.

Causal connection, common purpose, institutional procedure, and historical narrative can each organize activity. They may overlap, but one can hold while another fails. A procedure can continue despite changed intentions. A shared purpose can persist through different procedures. A causal chain can connect events that participants never understood as one undertaking.

The model can represent those criteria through separate predicates or records. It then becomes possible to ask whether one process has several forms of unity, whether its boundary is disputed, or whether a later interpretation reorganizes earlier occurrences. A single operation word leaves those questions open rather than settling them through sequence alone.

A relational account can emphasize how processes form and modify the conditions of later processes. This proposal is compatible with the action framework when the relevant conditions are encoded and updated. The explanatory work lies in specifying those conditions and demonstrating their role. Composition alone guarantees an endpoint calculation, not a general theory of historical generation.

Within ontological suspension, the process category therefore provides a disciplined way to discuss ordered formation and transformation. It can support arguments that give processes explanatory priority in a case. A universal claim that all entities or social facts are ultimately processes requires a further philosophical argument.

12.11 Process Use in the Coordinated Framework

The process category retains the sequence and intermediate manifestations needed to connect the other five roles over time. This subsection states its contribution to a complete representation.

Entity appearances can be tracked along a process under an identity or lineage criterion. Relations can be formed, exercised, or revised by its steps. Event indices identify particular occurrences. Attributes can describe initial conditions, intermediates, or the whole history. States provide the configurations through which the process proceeds.

A successful application declares the seed, operation labels, order convention, feasibility conditions, and occurrence status. It identifies the process-unity criterion and any duration or segmentation records. It then checks which queries survive reduction to products, effects, or endpoints.

The resulting account preserves the insight that a process is more informative than its final formula. The formula records a conditional consequence of the steps. The process record retains the path by which that consequence is calculated, interpreted, and, where evidence permits, situated in history.

13 A Cooperative-Agreement Illustration

This section coordinates the six categories within one finite model. It specifies the complete Boolean action, derives its transformation normal forms, compares order effects and commuting prerequisites, and constructs the observation-relative state quotient. It then examines the additional records required for entities, relations, events, attributes, and processes. The agreement vocabulary is an analytic interpretation of stipulated rules; empirical adequacy remains open.

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13.1 Configuration Variables and Their Scope

The example retains authorization, a resource condition, and an activity flag. This subsection defines their roles and explains which questions the small carrier can answer.

Let $S = \{0,1\}^3$, with $x = (a, r, e)$. Interpret a as a recorded authorization under a cooperative agreement, r as an available resource condition, and e as whether a focal joint activity has occurred at least once. The carrier has eight configurations.

The variables have deliberately limited meanings. Authorization is represented through a recorded condition; its recognition, validity, and practical effect require interpretation. The resource coordinate records persistent availability, rather than a consumable quantity. The activity coordinate records occurrence at least once and omits multiplicity.

Participant identities and the identity of the agreement are additional records. The three bits do not identify which organizations participate or which agreement is being tracked. They describe selected conditions of a case whose referents must be supplied separately.

The complete carrier leaves the initial configuration open. A particular inquiry can select a seed and study its reachable subset. Keeping the full carrier is useful for checking equality of transformations and continuation equivalence across all represented conditions.

13.2 Operations and the Generated Action

The maps specify how the selected variables change. This subsection gives the complete rules and the relation between words and transformations.

Define

$$\begin{aligned} c(a, r, e) &= (1, r, e), \\ k(a, r, e) &= (a, 1, e), \\ j(a, r, e) &= (a, r, e \vee (a \wedge r)). \end{aligned} \tag{30}$$

Operation c records authorization, k supplies the resource condition, and j attempts activation. Let M be the transformation semigroup generated by nonempty words over these labels.

The base equivalence is equality. The selected observation is $o(a, r, e) = e$. Equality of raw configurations is therefore finer than the current activity observation.

The maps are total. When a prerequisite is absent, j leaves the configuration unchanged. An application that distinguishes an unavailable attempt, a refusal, or a failed execution needs an availability or observation enrichment.

The resource condition remains set after activation. A consumable resource would require a different map or a quantity ledger. The current rule is suitable only for the persistent condition interpretation.

Words retain operation order and repetition. Their products in M retain only transformations of the eight configurations. The following derivation characterizes exactly what that effect compression preserves.

13.3 Normal Forms of the Transformations

The generated action contains twelve distinct nonempty-word transformations. This subsection derives that number and supplies a witness for every form.

For a word w, let C, K indicate whether c, k occur anywhere. Since neither coordinate is reset, the final first two values are $a \vee C$ and $r \vee K$.

If j never occurs, the activity flag remains e. If it occurs, let C_j, K_j indicate whether c, k occur before the last j. Successive activation attempts read prerequisite values that can only increase. Their contributions to e therefore are contained in the last contribution.

Consequently, when j occurs,

$$T_w(a, r, e) = \big(a \vee C,\ r \vee K,\ e \vee [(a \vee C_j) \wedge (r \vee K_j)]\big). \tag{31}$$

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Table 4: Transformation normal forms in the cooperative-agreement model

Final flag C	Final flag K	Added activity term $f(a, r)$	Witness word
0	0	$a \wedge r$	j
1	0	0	c
1	0	$a \wedge r$	jc
1	0	r	cj
0	1	0	k
0	1	$a \wedge r$	jk
0	1	a	kj
1	1	0	ck
1	1	$a \wedge r$	jck
1	1	r	cjk
1	1	a	kjc
1	1	1	ckj

When it does not, the last coordinate is simply e. Table 4 lists every possible effect.

Each row denotes $(a, r, e) \mapsto (a \vee C, r \vee K, e \vee f(a, r))$. The witness column contains words read left to right. It is distinct from the left-action product notation used when maps are applied to a configuration.

Proposition 13.1 (Complete finite transformation classification)**.** *The nonempty-word action has exactly twelve transformations, represented by Table 4. The zero-step identity is a thirteenth transformation in the generated monoid.*

Proof. If $(C, K) = (0, 0)$, a nonempty word consists of j operations and has added activity term $a \wedge r$. If $(C, K) = (1, 0)$, the possible terms are zero when there is no activation, $a \wedge r$ when the last activation precedes authorization, and r when it follows authorization. The symmetric case $(0, 1)$ gives zero, $a \wedge r$, and a.

For $(C, K) = (1, 1)$, the last activation can precede both setters, follow only c, follow only k, or follow both. Together with the case containing no activation, the terms are zero, $a \wedge r$, r, a, and one. Thus at most $1 + 3 + 3 + 5 = 12$ maps occur.

The table supplies a word for every form. Different flag pairs have different first or second output functions. Within a flag pair, the listed activity terms differ on an input with $e = 0$. Hence the twelve maps are distinct.

A word containing c or k changes a corresponding zero input bit. A nonempty word containing neither consists of j and changes $(1, 1, 0)$. Thus no nonempty word induces the identity. The empty word adds that map. □

The proof explains the enumeration. It also locates the information lost by the transformation record: many histories share the same setter flags and last-activation effect. Their earlier occurrences can remain distinct in a process record.

13.4 Order Effects and Joint Prerequisites

The model exhibits order sensitivity and joint contribution by commuting operations. This subsection derives both patterns and explains why they should remain distinct.

At $x = (0, 1, 0)$, applying authorization before activation gives

$$jc(x) = (1, 1, 1),$$

while activation before authorization gives

$$cj(x) = (1, 1, 0).$$

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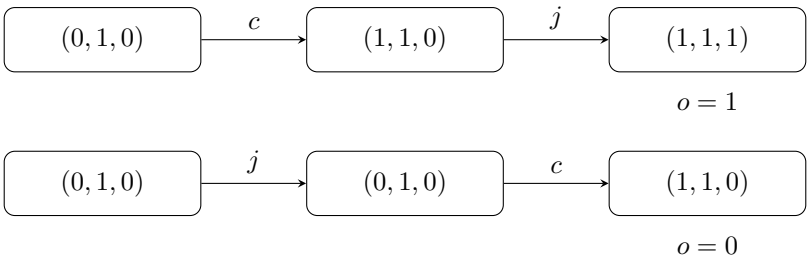

Figure 1: Two operation orders from the same resource-equipped configuration. Authorization followed by attempted activation sets the activity flag; the reverse order leaves it unset.

The expressions use left-action composition, so $jc(x)$ means $j(c(x))$. Figure 1 shows the corresponding word orders.

The order-effect predicate $R_{\text{ord}}(c, j, x)$ therefore holds. The authorization changes the result of a later activation under this stipulated comparison.

Meanwhile, $ck = kc$ on every configuration because the maps set different coordinates. Starting from $(0, 0, 0)$, either setter alone leaves one prerequisite absent. Applying both before j sets the activity flag.

The commuting setters thus jointly contribute to a later operation. Their commutation does not establish independence from every dynamic purpose. It states that their mutual order has the same effect on the chosen carrier.

The converse caution also holds. The order inequality is a mathematical property of the maps. Its interpretation as authorization dependence comes from the declared coding and update rules. Anonymous maps with the same table would satisfy the same predicate.

13.5 Occurrences and Historical Compression

Idempotence makes the difference between effects and occurrences especially clear. This subsection derives the relevant identity and identifies the records needed for repeated activity.

Boolean idempotence gives $j^2 = j$. After one activation attempt, the activity coordinate is $e \vee (a \wedge r)$. Applying the same rule again gives

$$[e \vee (a \wedge r)] \vee (a \wedge r) = e \vee (a \wedge r).$$

The first two coordinates are unchanged, proving equality of maps.

The one-step word j and the two-step word jj therefore have the same product and endpoint. Their occurrence counts differ. A process record can retain that difference through word positions or occurrence identifiers.

The activity flag adds another compression. Once $e = 1$, every later activation leaves the observed value one. A record of whether activity ever occurred cannot recover how often it occurred or how many attempts were made.

A counter extension can retain attempt count, but the extended operation then fails the old idempotence equation. One application adds one to the counter, and two applications add two. Projection to the old variables preserves the old effect. The event section derives that distinction in general.

The example therefore has two separate information losses: word-to-transformation compression and the choice of a Boolean occurrence summary. Identifying their locations makes a proposed repair precise.

13.6 Continuation Refinement

The activity observation merges states that later tests distinguish. This subsection derives the complete refinement and relates it to the common theorem.

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Table 5: Continuation partitions for the cooperative-agreement illustration

Horizon	Classes	Distinctions retained
0	2	Current activity flag e
1	3	With $e = 0$, the configuration $(1, 1, 0)$ separates from the other three
2	5	Four singleton classes with $e = 0$; one class containing all configurations with $e = 1$
3	5	The partition is unchanged, certifying stabilization

At horizon zero, o gives two classes: the four configurations with $e = 0$ and the four with $e = 1$. The pair $(0, 1, 0)$ and $(1, 1, 0)$ belongs to the first class, yet j distinguishes it.

At horizon one, $(1, 1, 0)$ separates from the other incomplete configurations. Only this state activates immediately. The other three still give zero under every single operation.

At horizon two, the remaining incomplete states separate. The word kj distinguishes $(1, 0, 0)$ from $(0, 0, 0)$, and cj distinguishes $(0, 1, 0)$ from $(0, 0, 0)$. The word kj also distinguishes $(1, 0, 0)$ from $(0, 1, 0)$.

Every configuration with $e = 1$ continues to report one under every word. These four states therefore form one final class. The four incomplete states are singletons, giving five classes in total.

Table 5 records the horizons and the repeated stable stage. The common theorem makes that stability an exact certificate within the model.

The observation-relative quotient is coarser than the original equality regime. If the inquiry must also retain every original distinction, Equation (12) intersects with equality and keeps eight classes. The two records serve different tasks.

13.7 Coordination of the Six Categories

The same finite inquiry can use all six categories without treating them as disjoint kinds of object. This subsection states the additional commitments associated with each use.

Entity records identify the participants and the agreement across indexed appearances. Their continuity criteria can involve documents, membership, or institutional succession. None is fixed by the three Boolean coordinates.

The relation description concerns authorization and its connection to formation and possible activation. Its historical account requires a record of how the condition was established. Its potential role is represented by the activation comparison.

Event records identify particular attempts or enactments. An occurrence can leave the current state unchanged, so transition difference alone cannot supply its identity. Evidence is needed to establish that the represented attempt occurred.

Attributes select or describe conditions, such as authorization, resource availability, or completion. Their coding rules and domains determine whether they descend to a chosen quotient. An activity-only quotient can omit attribute distinctions that another task requires.

State descriptions retain selected configurational distinctions and support the corresponding updates when compatibility holds. Process records retain ordered operations and their intermediate states. The product normal form can summarize effects while the process record preserves the sequence.

The categories therefore cooperate through linked records. The question is which information each role requires and whether the links preserve it. The example supplies a common setting in which those requirements can be checked.

13.8 Limits and Verification of the Illustration

The construction is deliberately small and its rules are complete. This final subsection states what verification supports and what a substantive application must add.

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Finite enumeration corroborates the eight configurations, twelve nonempty transformations, and horizon counts $2, 3, 5, 5$. Independent paired-state search gives the same continuation classes. The normal-form proof explains why the transformation count is complete.

The checks concern the stipulated model. They leave the interpretation of authorization, resources, and activity open. A real cooperative arrangement can involve withdrawal, consumption, uncertain responses, and disagreements about recognition.

Adding those features changes the maps or records. The existing proofs remain valid under their displayed assumptions, while the extended model requires renewed checks. Preserving that genealogy prevents a refinement from silently changing the meaning of an earlier result.

The next illustration takes a different constructive route: it derives candidate collective units from a relational graph. Together, the examples show how a common formal base can coordinate category uses while requiring different added interpretations.

14 A Constructive Model of Relational Unit Formation

This section supplies a positive construction of candidate collective units from a declared relational configuration. It derives connected components, examines their dynamics under addition and deletion, and applies the six categories to one finite history. The model also exposes a precise limit: a partition that is sufficient under one operation repertoire becomes insufficient under another. The construction is a stipulated illustration of relational unit formation, with social interpretation and temporal identity kept explicit.

14.1 Elementary Positions and Relational Configurations

The model begins with a finite set of elementary positions and a specified type of relation among them. These are declared inputs. The collective units will be constructed from their configuration, so the derivation concerns those units rather than every object appearing in the model.

Let V be finite and let

$$E_0 = \{\{u, v\} : u, v \in V,\ u \neq v\}$$

be the possible undirected edges. A configuration is $G \subseteq E_0$, and the carrier is $S = 2^{E_0}$. An edge can be interpreted in a hypothetical application as a specified cooperative connection. The model treats it as undirected and Boolean; direction, intensity, and contested meaning remain outside this illustration.

For every $e \in E_0$, define total maps

$$a_e(G) = G \cup \{e\}, \qquad d_e(G) = G \setminus \{e\}. \tag{32}$$

They add and delete the selected edge. Nonempty compositions generate a transformation semigroup acting on S. Full graph equality is the base equivalence.

Both elementary maps are idempotent. Adding an already present edge leaves the graph unchanged; deleting an absent edge does likewise. The equalities concern effects and permit separate occurrence indices for repeated applications. Thus the event distinction developed earlier is already present in this simple system.

The interpretation is intentionally bounded. Elementary positions can stand for participants only if that meaning is warranted. Edges can stand for cooperation only if the selected relation has evidence and a clear criterion. The graph construction derives groups relative to those inputs. It leaves their input justification and a broader account of individuals open.

14.2 Connected Components and Candidate Collective Units

The selected unit criterion is connectedness. This subsection proves that it gives a partition and explains the domain on which the resulting entities are represented.

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For $u, v \in V$, define $u \simeq_G v$ when a finite undirected path in G connects them. The empty path connects each position to itself.

Proposition 14.1 (Component partition)**.** *The relation $\simeq_G$ is an equivalence on V. Its classes form a partition $\mathcal{C}(G)$, whose members are candidate collective units under the declared connectedness criterion.*

Proof. The empty path gives reflexivity. Reversing an undirected path gives a path in the opposite direction, proving symmetry. Concatenating a path from u to v with a path from v to w gives a finite walk from u to w; removing repeated segments if necessary gives a path. Thus the relation is transitive.

Every position belongs to its equivalence class. Two classes that intersect are equal by symmetry and transitivity. The classes therefore cover V and are pairwise disjoint. □

The proof establishes a mathematical partition. Interpreting each component as a socially relevant unit requires the connectedness criterion to be appropriate to the inquiry. A chain of pairwise connections may support one collective task and fail another. The unit interpretation remains a proposal to test.

There are two different equivalences in this construction. The base equivalence on S compares whole graph configurations. The relation $\simeq_G$ compares elementary positions within one configuration. Confusing these domains would identify a state class with an internal collective unit. Their distinction is essential to the six-category argument.

Define the appearance domain

$$I = \{(G, C) : G \in S,\ C \in \mathcal{C}(G)\}.$$

The map $p(G, C) = G$ connects a component appearance to its configuration. One graph can have several appearances, one for each component. In a time-indexed history, appearances can instead be (t, C), retaining repeated visits to the same graph configuration.

This is a constructive answer to part of the entity question. The units are derived from relational configurations under a specified criterion. Their identity across configurations still needs a further rule. Deriving a unit at a moment and establishing its historical continuity remain different tasks.

14.3 Component Dynamics under Edge Addition

The component partition can serve as a reduced state for a restricted repertoire. This subsection derives that positive result before examining its limitation.

Let $\pi : S \to \mathcal{P}_V$ send a graph to its partition $\mathcal{C}(G)$, where $\mathcal{P}_V$ is the set of partitions of V. For an edge $e = \{u, v\}$, consider the blocks containing u and v.

Proposition 14.2 (Addition-compatible partition)**.** *Adding $\{u, v\}$ merges the two blocks containing u and v, with no change if they are already one block. Consequently,* $\ker \pi$ *is preserved by every addition map a_e.*

Proof. If u and v lie in the same component, a path already connects them. Adding their edge creates no connection between distinct components.

If they lie in distinct components, the new edge connects those components. Any path newly connecting old components must use the added edge, because all its other edges were already present. The new connection therefore joins exactly the two endpoint components and leaves the other blocks separate.

Two graphs with the same old partition have the same blocks containing u and v. The stated merger therefore gives the same new partition in both graphs. This is preservation of $\ker \pi$. □

The partition can consequently be updated deterministically under the addition-only repertoire. Internal edge differences are irrelevant to the next component partition for those operations. The quotient is useful because its sufficiency has been proved for a declared task.

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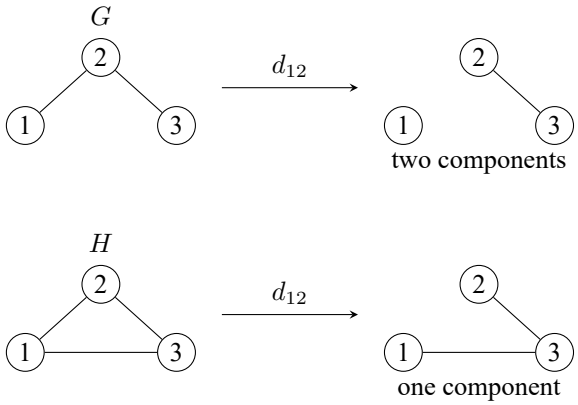

Figure 2: Edge-deletion comparison for graphs with a common initial component partition. The successor partitions expose a difference in internal relational support.

The construction also makes unit merger explicit. Adding a cross-component edge reduces the number of components by one. Adding an internal edge leaves the number fixed. Neither operation adds an elementary position. The change concerns how the fixed positions are grouped under the unit criterion.

An interpretation of merger must still explain why one new connection unifies the groups for the selected purpose. The mathematical component rule supplies that consequence once the criterion is adopted. It does not establish that every social connection should have that grouping effect.

14.4 Deletion and the Loss of Reduced-State Sufficiency

Allowing deletion changes which internal differences matter. This subsection gives a complete counterexample to partition-level sufficiency.

Take $V = \{1, 2, 3\}$ and abbreviate $\{i, j\}$ by ij in edge sets. Let

$$G = \{12, 23\}, \qquad H = \{12, 23, 13\}.$$

Both graphs are connected, so $\pi(G) = \pi(H) = \{\{1, 2, 3\}\}$. Deleting 12 gives

$$d_{12}(G) = \{23\}, \qquad d_{12}(H) = \{23, 13\}.$$

The first has components $\{1\}$ and $\{2, 3\}$. The second remains connected through the path 1–3–2. Hence their component observations differ.

Figure 2 displays the comparison. The inputs have the same group partition, while one common deletion produces different partitions.

The reduced-update criterion therefore excludes a deterministic function of the old partition alone for this deletion. The problem is located in the omitted internal structure, specifically whether another path maintains connectivity after the edge is removed.

The example gives a conditional account of robustness. The triangle retains connectivity after this deletion, whereas the path loses it. The component partition records current unity and omits this difference in its support. A model of persistence under withdrawal needs a richer description.

The result also explains why entity formation and entity persistence can demand different information. Connectedness identifies a present unit. Predicting whether it remains connected after a change can require the detailed arrangement of its relations. The unit label alone leaves that prediction unresolved.

14.5 Continuation Tests and Internal Structure

The enlarged repertoire can distinguish every graph in this finite model. This subsection derives the exact result and states its testing assumptions.

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Table 6: Graph configurations and component observations on three positions

Present edges	Component partition
$\varnothing$	$\{\{1\},\{2\},\{3\}\}$
$\{12\}$	$\{\{1,2\},\{3\}\}$
$\{13\}$	$\{\{1,3\},\{2\}\}$
$\{23\}$	$\{\{2,3\},\{1\}\}$
$\{12,13\}$	$\{\{1,2,3\}\}$
$\{12,23\}$	$\{\{1,2,3\}\}$
$\{13,23\}$	$\{\{1,2,3\}\}$
$\{12,13,23\}$	$\{\{1,2,3\}\}$

Proposition 14.3 (Graph separation by deletion words)**.** *With component observation π and all edge deletions available, distinct graph configurations have different continuation signatures. Their full continuation equivalence is therefore equality.*

Proof. Let $G \neq H$. Choose an edge e that belongs to exactly one of them. Apply a word that deletes every edge in $E_0 \setminus \{e\}$. The word is finite because V is finite.

These deletions leave e unchanged and remove all other edges. One resulting graph is $\{e\}$; the other is empty. The endpoints of e lie in one component only in the first graph. The final component observations therefore differ.

Every distinct pair has such a witness. Equal configurations trivially have equal observations under every word. Thus signature equality is graph equality. □

The theorem concerns exact tests in a stipulated system. It assumes the full deletion repertoire, a fixed edge universe, and exact component observation. Restricted access to operations or observations can leave some internal differences unresolved.

It also leaves the desirability of the tests open. Deleting connections can be a destructive intervention in an interpreted case. The proof uses hypothetical continuations to characterize information; it supplies no recommendation to perform them.

The addition-only and deletion-enriched models therefore give different continuation quotients on the same carrier. The difference follows from their test repertoires. It does not require a different underlying configuration to have appeared.

This demonstrates the constructive and critical roles of the continuation method. It can justify a coarse state when the task permits one, and prove that the same state is inadequate after the task changes.

14.6 Complete Three-Position Enumeration

The three-position case makes the construction fully inspectable. This subsection enumerates the states, observation classes, and transformation structure.

There are three possible edges, so the carrier has $2^3 = 8$ graphs. Table 6 lists every configuration and its component partition. Four graphs share the connected partition, giving five distinct current observations.

Under addition alone, graphs with the same partition remain equivalent under every word by Proposition 14.2. The empty word distinguishes different current partitions, so the full quotient has exactly five classes. Under addition and deletion, Proposition 14.3 gives eight classes.

The appearance domain I has thirteen members in this case. The empty graph contributes three component appearances. Each one-edge graph contributes two, giving six more. Each of the four connected graphs contributes one, giving four more. Thus $3 + 6 + 4 = 13$.

The full nonempty transformation semigroup has twenty-six elements. Each edge coordinate can be left unchanged, set to zero, or set to one. In a word, the last operation on that coordinate determines its constant value. There are 3^3 such coordinate descriptions, including the identity.

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A nonempty word sets at least one coordinate and therefore cannot be the all-unchanged identity. Every other description is realized by setting its constant coordinates once. The number is therefore $3^3 - 1 = 26$. The empty word remains available in the word calculus as the zero-step identity map.

A finite verification program enumerates these objects and independently compares paired configurations under the operation repertoires. Its results agree with the five-class and eight-class calculations. The checks concern the stipulated model; the displayed proofs provide the general conditional reasoning.

14.7 Formation, Merger, Fission, and Reappearance

A selected history gives the components temporal appearances. This subsection uses one history to distinguish group formation from identity across changes.

Begin with the empty graph and apply

$$a_{12},\ a_{23},\ a_{13},\ d_{12},\ d_{13},\ a_{12}.$$

The component history starts with three singletons, joins 1 and 2, then joins all three positions. Adding 13 changes internal structure without changing the component partition.

Deleting 12 from the triangle leaves all three positions connected through 13 and 23. Deleting 13 then leaves $\{1\}$ and $\{2, 3\}$. Adding 12 reunites all three positions. The graph trajectory records formation, internal reinforcement, fission, and reappearance under the connectedness criterion.

Whether the final three-position group is the same entity as the earlier one requires another criterion. Equality of membership sets would identify them. A criterion requiring uninterrupted connected continuity would distinguish the two intervals. Both can be represented, and the graph history makes their disagreement explicit.

A directed lineage can link components at consecutive steps when their vertex sets overlap. At fission, one component overlaps two successors. At merger, a successor overlaps several predecessors. The lineage therefore preserves directional continuation without satisfying the identity equivalence implied by treating all such links as sameness.

This history shows why a derived unit criterion does not settle every entity question. It constructs components at each configuration. The interpretation of their temporal continuity remains an additional commitment that can be tested against the purpose of the inquiry.

14.8 Coordination of the Six Categories

The same graph case can represent all six analytical roles. This subsection makes their connections and differences explicit.

The entity representation consists of component appearances and a declared continuity criterion. The relation representation includes direct edges and derived path connectivity. These differ: two positions can be connected without a direct edge between them.

Events are indexed applications of additions and deletions. Adding a present edge can be a silent graph transition and still remain one application in the history. Exact event count requires retaining positions or a counter, because the update maps are idempotent.

Attributes can concern edge presence, component size, or connectivity of a selected pair. Edge presence fails to descend to the component partition, because connected graphs can have different edges. Pairwise connectivity does descend: it is determined by whether the pair occupies one block.

States can be full graphs or reduced partitions when the repertoire permits. The addition-only case proves that a reduced state can be exact for a task. The deletion counterexample proves its limit.

Processes are operation words and graph trajectories. Their products can forget repeated applications and intermediate partitions. The selected history therefore retains information needed for formation and continuity questions that the final graph omits.

These coordinated uses establish representability under declared commitments. They leave open whether the social meaning of a graph component is appropriate in a particular case. The formal clarity helps locate that remaining question.

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14.9 Philosophical Interpretation and Alternative Unit Criteria

Connectedness is one possible way to derive a collective unit. This subsection evaluates its strengths and limitations without giving it universal authority.

The criterion has a clear construction and definite consequences. It can identify groups from relations among supplied positions, explain mergers through new links, and describe fission through loss of connections. It also supports precise questions about which internal differences matter to persistence.

A social unit can require more than connectedness. A chain may connect participants whose commitments are incompatible. A single weak link may join otherwise independent groups. An institution may recognize a group despite sparse interaction, or participants may coordinate across a structure that this graph omits.

Alternative criteria can therefore use direction, thresholds, shared procedures, repeated interaction, or institutional records. Each criterion changes the unit construction and its evidence requirements. A thresholded graph, for example, needs a scale and a threshold whose meaning must be argued.

The model's philosophical contribution is narrower and constructive. It shows how a relational configuration can support derived units without taking those collective units as initial carrier elements. It also shows that the chosen relation structure and criterion are indispensable inputs.

This leaves ontology suspended. The result concerns a representational and explanatory strategy. An argument that all entities are ultimately relational formations would need to extend the reasoning beyond the fixed elementary positions and this specific grouping criterion.

The case nevertheless advances the original question beyond an inventory of limitations. It provides a workable construction, proves its dynamical adequacy under stated conditions, and demonstrates exactly where a richer representation becomes necessary.

15 Coordination of the Six Category Records

This section develops a joint representation in which the six categories can cooperate without losing their different roles. It specifies the domains for appearances, occurrences, states, and processes; derives the coherence of event chains with the action; and examines which quotient maps should commute. A central countercondition is that a continuing entity can occupy different states. Requiring every record to descend through every quotient would therefore impose an unjustified identity criterion.

15.1 Distinct Domains in a Common Inquiry

The category treatments introduced several kinds of record. Their coordination begins by preserving their domains. This subsection collects the necessary maps and explains why a single undifferentiated carrier of descriptions would obscure their responsibilities.

Retain a configuration carrier S, labeled operations T_b, and an action-compatible quotient $q : S \to Q$. Add an appearance domain I with anchor $p : I \to S$. The anchor associates an appearance with its represented configuration. Let E_{id} be a separate equivalence on I, with quotient $e : I \to I/E_{\mathrm{id}}$.

Add an occurrence domain Ω with source, target, and label maps

$$\mathrm{src}, \mathrm{tgt} : \Omega \to S, \qquad \mathrm{lab} : \Omega \to B.$$

These maps describe how an occurrence record relates to the operation model. The occurrence itself remains independently indexed.

A process record can retain a seed and an ordered chain of occurrences. Attributes can be attached to configurations, appearances, occurrences, or processes according to the question. Incidence relations likewise need a declared participant domain and context.

The collection is an enriched construction. An inquiry can use only the components it needs. The purpose is to expose their relationships, rather than to require a maximal record for every social fact.

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15.2 Occurrence Coherence with the Action

An occurrence described as an instance of a modeled transition should agree with that transition's source and target. This subsection states the condition and its evidential status.

For the relevant transition occurrences, require

$$\mathrm{tgt}(\omega) = T_{\mathrm{lab}(\omega)}\big(\mathrm{src}(\omega)\big). \tag{33}$$

The equation links the occurrence description to the action model. It is a coherence assumption about the representation.

The assumption does not establish that the occurrence happened. A hypothetical event record can satisfy it, and an actual record can fail it because the model, coding, or evidence is incomplete. The failure needs interpretation before it becomes a historical conclusion.

An attempted operation can leave source and target equal. The equation permits such a record when the map fixes the source. A blocked attempt requires an availability or failure convention. An unattempted operation is a possibility in the model, rather than an occurrence record by default.

Several occurrence tokens can share the same source, label, and target. Repeated idempotent attempts supply a direct example. The coherence equation therefore need not make the description map injective.

The distinction protects occurrence identity from effect compression. A record system can retain the token, its evidential status, and its transition description separately. Each component can be revised without silently replacing the others.

15.3 Event Chains and Process Endpoints

Compatible occurrence records can be assembled into a process chain. This subsection derives the relation between the chain's endpoint and the composite action of its labels.

Let a process record be $h = (x, \omega_1, \dots, \omega_k)$, where the seed satisfies $\mathrm{src}(\omega_1) = x$ when $k > 0$, and adjacent occurrences satisfy

$$\mathrm{tgt}(\omega_i) = \mathrm{src}(\omega_{i+1}).$$

The empty chain retains its seed explicitly.

Proposition 15.1 (Coherence of process endpoints)**.** *If every occurrence in the chain satisfies Equation* (33)*, then its final endpoint is*

$$T_{\mathrm{lab}(\omega_k)} \cdots T_{\mathrm{lab}(\omega_1)} x.$$

Applying q gives the same outcome as successively applying the induced quotient operations to $q(x)$.

Proof. For one occurrence, the endpoint formula is exactly the coherence equation. Suppose it holds for the first i occurrences. Adjacency identifies their endpoint with the source of ω_{i+1}. The next coherence equation applies the next labeled map to that endpoint. Induction proves the first statement.

For the quotient statement, action compatibility gives $q(T_b z) = \bar{T}_b(q(z))$ at every step. Substituting this equality successively through the endpoint formula gives the quotient trajectory. The empty chain has endpoint x and quotient endpoint $q(x)$. □

The proof identifies the exact role of chain completeness. If two recorded occurrences have mismatched endpoints, an unrecorded intermediate step may be needed. Silently joining them would assert a transition that the record has not represented.

A process can also have a coarser segmentation whose stages contain several occurrences. Associativity preserves the endpoint when the underlying chain is coherent. It leaves the segment boundaries and their meaning to a separate record.

The result coordinates event, process, and state descriptions while preserving their different information. A shared endpoint does not recover the chain, and a coherent chain does not establish actual occurrence without evidence.

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15.4 Entity Identity and State Anchors

Entity identity and state equivalence occupy different domains. This subsection examines their relationship and proves why state constancy should not be imposed on identity by default.

The relation E_{id} is a subset of $I \times I$. The state relation $\ker q$ is a subset of $S \times S$. A direct intersection has no intended role in this typed construction. A set-theoretic operation on their encodings would not supply the missing domain alignment.

The anchor permits a pullback:

$$uE_{\text{state}}v \quad \Longleftrightarrow \quad q(p(u)) = q(p(v)).$$

This is an equivalence on appearances. Its intersection with E_{id} is mathematically defined, but it adds state agreement to the identity criterion.

Proposition 15.2 (State assignment to an entity class)**.** *The map $q \circ p : I \to Q$ factors through the entity quotient e if and only if*

$$uE_{\text{id}}v \implies q(p(u)) = q(p(v)). \tag{34}$$

Proof. If $q \circ p = \bar{p} \circ e$, equal entity classes receive the same value under $\bar{p}$, proving necessity. Conversely, if the displayed condition holds, assign to each entity class the common state class of its appearances. The value is representative-independent and gives the required factorization. □

A continuing organization can have appearances before and after authorization, resource acquisition, or activity. Those appearances can belong to different state classes. The factorization condition then fails even when the identity criterion is appropriate.

The failure is not a defect in tracking change. It shows that current state is generally a property of an entity appearance or an entity at a context, rather than a timeless function of entity identity alone.

The pair record

$$u \longmapsto \big(e(u), q(p(u))\big)$$

retains both answers on the appearance domain. One entity can appear in several states. Repeated appearances with the same pair can still require an occurrence or time index. The pair is not automatically a complete appearance identifier.

15.5 Attributes and Incidence across Records

Attributes and relations can be transferred between record levels only under their own descent conditions. This subsection coordinates those conditions with identity and state.

A state attribute $a : S \to V$ descends through q precisely when it is constant on state classes. An appearance attribute descends through e precisely when it is constant on identity classes. The two tests concern different domains and can have different answers.

A changing attribute can be retained on appearances or on entity-context pairs. Requiring it to be constant over the entity's entire history would replace a dynamic attribute with a timeless one. That change needs an explicit research purpose.

For incidence at a configuration, let $I_s = p^{-1}(s)$ and $R_s \subseteq I_s^n$. A relation on reidentified participants requires saturation under the restricted identity criterion in each coordinate. The relation section derives that condition.

Context matters because the same participants can enter or leave a relation over time. A timeless relation on their global identity classes can merge those changes unless the context is retained in the predicate or its domain.

The compatibility tests should therefore follow the question. Some maps should commute because they report the same target through different records. Other maps should remain distinct because their targets change through time or belong to different analytical roles.

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15.6 Shared Subjects and Category Overlap

One subject can support several category uses in a single inquiry. This subsection explains that overlap without reducing all roles to one identity criterion.

An agreement can be tracked as a continuing referent, described through obligations, located in signing or revision occurrences, assigned attributes, reported in a state, and reconstructed through a process. The records answer different questions about the same inquiry.

A process can itself become a referent in another question. An investigator can track a negotiation across stages while also using its internal occurrences to explain an outcome. The entity-like tracking role and the process role can coexist through different maps.

A relation can likewise be named, revised, or entered into another relation. A finite model can add records of those relation instances to an appropriate participant domain. The enrichment should state the new roles and their identity criteria.

Such overlap creates no requirement that every object occupy one exclusive category. An exclusive classification would be an additional theoretical proposal whose usefulness needs argument.

The six-category repertoire also remains open to challenge. A research question can expose a missing role or an inadequate distinction within a current role. The appropriate response is to specify the missing information and test a revised construction.

15.7 A Compatibility Audit for a Joint Model

A joint model can be checked through a small set of explicit obligations. This subsection organizes them by the map whose use is being claimed.

For operation-to-state transfer, verify that the state equivalence is preserved. For occurrence-to-transition transfer, verify the source, label, and target equation. For process construction, verify adjacency or state the convention for unrecorded gaps.

For attributes and incidence, check the appropriate fibre constancy and saturation conditions. For historical queries, check the record factorization criterion. For entity tracking, state the continuity criterion independently of the dynamic observation quotient.

The audit should also identify conditions that are intentionally not imposed. A continuing entity need not occupy one state. A quotient-silent event need not disappear from the occurrence record. A process with the same endpoint need not share a formation history.

A failed coherence check has several possible causes. The model can omit a relevant variable, the records can refer to different contexts, or the proposed transfer can be inappropriate for the question. The failure should be investigated at that level.

This method provides a constructive alternative to a single grand equation for all six categories. It specifies the maps and conditions that coordinate their particular uses, while preserving the distinctions that the inquiry needs.

15.8 Representation and Factual Warrant

The coherence results concern a model and its records. This final subsection states the additional requirement for a claim about social facts.

An internally coherent occurrence chain can be hypothetical or incorrectly recorded. An entity criterion can be consistently applied and still poorly suited to the practice under study. An attribute can descend through a quotient while its coding rule remains disputed.

Factual warrant requires a connection between the representation and the case. Sources, observation, interpretation, and comparison design supply that connection. The formal audit identifies where they enter.

The distinction permits a model to remain useful during disagreement. Several candidate histories or identity criteria can be represented and their consequences compared. The research state can preserve the alternatives until evidence or argument supports a refinement.

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The coordinated category account therefore combines mathematical discipline with epistemic openness. Its maps make commitments explicit, its proofs establish conditional consequences, and its records retain the questions that those consequences leave unresolved.

16 Philosophical Scope and Factual Warrant

This section examines the philosophical commitments of the category representations and the evidence needed for their use in social inquiry. It develops ontological suspension, distinguishes formation from description and classificatory uptake, and considers historical explanation, identity, and evaluation. The aim is to preserve the questions that the formal constructions clarify without allowing their mathematical consistency to decide those questions by itself.

16.1 Ontological Suspension and Analytical Commitment

The six categories serve analytical roles in an inquiry about social facts. This subsection explains what ontological suspension permits and what it leaves the modeler responsible for.

The framework can ask how an entity is reidentified, how a relation is formed, how an occurrence is recorded, how an attribute is assigned, how a state supports updates, and how a process is reconstructed while leaving ultimate ontological priority unsettled. The questions concern representational and explanatory commitments that can be investigated within a declared scope.

Suspension does not make every modeling choice neutral. Selecting a carrier, identity criterion, or observation can privilege some distinctions and obscure others. Those choices can shape the conclusions of an inquiry even when the author withholds a metaphysical claim about what fundamentally exists.

The appropriate response is to make the choices inspectable. The entity section states its continuity criterion. The attribute section states its coding and scale. The state section states its observation and update responsibilities. The process section retains the relation between a sequence and its compressed effect.

The inherited series title connects this paper to Part I. The present subtitle and argument specify the narrower task of modeling six categories of social facts. A successful construction establishes an analytical possibility under its assumptions. An argument about the ultimate nature of social reality would require further premises.

The suspension therefore has a positive methodological role. It allows competing representations to be developed and criticized without deciding their metaphysical hierarchy in advance. Their adequacy can first be tested through the questions they answer and the distinctions they preserve.

16.2 Formation, Description, and Uptake

A pattern can form, become distinguishable in a description, and enter subsequent action through recognition or classification. This subsection separates those achievements and examines their possible interaction.

Formation concerns the development of the practice, organization, or dependence pattern being studied. Description concerns a record through which an investigator or participant distinguishes it. Uptake concerns the use of that description in further activity.

These achievements can occur in different orders. A practice can persist before an official category recognizes it. A proposed category can precede the organization it is intended to support. A description can become consequential when an institution uses it to allocate access or select a procedure.

The graph illustration derives a candidate unit from a declared connectivity rule. That construction identifies a partition of a relational configuration. A claim that participants recognize those components or act through them requires an additional uptake model and evidence.

The distinction prevents two opposite shortcuts. A new description need not create a new social organization. A description can nevertheless contribute to later formation when participants respond to it. The response must be represented explicitly before its effects are inferred.

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A comprehensive account can therefore connect the three roles without identifying them. It can record a formation history, a descriptive rule, and a response process, then examine their dependencies and disagreements. The next subsection gives one conditional representation of the response process.

16.3 Classification-Mediated Updates

A classification can enter dynamics through a rule selecting subsequent operations. This subsection defines that enrichment and derives its compatibility with a state quotient.

Let $o : S \to Y$ be a classification or observation, and let $\pi : Y \to B$ be a deterministic response rule. Define

$$U_\pi(x) = T_{\pi(o(x))}(x). \tag{35}$$

The rule selects an operation from the observed value and applies it to the configuration.

Proposition 16.1 (Compatibility of an observation-mediated response)**.** *If an equivalence E is preserved by every T_b and $E \subseteq \ker o$, then E is preserved by U_π. The response therefore has a well-defined induced update on S/E.*

Proof. If xEy, containment in $\ker o$ gives $o(x) = o(y)$. The response rule selects the same label $b = \pi(o(x)) = \pi(o(y))$. Preservation by that map gives $T_b x \, E \, T_b y$, which is the required relation between $U_\pi(x)$ and $U_\pi(y)$. □

The theorem is conditional on uptake. The classification o and response rule π are additional inputs. A description's existence does not establish that an actor uses it, nor does a formal response rule establish its legitimacy or empirical accuracy.

The response map can lie outside the original semigroup generated by the primitive maps. On $\{0, 1\}$, let the primitives be identity and flip. Observe the state, choose flip at zero and identity at one. The response sends both states to one, while every old primitive composition is a bijection.

The example shows that conditional selection can introduce a noninvertible global update even when every selected primitive is invertible. The selection rule is part of the enlarged mechanism. The result supplies no contradiction to an earlier theorem about one fixed semigroup.

This construction provides a limited formal account of classificatory uptake. A substantive study must identify the classification, the responding actors, their information, and the actions through which the description becomes consequential.

16.4 Social Facts and Assertions About Them

A representation can encode a claim about a social condition without establishing that condition. This subsection separates the record, its asserted content, and the warrant for that content.

A database can contain an authorization entry. That is a fact about the record under a suitable evidential description. The proposition that authorization holds under the relevant practice is another claim. A disagreement can concern the entry's accuracy, the coding rule, or the governing criterion.

The same separation applies to events. An occurrence record can assert that an agreement was signed or an activity attempted. Its presence in the model supplies a representation of that claim. Evidence is needed to connect it to an actual episode.

Identity claims can also be recorded without being settled. Two sources can disagree about whether an organization continues through a change. The model can preserve both criteria and compare their consequences. A single identifier should not silently resolve the dispute.

PROV-DM offers a useful comparison through its separate treatment of entities, activities, and derivation records [6, Sections 2.1 and 5.2.1]. The present framework has its own category commitments. A translation between the schemes requires an account of the meanings and information preserved.

Huang's conformance specification likewise emphasizes declared encodings and partitions in reconstructing generative structure [4]. The category audit adds a complementary responsibility: identify the base data, added records, and interpretive premises on which each claim depends.

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16.5 Historical Explanation and Predictive Sufficiency

A record sufficient for future observation can remain inadequate for historical explanation. This subsection examines why both uses can be legitimate and how they should be coordinated.

Two histories can reach the same configuration and agree under all selected future observations. A query about formation mode, contribution, or an earlier alternative can still distinguish them. Predictive equivalence therefore leaves historical questions open unless their information is included in the task.

A historical explanation can seek why the present arrangement arose, which processes sustained it, or how participants understood a transition. Those questions can require records that a compressed predictor omits. Their relevance needs a substantive argument beyond future-output difference.

Conversely, a detailed history can contain distinctions irrelevant to a selected forecast. The framework permits a smaller operational record while preserving the larger history in an archive. The relation between the records should remain traceable.

If a later operation consults a historical field, the predictive problem changes. The sufficient state must retain that field or equivalent information. The historical-relations companion paper develops this dynamic coordination in a finite example.

The philosophical lesson is that historicity has several roles. A process can produce a present condition, a record can preserve its formation, and later activity can respond to that record. The roles can interact without becoming one unqualified claim that history determines every future difference.

16.6 Identity, Behavior, and the Boundary of Selfhood

The entity construction tracks appearances through a declared equivalence or lineage. This subsection states what such tracking can contribute to identity questions and where further philosophical work is needed.

Behavioral equality can hold between separately identified entities. A continuing entity can also change its behavior. The continuation quotient therefore cannot replace every identity criterion. Its equivalence concerns a selected observation task.

A lineage records directional continuity through change and can branch through fission or merge through combination. Turning that relation into numerical identity requires additional choices. Undirected connectivity can join branches that the inquiry needs to distinguish.

The same caution applies to a model of a self. Embodied continuity, first-person appropriation, social recognition, and practical responsibility can disagree. A causal chain or an observation profile can contribute to an account of those questions while leaving their resolution open.

A commitment to a future self can matter precisely because future preferences or abilities may change. A model that identifies identity with unchanged behavior would miss that possibility. The relevant continuity criterion needs an independent philosophical argument.

The present metamodel supplies formal preparation for such an inquiry. It distinguishes appearance, state, history, and lineage and identifies their information requirements. An account of lived selfhood remains a further research project.

16.7 Evaluation and the Selection of Descriptions

Descriptive choices can influence what an inquiry evaluates, while the formal results leave evaluative standards open. This subsection examines that relation.

An observation of whether activity occurred differs from an observation of its distribution, burden, or meaning. A quotient preserving the first can merge distinctions needed by the others. Selecting the observation therefore shapes the questions the model can answer.

The choice can be justified by a bounded purpose. A completion flag can be sufficient for one technical calculation. Its use becomes problematic when the result is extended to a broader judgment without retaining the missing dimensions.

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Generative and reproductive roles also remain evaluatively open. Formation of a new route can support or undermine participants' aims. Maintenance of an existing relation can preserve cooperation or sustain an unwanted dependency. The formal role alone supplies no fixed ranking.

A plural description can retain several observations and their joint continuation requirements. That construction preserves the selected information but does not decide how conflicting values should be weighed.

The framework therefore separates a formal measure from the reasons for using it. Cardinality, robustness, and predictive sufficiency can inform an evaluation when their relevance is argued. They should remain linked to the standards and participants that give the comparison its meaning.

16.8 Adequacy through Explicit Revision

The metamodel's adequacy depends on its capacity to support and survive criticism in a specified inquiry. This final subsection identifies the kinds of revision that the preceding distinctions permit.

A failed update prediction can expose an omitted condition or an overly coarse state. A disputed identity can expose an inadequate continuity criterion. A history collision can expose insufficient records for a target query. These failures belong to different parts of the representation.

A revised construction should retain the earlier formulation and explain the change. Adding a variable, refining a quotient, or changing an operation repertoire can repair one problem while introducing new assumptions. Those assumptions should remain visible.

The category framework is useful when it makes the repair more precise. It should help identify which record needs enrichment, which proof needs rechecking, and which interpretive claim remains unsupported.

Its philosophical contribution is therefore a disciplined coordination of questions. The six categories organize different responsibilities within social inquiry, and the formal constructions show how some of those responsibilities can be met under declared assumptions. The remaining tensions continue to guide research.

17 Changes of Regime and Extensions of the Dynamics

This section examines changes to the mathematical setting that the six category representations may require. The discussion first treats transitions between declared regimes of description. It then introduces a finite probabilistic extension and derives its consistency condition. Partial availability, concurrent activity, and history-dependent responses complete the comparison. Each extension identifies its additional inputs and the conclusions that survive under those inputs.

The fixed action supplies a controlled starting point. A more detailed inquiry can reveal a changing classification, a restricted operation domain, uncertain outcomes, or several activities occurring during an overlapping interval. These discoveries pose different mathematical problems. Treating them all through a larger carrier can sometimes produce a formally unified representation. The substantive value of that representation depends on the interpretation of its new coordinates and on the evidence available for their updates.

17.1 A Declared Family of Descriptive Regimes

A regime can specify a vocabulary of observations, a criterion for following entities, or an operation repertoire. To represent anticipated changes among such regimes, the model must retain which regime is active and how a transition alters the represented situation. The following construction makes those commitments explicit.

Let $\mathcal{R}$ be a set of regime labels. For each $r \in \mathcal{R}$, let S_r be a carrier and let E_r be an equivalence on that carrier. The tagged union

$$X = \coprod_{r \in \mathcal{R}} \{r\} \times S_r$$

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keeps the regime and its state together. A point (r, x) records a state under a specified regime. Define

$$(r, x)\, E\, (s, y) \quad \Longleftrightarrow \quad r = s \text{ and } x\, E_r\, y.$$

This definition compares states within a common regime. It leaves cross-regime alignments to an additional construction.

A primitive operation can now be a partial map $U_b : X \rightharpoonup X$. Whenever it is defined, write

$$U_b(r, x) = \big(\kappa_b(r, x), F_b(r, x)\big), \qquad F_b(r, x) \in S_{\kappa_b(r,x)}.$$

The map κ_b chooses the successor regime, while F_b supplies the successor state in its corresponding carrier. This typing matters: a state code valid under one regime may lack a declared interpretation under another. Even when the carriers happen to use the same numerical codes, their alignment requires a modeling decision.

Proposition 17.1 (Descent across declared regimes)**.** *A partial operation U_b induces a partial operation on X/E if and only if E-related inputs have the same definedness and, whenever their outputs are defined, the outputs have equal regime tags and equivalent state coordinates under that common successor regime.*

Proof. A partial quotient operation needs a domain consisting of whole E-classes. Thus definedness must agree for related representatives. For an admitted class, its successor class must also be independent of the representative. By the definition of E, this requires equality of the successor regime tags and equivalence of the successor state coordinates under that tag. These requirements are necessary. Conversely, their satisfaction defines an unambiguous domain on X/E and one successor class for each admitted input class. The resulting partial map is the required quotient operation. □

Internal consistency of each regime supplies only part of this condition. A regime can preserve its own state distinctions under its ordinary operations while a transition to another regime separates states previously identified. The transition therefore deserves its own proof. This distinction is relevant whenever a modeling account proposes to accommodate changing institutions simply by allowing its parameters to change. The parameter change can alter the very distinctions needed to determine a successor.

17.2 Refinement of Descriptions and Recovery of Omitted Information

A common-carrier example isolates the cost of moving to a finer description. Suppose $S_c = S_f = S$, where c and f name coarse and fine regimes. Let a regime switch preserve the raw coordinate:

$$U(c, x) = (f, x).$$

Related inputs in the coarse regime have xE_cy. Their outputs are related in the fine regime exactly when xE_fy. Consequently the switch descends precisely under

$$E_c \subseteq E_f.$$

The direction of this inclusion deserves attention. A finer description has smaller equivalence classes, so its equivalence typically satisfies $E_f \subseteq E_c$. A strict refinement therefore generally violates the condition needed to compute the switch from a coarse class alone.

For example, take $S = \{0, 1\}$. The coarse regime identifies both points, while the fine regime distinguishes them. The unique coarse class supplies insufficient information to choose between the two fine classes. A raw-state model retaining x can execute the switch without difficulty. Its ability comes from information retained in that model. The coarse record cannot acquire the missing bit merely through a change of notation.

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This example separates three tasks in the interpretation of social change. A descriptive revision can introduce a distinction already represented in the raw data. An evidential revision can recover a distinction through additional observation or historical records. A substantive transition can change the represented situation itself. The three tasks can coincide in a case, yet their justification differs. A revised institutional classification may use archived information, require new documentation, and affect future action. Each component should receive its own update or evidential account.

The construction also clarifies the status of anticipated novelty. A regime catalog can include several possible successor vocabularies and explicit transitions between them. Such a catalog models revision within its declared possibilities. An account of how investigators or participants develop a previously unrepresented vocabulary requires additional work. Including a symbol named *new regime* leaves the content and interpretation of that regime to be supplied.

Cross-regime entity identity raises a related issue. The tagged equivalence above keeps regimes separate because it serves a state description. An organization may remain the same organization under two descriptions. A cross-regime alignment can represent that continuity through matched entity appearances, documentary succession, or another declared criterion. Merging regime tags in the state quotient would conflate this identity question with the consistency of the descriptive dynamics.

17.3 Finite Probabilistic Transitions

Some inquiries seek probabilities of successor states. A stochastic transition model adds information beyond deterministic reachability. The finite case permits a complete statement of the exact aggregation condition and a direct comparison with the quotient action.

Let S be finite and let K be a stochastic matrix, with $K(x, y) \geq 0$ and $\sum_{y \in S} K(x, y) = 1$. Let $q : S \to Q$ be a surjective description. For a quotient value $C \in Q$, its block is $q^{-1}(C)$. The probability of entering this block from x is

$$K(x, q^{-1}(C)) = \sum_{y : q(y) = C} K(x, y).$$

An exact quotient transition must assign the same block probability to every state receiving the same current description.

This requirement is the classical finite-state lumpability condition. Kemeny and Snell give the block-sum criterion and its proof in Theorem 6.3.2 of *Finite Markov Chains* [5]. The result is used here as an established antecedent. Its role is to specify the added consistency obligation when a category description is asked to support probabilistic prediction.

Proposition 17.2 (Exact finite probabilistic aggregation)**.** *A representative-independent quotient transition matrix exists for every initial distribution if and only if*

$$q(x) = q(x') \implies \sum_{y : q(y) = C} K(x, y) = \sum_{y : q(y) = C} K(x', y) \quad (C \in Q).$$

Under this condition,

$$\bar{K}(q(x), C) = \sum_{y : q(y) = C} K(x, y).$$

For a distribution μ on S, write $\mu_q(C) = \sum_{q(x) = C} \mu(x)$. Then

$$(\mu K)_q = \mu_q \bar{K}.$$

Proof. Initial distributions concentrated at two representatives of the same block induce the same quotient initial distribution. A common quotient transition therefore requires equal probabilities into each

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target block, proving necessity. Under the stated condition, the displayed formula defines $\bar{K}$ independently of the representative. Its entries are nonnegative, and its row sums equal one because the blocks partition S. Finally,

$$\begin{aligned}(\mu K)_q(C) &= \sum_x \mu(x) \sum_{y:q(y)=C} K(x,y) \\ &= \sum_{A\in Q} \sum_{x:q(x)=A} \mu(x)\bar{K}(A,C) \\ &= \sum_{A\in Q} \mu_q(A)\bar{K}(A,C).\end{aligned}$$

This is the required commutation identity. □

The hypothesis concerns every initial distribution. A successful aggregation under one selected distribution can depend on how probability is distributed among hidden states inside each block. The proposition gives a stronger guarantee: the quotient transition remains valid independently of that hidden mixture. A project using a weaker guarantee should state the relevant initial distributions and the resulting restriction of scope.

17.4 Possible Successors and Their Probability Distributions

A small counterexample shows why possible successor classes give insufficient information for probabilistic aggregation. Let $S = \{0, 1, 2\}$, with blocks $A = \{0, 1\}$ and $B = \{2\}$, and set

$$K = \begin{pmatrix} 4/5 & 0 & 1/5 \\ 1/5 & 0 & 4/5 \\ 0 & 0 & 1 \end{pmatrix}.$$

From either state 0 or state 1, the possible successor blocks are A and B. Their probabilities of reaching B are $1/5$ and $4/5$, respectively. The current description A therefore preserves the set of possible successor blocks while omitting a distinction essential to the next-step probability.

For social interpretation, the difference concerns the claim made by a model. An account can state that two arrangements permit the same classes of outcome. An account can also state that those outcomes have equal probabilities under specified conditions. The second statement demands further information. The deterministic architecture supplies a disciplined language for the first kind of possibility comparison; it leaves the probability assignment to an enrichment with its own evidence.

A family of primitive kernels K_b supports finite operation sequences when the same block condition holds for each primitive. Applying the commutation identity successively gives the quotient distribution after any declared finite word. This sequential result presumes that the kernel assigned to the next primitive is appropriate to the represented state. If unrecorded history changes the next-step probabilities, the chosen state is incomplete for that model.

The deterministic case appears as a special instance. For a map $T_b : S \to S$, define

$$K_b(x, y) = \mathbf{1}_{\{T_b(x)=y\}}.$$

Its mass in a target block is one exactly when the deterministic successor belongs to that block. Equality of block masses is therefore equivalent to equality of successor descriptions. The probabilistic condition recovers preservation of $\ker q$. This relation explains the common structural role of the two criteria while keeping their empirical inputs distinct.

17.5 Partial Availability and the Meaning of Failed Operations

An operation may be executable only on part of the state space. Representing it by a partial map makes availability visible in the domain. A quotient partial operation then requires both constant definedness

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within each class and a common successor class whenever execution is available. These are distinct requirements. Equivalent outcomes following successful execution leave open whether execution is possible at each representative.

A total-map representation can encode failure by adding failure states or by declaring that an unavailable operation leaves the state unchanged. Either convention can be useful for a specified question. Their meanings differ. A failed attempt can consume resources, produce a documentary record, alter expectations, or trigger a sanction. A self-loop on the original state can represent such an attempt only if those consequences are outside the declared state question or are retained elsewhere.

The occurrence record is particularly valuable here. Two situations may have the same resulting state while differing in whether an operation was attempted. An event ledger can retain that difference even when the state dynamics compress it. If future responses depend on the attempt, its record must also enter the information available to subsequent updates. The category architecture identifies the relevant coordination obligation without forcing every event detail into every state description.

The feasible-path model developed separately in the paper portfolio supplies more detailed conditions involving permissions, resources, and execution prefixes. The present partial-map discussion establishes the simpler point: availability has a formal location, and that location must be preserved by the description when the description is used to determine executable operations.

17.6 Concurrent Activity and Temporal Resolution

A word orders its primitive occurrences. That order can represent an observed sequence, an imposed scheduling convention, or an approximation at a chosen temporal resolution. Concurrent activity requires an interpretation of how the sequential description relates to overlapping occurrences.

Commutation of two state transformations gives a limited result. If $T_a T_b = T_b T_a$, reversing their order preserves their composite effect on every state in the declared carrier. The equation concerns transformation effects. Occurrence times, exposure intervals, participants' knowledge, and temporary resource conflicts may still differ. A representation retaining only the composite transformation omits those questions.

Conversely, two operations can overlap in clock time while their effective dependencies impose an order on particular subevents. An authorization may be issued during a resource transfer yet become usable only after a confirmation step. A sequential approximation must specify which events it treats as atomic and which timing relations it suppresses. The choice is assessed against the outcome or historical query.

A fuller concurrent model would need an explicit account of compatible occurrences, temporal constraints, and composition. The present architecture supplies two starting resources: occurrence-level records preserve individual executions, and process-level records preserve their organization. The exact relation between such records and the semigroup action remains a research obligation when concurrency carries substantive content.

17.7 History-Dependent Responses and Expanded State

History dependence can be represented by storing a record that determines the information used in the next update. The resulting state might include the current condition, the most recent formation mode, and a selected event summary. This strategy is useful when the retained record has an explicit update rule and a clear relation to the questions being answered.

The cost of the strategy appears in the size and interpretation of the record. A history coordinate can contain an entire sequence, yielding an exact but large state space. A finite summary needs a preservation proof for the selected future and historical readouts. Sufficiency for one query gives a local achievement. Adding another query or operation can require refinement.

The same issue affects institutional learning or classificatory uptake. A response may depend on a participant's remembered experience, an institution's archive, or an investigator's classification. Each

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is a different information source. A response function $\pi(o(x))$ gives a compact model only when the observation o contains the information actually used by the response rule.

These extensions support a common methodological conclusion. Enlarging the mathematics should make an additional commitment explicit and testable. A larger carrier, a stochastic kernel, or a regime tag gains explanatory value through its interpretation and the questions it helps answer. The six-category architecture organizes those commitments while leaving the choice of an adequate empirical model open.

18 Approximate Descriptions and Finite-Horizon Error

This section develops a quantified alternative to exact descriptive consistency. It introduces a metric on reduced descriptions, derives trajectory error from local approximation residuals, and examines the consequences for threshold classifications. It then explains why numerical tolerance differs from an equivalence relation and identifies the evidence needed to use an approximate model.

The exact quotient construction provides a clear baseline: equivalent configurations have equivalent successors under each declared operation. An empirical or computational model can aim for a controlled approximation when exact preservation is too demanding. That change requires a measure of discrepancy and a statement of how error propagates. A phrase such as *approximately the same state* leaves these commitments unresolved.

18.1 Metric Structure and the Meaning of Approximation

A metric supplies a nonnegative distance between descriptions, with zero distance identifying equal points, symmetry, and the triangle inequality. The triangle inequality will perform the main work in the derivation. The interpretation of the distance remains an additional modeling choice.

For numerical attributes, a distance can compare values expressed in declared units. For a vector of attributes, a distance can also combine differences across coordinates. Such a combination needs justification. Changing a unit or a coordinate weight can alter which descriptions count as close. The attribute analysis therefore remains relevant to the approximate state model.

A categorical difference may resist a useful graded interpretation. An occurrence can be correctly or incorrectly identified; two organizations can be assigned different identity claims. A numerical distance between their codes has meaning only through an independently specified comparison. The introduction of a metric should follow the question it is meant to answer.

Girard and Pappas develop a broader framework of metric comparisons and approximate simulation and bisimulation for transition systems [2]. That work provides an established antecedent for quantified approximation. The present section proves a narrower elementary bound for two deterministic evolutions following the same label sequence. It leaves a full comparison with the broader framework to later investigation.

18.2 Reduced Updates and Local Residuals

Let $T_b : S \to S$ be the declared operations of the detailed model. Let $q : S \to Q$ be a description map, where (Q, d) is a metric space. Proposed reduced updates are maps $\widehat{T}_b : Q \to Q$. Surjectivity of q is unnecessary for the following bound.

The local residual compares two ways of taking one step: update the detailed configuration and then describe it, or describe the configuration and apply the reduced update. Assume that, for each b,

$$d\big(q(T_b x), \widehat{T}_b(qx)\big) \le \delta_b \qquad (x \in S). \tag{36}$$

The parameter $\delta_b \ge 0$ is a uniform upper bound on that discrepancy.

Also assume that the reduced update satisfies

$$d\big(\widehat{T}_b u, \widehat{T}_b v\big) \le \lambda_b d(u, v) \qquad (u, v \in Q), \tag{37}$$

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with $\lambda_b \geq 0$. This condition controls how a discrepancy already present in the reduced description can change under the next operation.

The two assumptions address different sources of error. The residual is introduced even when the reduced input exactly equals qx. The Lipschitz factor governs propagation of an earlier discrepancy. Their combination gives a bound over a finite sequence.

Both assumptions require support. A fitted model can have small residuals on observed configurations while behaving differently elsewhere. The displayed uniform inequalities are mathematical premises. A finite sample becomes evidence for them only through a separate estimation, coverage, or structural argument.

18.3 Derivation of the Trajectory Bound

Fix a word $w = b_1 \cdots b_n$. Let the detailed and reduced evolutions be

$$x_i = T_{b_i} x_{i-1}, \qquad z_i = \widehat{T}_{b_i} z_{i-1}.$$

Their discrepancy at step i is

$$e_i = d(qx_i, z_i).$$

The initialization can itself be approximate, so e_0 is retained in the general result.

Proposition 18.1 (Propagation of local description error)**.** *Under* (36) *and* (37)*,*

$$e_n \leq \left(\prod_{j=1}^{n} \lambda_{b_j} \right) e_0 + \sum_{i=1}^{n} \delta_{b_i} \prod_{j=i+1}^{n} \lambda_{b_j}. \tag{38}$$

An empty product equals one.

Proof. Insert $\widehat{T}_{b_i}(qx_{i-1})$ between the two descriptions being compared. The triangle inequality gives

$$\begin{aligned} e_i &\leq d\big(q(T_{b_i} x_{i-1}), \widehat{T}_{b_i}(qx_{i-1})\big) \\ &\quad + d\big(\widehat{T}_{b_i}(qx_{i-1}), \widehat{T}_{b_i}(z_{i-1})\big) \\ &\leq \delta_{b_i} + \lambda_{b_i} e_{i-1}. \end{aligned}$$

The first term uses the local residual bound and the second uses the Lipschitz condition. For one step, the product-sum formula is exactly this inequality. Suppose the formula holds at $n-1$. Substituting it into $e_n \leq \delta_{b_n} + \lambda_{b_n} e_{n-1}$ extends every earlier product by λ_{b_n} and adds the new residual with an empty trailing product. Induction proves (38). □

The formula retains the order of the operations. A residual introduced early is multiplied by the sensitivity factors of subsequent updates. A large factor late in the word can amplify several earlier errors. A small residual bound for each primitive therefore has to be interpreted together with the continuation.

The initialization term matters for uncertain current records. Even an exact reduced update can propagate initial discrepancy. Conversely, exact initialization removes that term while leaving the residuals introduced by the approximation itself.

18.4 Uniform Bounds and Horizon Dependence

Suppose $\delta_b \leq \delta$, $\lambda_b \leq \lambda$, and $e_0 = 0$. Since all factors are nonnegative, the general bound yields

$$e_n \leq \delta \sum_{k=0}^{n-1} \lambda^k.$$

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The finite sum has the explicit form

$$e_n \leq \begin{cases} n\delta, & \lambda = 1, \\ \delta \dfrac{\lambda^n - 1}{\lambda - 1}, & \lambda \neq 1. \end{cases} \tag{39}$$

For $\lambda \neq 1$, multiplication of the finite sum by $\lambda - 1$ cancels its intermediate powers and leaves $\lambda^n - 1$. For $\lambda = 1$, the sum has n unit terms.

When $0 \leq \lambda < 1$, the bound is at most $\delta/(1 - \lambda)$. The reduced dynamics contract earlier discrepancies enough to bound their accumulation. When $\lambda = 1$, the bound grows linearly with the number of steps. When $\lambda > 1$, the bound can grow geometrically.

These are properties of the declared metric model. A claim of approximation adequate for one horizon therefore needs to specify the horizon. A longer continuation can cross the permissible error threshold even when each individual update appears accurate.

The distinction also affects model comparison. One reduced model can have smaller local residuals and larger sensitivity factors than another. The preferred model for a long horizon can differ from the preferred model for a single step. The derived expression makes the tradeoff available for inspection.

18.5 An Example Attaining the Growth Bound

The geometric expression can be attained exactly. Let $S = Q = \mathbb{R}$, let q be the identity, and consider one operation with

$$T(x) = \lambda x, \qquad \widehat{T}(z) = \lambda z + \delta, \qquad x_0 = z_0 = 0,$$

where $\lambda, \delta \geq 0$. The local residual is exactly δ, and the reduced map has Lipschitz factor λ.

The detailed trajectory remains zero. The reduced trajectory satisfies

$$z_n = \delta + \lambda z_{n-1} = \delta \sum_{k=0}^{n-1} \lambda^k.$$

Since the values are nonnegative, the distance between the trajectories equals the displayed expression. The upper bound is therefore exact for this model.

With $\lambda = 2$, the error is $\delta(2^n - 1)$. A small constant local discrepancy can exceed any fixed tolerance if the horizon is sufficiently long. The example shows that a general inference from small one-step residual to uniform long-run accuracy needs additional assumptions.

The social interpretation remains limited. The scalar state is a mathematical counterexample to an approximation claim. It supplies no empirical assertion that a particular social process has the displayed sensitivity. A substantive application would need to justify the variables, update, and metric.

18.6 Threshold Decisions and Margins

An inquiry can use a numerical description to make a categorical decision. Let $g : Q \to \mathbb{R}$ satisfy

$$|g(u) - g(v)| \leq K_g d(u, v).$$

If $e_n \leq B_n$, then

$$|g(qx_n) - g(z_n)| \leq K_g B_n.$$

The metric bound therefore transfers to the readout.

Consider the classification $\mathbf{1}_{\{g \geq \theta\}}$. If

$$|g(z_n) - \theta| > K_g B_n, \tag{40}$$

the detailed and reduced classifications agree. When the predicted value exceeds $\theta + K_g B_n$, the detailed value remains strictly above the threshold. When it lies below $\theta - K_g B_n$, the detailed value remains strictly below it.

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The margin condition is sufficient. Its failure leaves the classification unresolved by this bound. The actual classifications can still agree. Reporting agreement as guaranteed requires the appropriate margin or a stronger argument.

A small numerical discrepancy can matter near a threshold. If the classification enters a response rule, the two models can then select different subsequent operations. The same-word error theorem ceases to apply directly after that selection difference. A feedback approximation needs a further argument about policy stability or operation mismatch.

This observation connects approximation to social uptake. A descriptive error can remain small in its own metric while crossing a decision boundary that changes access, priority, or the next institutional step. The importance of the error depends on the use of the description.

18.7 Tolerance Relations and Transitive Closure

A common attempt to represent approximation identifies descriptions whenever $d(u, v) \leq \varepsilon$. The resulting relation is reflexive and symmetric, yet it can fail transitivity. Three real values $0, 0.6, 1.2$ with tolerance 0.7 give an elementary example.

Taking a transitive closure repairs transitivity at a further cost. On $\mathbb{R}$ with any $\varepsilon > 0$, the closure identifies every pair of points. For given x, y, choose a positive integer n with $|x - y|/n \leq \varepsilon$. The sequence

$$x, \quad x + \frac{y - x}{n}, \quad \ldots, \quad x + n\frac{y - x}{n} = y$$

joins them through ε-close pairs. Thus every pair belongs to the transitive closure.

A finite chain can exhibit the same problem at its own scale. Neighboring descriptions may each be within tolerance while the chain's endpoints are far apart. Closing the neighbor relation transitively merges the entire chain.

Consequently an equivalence constructed by closure can lose the original error guarantee. A partition into declared bins supplies another possible description, with its own boundary and diameter properties. The partition should be assessed through those properties, rather than through the tolerance relation it replaced.

This matters particularly for entity modeling. Approximate similarity of attributes can support a comparison among appearances. It leaves historical identity and continuity criteria to be supplied. An approximate state metric should not silently become an entity equivalence.

18.8 Evidence and the Scope of Approximate Adequacy

An approximate application should specify the distance, permitted discrepancy, residual bounds, update sensitivity, and horizon. It should also state which decisions depend on the description and whether those decisions have adequate margins.

Observation uncertainty and approximation residual are different inputs. A record may inaccurately measure the detailed state. A reduced update can also deviate from the detailed model even when that state is known. The general bound retains an initialization discrepancy, while a full measurement model may need uncertainty at several stages.

The theorem compares a fixed label sequence. Partial availability, adaptive choices, changing regimes, and stochastic transitions can require additional reasoning. These extensions should preserve the distinction between a mathematically derived bound and evidence that its assumptions hold in the application.

Approximation therefore broadens the architecture through quantified commitments. It permits a reduced description to be evaluated at a specified precision and horizon while retaining the exact construction as a reference point. The meaning and adequacy of that precision remain questions for the substantive inquiry.

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19 Research Design and Revision Obligations

This section develops a proposed research design for evaluating the category architecture in a bounded social inquiry. It first specifies the unit of investigation and the competing representations. It then states evidence requirements for the six categories, explains how failures should be diagnosed, and identifies the conditions for extending or revising the model. The design remains prospective.

The conditional results establish relations among declared mathematical objects. Their use in social inquiry requires interpretations for those objects and evidence relevant to the resulting claims. A satisfactory study should make both levels visible. It should also retain discrepancies that reveal a poor representation, since those discrepancies can identify precisely which enrichment the inquiry needs.

19.1 A Bounded Arrangement and Its Comparison Questions

A first empirical study could follow one cooperative arrangement through formation, activation, and revision. The study would declare a temporal interval, a focal activity, and the organizations or other participants whose appearances enter the record. The cooperative example in Section 13 supplies a set of logical contrasts for designing such a study. Its binary states would be assessed and revised in light of the actual case.

The initial question should specify what the model is expected to recover. An inquiry into whether implementation occurred needs different evidence from an inquiry into the source of an authorization. An inquiry into the continuing identity of an organization needs a different comparison from one into the conditions enabling a particular action. These questions can share a case while retaining distinct success criteria.

A useful first comparison would involve three descriptions. A current-condition description would retain the variables initially proposed to determine the next operation. A history-enriched description would add the formation and occurrence information needed for selected historical questions. A feasibility-enriched description would add conditions that restrict execution. The comparison would assess each description against its declared task, including tasks for which its limitations are expected.

This design avoids rewarding a model simply for retaining more data. An expanded record gains value when the added information supports a stated question or repairs a demonstrated failure. It also carries costs: more demanding evidence, additional ambiguities, and a larger space of possible records. Those costs should be reported alongside gains in recoverability or consistency.

19.2 Evidence for Entity Continuity

Entity reidentification requires a declared relation among appearances and evidence relevant to that relation. The study would retain dated names or identifiers, membership records, succession claims, and the criteria used by the investigation. Participant assertions of continuity would receive their own record, allowing agreement and disagreement among sources to remain visible.

A discriminating case would compare unchanged membership after an interruption with changed membership under an uninterrupted institutional procedure. A membership-based criterion and a procedural-continuity criterion may give different answers. The inquiry should state which answer serves its focal question and what consequences follow from the alternative.

Fission and merger deserve explicit treatment. If one organization divides into two successors, a directed lineage record can preserve both successor relations. A single equivalence-based identity criterion must explain whether it selects one successor, regards both as new entities, or identifies a different continuing unit. The record should retain the lineage even when the focal identity criterion selects only part of it.

Research Obligation 19.1 (Identity criteria and evidential scope)**.** State the appearances being compared, the criterion under which they count as the same entity, and the evidence supporting each required continuity relation. Preserve alternative criteria when they alter a substantive inference.

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The resulting obligation concerns the adequacy of a representation for a question. It permits several well-specified identity criteria within one study. It also permits a criterion to be rejected when its consequences conflict with the distinctions the study has committed to retain.

19.3 Evidence for Relations and Their Formation

A relation record should specify its participants, roles, scope, and formation information. For a cooperative arrangement, these might include which party can request performance, which party bears a stated obligation, and which recorded procedure established the arrangement. The coding would remain a proposed representation until checked against the relevant case evidence.

A particularly useful comparison involves two candidate histories leading to the same current-condition record. If the historical question gives different answers under those histories, the current record is insufficient for that question. Documentary evidence may narrow the compatible history set. Its effect should be reported as a reduction of uncertainty, with remaining alternatives identified.

Prospective effects require another comparison. The study must specify the continuation or intervention under which a relational difference is expected to matter. Two arrangements may have the same currently observed implementation status while differing in their response to a request, review, or withdrawal. The model should declare which aspects of the comparison are held fixed and which change.

Research Obligation 19.2 (Historical warrant and continuation comparisons)**.** Separate evidence that a relation was formed through a specified history from evidence that a selected continuation distinguishes its potential effects. State the comparison assumptions needed to attribute that difference to the relation.

This separation protects a central insight of the paper. A relation can remain relevant through unrealized continuations, while its actual formation remains a historical question. Evidence supporting one side can leave the other unresolved.

19.4 Evidence for Occurrences and Attempts

Occurrence records require a method for distinguishing individual events even when their transition descriptions coincide. The study would retain source identifiers, date or interval information, operation labels, and links among reports believed to concern the same occurrence. Conflicting reports would remain separate until their relation is assessed.

Repeated applications of an idempotent operation provide a decisive test of the chosen record. If two authorization attempts leave the represented condition unchanged after the first, a state-only record may merge them. A question about frequency, administrative burden, or procedural compliance requires the occurrence distinction.

Attempts and completions also need separate coding. A request can be submitted, rejected, withdrawn, or left unresolved. The relevant event boundary depends on the question. A record that counts only completed implementation can be adequate for an outcome query while being inadequate for an inquiry into barriers to implementation.

Temporal precision should match the inference. An ordered record can establish that one reported event precedes another without establishing the duration between them. Coarse dates may leave order unresolved. The study should retain those limits through partial temporal information or explicit uncertainty, rather than assign a convenient total order without support.

19.5 Evidence for Attributes and Measurement Choices

Attribute coding requires the subject, value domain, interpretation, and definedness conditions to be declared together. An investigator should be able to identify whether a missing value reflects unavailable evidence, an inapplicable predicate, a disputed classification, or a measurement that has yet to be performed.

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When an attribute is used at a quotient level, the study should examine representatives within each proposed class. A value that changes among those representatives fails the descent criterion. The response can involve refining the quotient, changing the attribute question, or retaining the attribute at a more detailed level. The choice should reflect the inquiry's purpose.

Numerical attributes require particular care. A score can provide an ordered comparison without supporting arithmetic differences or averages. If a conclusion changes under a recoding permitted by the stated scale, the conclusion relies on more structure than the measurement convention supplies. A proposed aggregation should therefore state why the relevant operations on values have a substantive interpretation.

A coding rule can also have consequences when it is used by participants or an institution. The study should distinguish the classification recorded by the investigator from the classification that enters an actual decision rule. The feedback construction in Section 16 describes one way to represent uptake after its presence and form are established.

19.6 Evidence for State Sufficiency

A state description supports a declared future task when it retains the distinctions needed for the selected observations under the relevant operations. Empirical assessment therefore requires an operation repertoire, an observation scheme, and a comparison horizon.

The study should seek pairs of cases or modeled configurations with the same current record and different responses to a specified continuation. Such a pair can reveal hidden memory or an omitted condition. The interpretation depends on the evidence: the discrepancy could also reflect recording error, changed operation meaning, or an incorrect deterministic assumption.

Research Obligation 19.3 (Observation and operation design)**.** Specify which social question fixes the observation map, the operation repertoire, and the comparison horizon. Identify distinctions that these choices omit and test whether the omissions affect the intended use.

The continuation quotient gives an exact mathematical response once these inputs are fixed. A finite empirical sample typically supports a more restricted assessment. Successful agreement on observed continuations should be reported at that scope. The extension to unobserved continuations remains an assumption or a further test.

19.7 Evidence for Process Organization

A process record links occurrences through an organizing criterion. The study should state whether the process is bounded by a common objective, a procedural sequence, a continuing institutional activity, or another relation. The criterion determines which occurrences belong to the process and how interruptions are interpreted.

Intermediate conditions can be decisive. A final resource balance can conceal an unavailable intermediate step. A final implementation state can conceal failed attempts, temporary suspensions, or repeated reversals. A process account therefore needs the record required by its path-sensitive questions, even when its endpoint is well established.

Segmentation should also be justified. Grouping several operations into one phase can support explanation at a useful scale. A phase boundary can mark a change of authority, a resource threshold, or a shift in the relevant participants. Alternative segmentations should be compared when they alter the explanation of the process.

Duration introduces an additional evidence requirement. A word supplies an order of labels; durations require temporal data and a rule relating those data to the process. The idempotence counterexample shows why a composite effect alone generally cannot recover elapsed time or occurrence count.

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19.8 Diagnosis of Discrepancies and Revision Order

A discrepancy between a model and a record should initiate diagnosis at the narrowest relevant level. The first task is to check that the observed record and the formal prediction refer to the same subject, time, operation meaning, and question. A mismatch of those references can produce an apparent contradiction.

The next task is to examine the representation's assumptions. An attribute may fail to descend, an identity criterion may collapse distinct participants, or a state may omit a formation variable. The mathematical counterexamples in the paper identify possible failure forms. Case evidence is needed to determine which form, if any, explains the discrepancy.

Revision should preserve a traceable account of what changes. Refining a state can alter its continuation classes and the records that depend on those classes. Revising entity identity can alter relation incidence and attributed properties. A coordinated model therefore needs to revisit dependent records after a material change.

The study should also record successful preservation results. A reduced description that retains the intended readouts under tested operations can justify a useful compression at that scope. Demonstrating such success makes the eventual limitations more informative: the inquiry can identify which new question or operation first requires additional structure.

19.9 Extension and Abandonment Conditions

The proposed architecture warrants further development when its distinctions organize evidence, reveal otherwise hidden assumptions, or produce comparisons that can discriminate among candidate models. A new enrichment should name the failure it repairs and the evidence supporting its added inputs.

Abandonment or substantial revision is appropriate when the proposed categories repeatedly obscure the case's central distinctions, when the required identity criteria cannot be defended for the focal question, or when the operation model suppresses the very changes the inquiry aims to explain. These are substantive limitations of an application, even when the conditional algebra remains correct.

The research program can therefore advance through both successful applications and informative failures. Its immediate task is to connect precise constructions to bounded questions while retaining uncertainty about the evidence, the interpretation, and the eventual theoretical reach of the framework.

20 Conclusion

This paper has developed a coordinated representation of six categories of social facts from an abstract action framework and explicitly declared enrichments. The construction assigns entity reidentification, historically formed dependence, event occurrence, attribute description, state comparison, and process history different tasks within a common inquiry. The conclusion draws together the formal results, their philosophical interpretation, and the research obligations that follow.

The central result is an architecture of representational commitments. A common dynamics can support several category-specific records, yet the data required by those records differ. A carrier and an action supply configurations and transformations. A preserved equivalence supports quotient dynamics. Occurrence indices, historical records, attribute interpretations, and identity criteria supply further information. Keeping their roles explicit permits an account to be evaluated at the level where its substantive commitments enter.

The entity construction begins from indexed appearances and a declared reidentification relation. Its quotient groups appearances according to that criterion. Forward reachability alone leaves the criterion underdetermined, and directed lineage retains information that an identity equivalence can obscure. The relational-unit example shows how a membership criterion can generate collective units from configurations while also showing how a change of operation repertoire can defeat a compressed description of those units.

The relation construction distinguishes participant incidence, historical formation, and prospective comparison. Incidence descends through a participant quotient only when it is invariant under the rel-

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evant representative choices. Formation questions depend on the historical information retained by the record. Potential effects concern distinctions under declared continuations, including continuations that remain unrealized. A causal interpretation requires further comparison assumptions and evidence.

The event construction preserves occurrence identity separately from transition effects. Repeated idempotent operations can produce the same composite transformation while contributing different numbers of occurrences. Attempts, completions, and quotient-silent events therefore require records suited to the question. The event category supplies a location for those distinctions within the common dynamics.

The attribute construction specifies subjects, value domains, interpretations, and definedness. Its quotient criterion makes clear when a value is well-defined at a reduced descriptive level. Numerical interpretation adds measurement commitments beyond the existence of a value map. Classification can also enter subsequent dynamics through a declared response rule, creating a further distinction between description and social uptake.

The state construction asks which information supports selected current and future readouts. Equality of continuation observations gives a dynamically preserved equivalence under the declared operations. This established behavioral construction supplies a precise sufficiency criterion. Historical questions and entity identity can require distinctions that predictive sufficiency omits.

The process construction retains ordered occurrences and their intermediate states. Its reductions to products, transformations, and endpoints preserve different information. Segmentation, duration, interruption, and prefix feasibility require additional records when they form part of the inquiry. The usefulness of a composite effect is assessed together with the process questions it leaves unresolved.

The formal developments also repair several tempting shortcuts. The exact composition of collapse sets involves a preimage of the later collapse, which prevents an unjustified additive count. Positive-future equivalence differs from a comparison that includes the present observation. A family of internally consistent descriptive regimes can fail to preserve distinctions across a regime switch. A probabilistic quotient requires equal transition masses into each block, extending the deterministic preservation condition through an established finite-state result.

The cooperative-agreement illustration connects the categories in a complete finite action. Its twelve nonempty-word transformations are derived through their normal forms. The example distinguishes order effects, jointly enabling operations, historical alternatives, and several choices of observation. The graph illustration adds a different test: a component-level description supports edge additions while edge deletions can expose distinctions it omits. Together the examples show how a representation's adequacy depends on the operations and questions attached to it.

The philosophical position remains one of ontological suspension. The six categories are developed through the analytical work they perform and the commitments required to sustain that work. This position permits substantive criticism of a model's identity criteria, historical omissions, classification choices, and explanatory reach. It keeps the broader ontological question available for separate investigation.

A bounded application is the next evidential task. Such an application should declare its focal arrangement, category records, operation meanings, observations, and comparison questions. It should examine competing representations and preserve the discrepancies that force revision. The conditional results provide a framework for that assessment; the evidence determines which proposed interpretations survive.

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Chapter 1

Historical Conditions of the Contemporary Economy

This chapter establishes the historical ground from which Generative Relational Economics (GRE) becomes intelligible as a contemporary economic research programme. Its role within Part I is preparatory and diagnostic. Before the book reconstructs the intellectual lineages of GRE in Chapter 2 or states its disciplinary constitution in Chapter 3, the present chapter asks what historical transformations make a relational and generative reconsideration of economic life increasingly salient. The objective is therefore to locate GRE within a changing material, institutional, epistemic, and technical environment. The chapter treats economic categories, economic subjects, and economic objects as historically stabilized formations whose analytical usefulness depends on the conditions under which they are produced, recognized, and governed.

The discussion follows a historical-material orientation without reducing economic thought to a mechanical reflection of productive conditions. Economic concepts emerge within relations among productive forces, institutions, law, administrative practice, scientific techniques, political norms, and historically specific problems of coordination and allocation. Categories such as labor, capital, property, firm, household, scarcity, and allocation acquired particular analytical force because modern economic orders made corresponding subjects, resources, and transactions increasingly legible and actionable. Entity-centered and allocation-centered approaches therefore appear in this chapter as historically successful abstractions with identifiable scope conditions. Their historical success forms part of the explanation for GRE's emergence, because a new framework has to account for the achievements of inherited abstractions as well as the situations in which those abstractions become strained.

The chapter develops its argument through three connected movements. Sections 1–7 reconstruct the historical formation of economic categories, economic problematics, modern institutional entities, allocation mechanisms, and differentiated sources of economic power. Sections 8–18 then follow the expansion of relational production through organizational interdependence, transnational networks, digital mediation, artificial intelligence, changing forms of scarcity, capability asymmetry, symbolic abundance, and the destabilization of inherited economic subject positions. This middle movement gradually shifts the analytical focus from

entities considered in relative isolation toward relations that constitute subjects, distribute capacities, and alter future possibilities. Sections 19–27 examine the scientific, computational, evidential, political, legal, and institutional conditions that make richer relational and generative analysis increasingly feasible, while also identifying the epistemic and governance limits that accompany this expansion of analytical capacity. Sections 28–29 synthesize these developments into an account of the historical opening, possibilities, and limits of GRE.

A central distinction throughout the chapter concerns the difference between relational importance and generative importance. Economic life has always depended on relations. The contemporary issue is that more of what matters economically is becoming difficult to understand through recipient-level states, isolated transactions, or stable entity boundaries alone. Relations can organize access, recognition, dependence, knowledge, authority, and productive coordination; they can also transform the capacities of the participants and the conditions under which later relations become possible. Generative analysis begins when the object of inquiry includes these downstream transformations: the production of new subjects, capabilities, constraints, institutional forms, option spaces, and transformation rules. GRE therefore enters the chapter gradually, after the historical and institutional conditions that motivate this extension have been reconstructed.

The same historical transformations that enlarge the relevance of relational and generative analysis also enlarge the risks of overclaiming. Digital infrastructures increase observability while creating new possibilities for surveillance and classification. Computational capacity enables larger and more heterogeneous models while increasing dependence on representation, parameterization, and model selection. Artificial intelligence expands productive and analytical capacity while intensifying questions concerning concentration, epistemic dependence, subjecthood, and the conversion of capability asymmetry into economic power. Political participation, human-rights recognition, capability-oriented development, commons institutions, and environmental or intergenerational concerns broaden the range of economically relevant relations and values, while preserving normative plurality. The chapter therefore treats technical possibility, evidential possibility, institutional possibility, and normative justification as distinct dimensions.

The resulting historical claim is modest in form and substantial in consequence. GRE is situated within a period in which relational and generative processes have become increasingly consequential for production, allocation, subject formation, value creation, knowledge, and power, while contemporary analytical infrastructures make those processes more accessible to systematic inquiry. This conjunction supplies neither a proof of GRE nor a prediction that economics must converge toward it. It establishes a problem-space in which GRE can be developed, compared with existing theories, tested against evidence, and revised through later inquiry. The next chapter turns from these historical conditions to the intellectual lineages and theoretical resources through which such a programme becomes conceptually possible.

1.1 Material Conditions of Economic Thought

This section establishes the historical-material premise of the chapter. Its role is to explain how economic categories, analytical objects, and preferred abstractions acquire their scope within historically specific social orders. The objective is narrower than a general philosophy of economic knowledge: the discussion identifies material, institutional, and epistemic conditions that make particular forms of economic reasoning possible, useful, and credible at particular moments. The argument proceeds in five stages. It first treats economic categories as historical formations; it then considers how productive capacities alter the practical and epistemic environment of inquiry, how relations of production become stabilized through institutions, how abstraction depends on historically available techniques of representation, and how the objects recognized by economics can change with these conditions. The method is historical and interpretive. Several established traditions are used as partial resources for specifying the problem, while the chapter keeps their stronger ontological and teleological commitments open for later examination.

The guiding position is that economic thought develops within the same world it seeks to describe. Changes in production, administration, law, measurement, communication, and institutional organization therefore have a double relevance: they alter economic life, and they alter the evidence, categories, and representations through which economic life becomes intelligible. Marx's materialist formulation is important for the first dimension because it connects productive forces, relations of production, and forms of social consciousness while locating legal and political forms within a wider material configuration (Marx 1859). Historical studies of quantification and statistics are important for the second dimension because they show that objectivity, classification, and measurement acquire authority through specific institutional settings and practical demands (Porter 1995; Desrosières 1998). GRE takes these contributions as reasons to historicize its own concepts. A theory that treats institutions, subjects, and values as generated within relations should also expect its categories to bear traces of the historical conditions under which they became thinkable.

1.1.1 Economic Categories as Historical Formations

The first analytical task is to distinguish the recurrence of an economic phenomenon from the historical stability of the category used to describe it. Exchange, provisioning, obligation, accumulation, scarcity, and coordination occur across very different social formations. Their recurrence leaves open whether the same analytical category has the same extension, institutional support, or causal role in each setting. A category such as labor, property, market, capital, household, or economy becomes analytically determinate through a historically specific configuration of practices, institutions, legal forms, measurement procedures, and relations among participants. Historical ontology provides a useful philosophical vocabulary for this point because concepts and objects can emerge together with new styles of reasoning and new practices of classification (Hacking 2002). The implication for GRE is methodological: historical inquiry concerns the formation and stabilization of an economic object together with the vocabulary and practices through which that object becomes describable.

Marx's critique of political economy offers an early and influential formulation of this historical specificity. In the 1859 Preface, relations of production are linked to a definite stage in the development of material productive forces, and legal and political forms are treated as historically connected with that economic structure (Marx 1859). The relevance here lies in the mode of inquiry. Stage claims and teleological implications associated with later readings of historical materialism remain separate questions. Economic categories acquire their content within determinate social relations. Capital, for example, is analytically different from a generic stock of useful objects because the category refers to a structured relation among property, production, labor, exchange, and accumulation. The same discipline applies to categories that appear more neutral. A household, a firm, a worker, or a market becomes an analytical unit through institutional and representational practices that determine which relations are treated as internal, external, relevant, or invisible.

Polanyi's historical account strengthens this point from a different direction. His analysis of nineteenth-century market society treats the expansion of market relations as part of a historically specific reorganization of economic and social relations (Polanyi 1944). This perspective matters for GRE because it shifts attention from the mere presence of exchange to the organization of exchange within a wider relational order. A market category may be analytically adequate in one domain and much less adequate when generalized across activities organized by reciprocity, household provision, public obligation, care, or other institutional forms. Historical specificity therefore constrains both the object under analysis and the permissible range of abstraction.

The historical character of categories also applies to the category of "the economy" itself. Mitchell reconstructs the modern understanding of the economy as a bounded totality of production, distribution, and consumption as a product of a mid-twentieth-century transformation in economic representation (Mitchell 1998). This example is important because changes in economic theory can accompany changes in the scale and boundary of the object itself. Once a national economy is represented as an integrated totality, questions about aggregate output, demand, employment, growth, and management become newly central, while many relations remain outside the principal frame. The formation of an economic category can therefore be an epistemic gain and a selective construction of visibility at the same time.

GRE adopts this historical stance while preserving standards of analytical adequacy. Categories can be more or less adequate to the relations they are used to analyze, and historically formed categories can still identify durable mechanisms or recurrent structures. The relevant discipline is to separate analytical usefulness from presumed timelessness. A category earns its place through the work it performs in a specified relational and historical domain, and its continued use remains open to revision when the domain, evidence, or relations change.

1.1.2 Productive Forces and Forms of Economic Knowledge

The second analytical task is to identify how transformations in productive capacity alter the environment in which economic knowledge is produced. Productive forces are used here in a broad historical sense that includes material techniques,

energy systems, transport, communication, computational capacity, organizational techniques, and the skills through which production can be coordinated. Their development changes the practical problems that demand explanation and the epistemic possibilities available for explaining them. GRE treats the relation between productive capacity and theory as historically mediated and contingent. Marx's formulation remains useful because it directs attention to the relation between changing productive capacities and changing relations of production while leaving room for more specific mechanisms through which knowledge responds (Marx 1859).

Changes in productive capacity can affect economic knowledge through several channels. New forms of production can generate new contractual relations, organizational units, and coordination problems. Changes in transport and communication can enlarge the spatial scale at which economic activity is coordinated. Changes in recording and computation can alter temporal resolution, making processes observable continuously or at shorter intervals. Productive development can also create new evidential infrastructures. Accounting systems, censuses, surveys, standardized classifications, and computational records participate in determining which economic differences can be aggregated, compared, and acted upon.

The history of quantification makes this point especially clear. Porter argues that the authority of quantitative objectivity developed partly in response to institutional demands for impersonal and standardized judgment across settings such as government, business, engineering, and social inquiry (Porter 1995). Desrosières reconstructs statistical reasoning through the history of classification, coding, aggregation, correlation, and modeling, emphasizing the conventions through which heterogeneous cases become comparable (Desrosières 1998). These histories place measurement inside the institutional history of economic knowledge. Measurement practices can become part of economic reality because decisions, eligibility, budgets, targets, and expectations are organized around the quantities they produce.

This observation is central to the historical possibility of GRE. Earlier economic thought analyzed relations with the conceptual and technical resources then available. Contemporary computation changes the tractability of relational questions by making large networks, longitudinal records, higher-order interactions, and multiscale simulations technically accessible. A relation-centered or generative analysis therefore has a historical condition of possibility in the development of computational and evidential infrastructures, while its concepts retain analytical content beyond the infrastructures that support their investigation. Contemporary productive forces enlarge the possibility of GRE by making certain relational and generative questions more systematically researchable than under earlier technical conditions.

The same development creates new epistemic risks. Expanding measurement can encourage the identification of an object with its measurable manifestation. A productive system may become legible through variables that are administratively stable while remaining partial descriptions of its relational structure. Large computational representations can intensify this tendency by creating an appearance of completeness through scale. GRE therefore treats technical capacity as an expansion of possible inquiry accompanied by a stronger requirement to distinguish relational reality, manifestation, and representation. Productive forces transform both the reach of economic knowledge and the forms of error that economic knowledge can institu-

tionalize.

1.1.3 Relations of Production and Institutional Form

The third analytical task is to connect economic relations with the institutional forms that stabilize them. Relations of production concern organized positions in production, access to resources, authority over decisions, claims on output, and the conditions under which participants enter, remain within, or leave a productive arrangement. These relations become durable through legal, organizational, administrative, cultural, and infrastructural forms. Institutional form therefore participates in constituting the economic relation and the terms under which that relation can be recognized.

The materialist tradition provides one route into this problem by linking property relations and relations of production with stages of productive development (Marx 1859). Polanyi provides another by showing that market society depended on institutional transformations that reorganized the relation between economic exchange and wider social life (Polanyi 1944). Read together while preserving their differences, these approaches support a modest claim useful to GRE: productive activity is mediated by historically specific institutional arrangements, and changes in those arrangements can transform the economic meaning of otherwise similar acts. The transfer of an object, the performance of labor, or the provision of care can occupy different economic positions depending on property rules, contractual status, household organization, public provision, professional classification, and institutional recognition.

Institutional form also affects the scale at which economic entities appear coherent. A corporation can be treated as a unit in accounting, law, taxation, and contract because multiple internal relations are condensed into a recognized organizational person. A household can appear as a consumption unit, a care relation, a property-sharing arrangement, or an internally differentiated organization depending on the institutional and analytical frame. The same nominal entity can therefore support multiple relational descriptions. GRE later develops this point as a problem of economic architecture; its historical implication belongs here because the apparent stability of entities is partly an achievement of institutional form.

The relation between institution and economic knowledge is recursive. Institutions stabilize categories, and categories feed back into institutions. Once an administrative system recognizes a class of worker, firm, asset, household, industry, or transaction, the category can organize reporting, eligibility, taxation, regulation, contracting, and comparison. Desrosières' history of statistical classification is relevant because classification and encoding are practical operations that help create standardized populations for analysis (Desrosières 1998). Hacking's historical ontology supplies a broader philosophical formulation: classifications and styles of reasoning can participate in the historical emergence of the objects to which they refer (Hacking 2002). In economic life, institutional categories can therefore become causally effective while remaining partial representations of the relational realities they organize.

GRE approaches institutional form through two linked concerns. Stabilization concerns the rules, classifications, infrastructures, and expectations that make a relation durable enough to function as an economic object. Transformation concerns changes

in those supports that alter the relation itself. This dual focus treats institutions as historically generated relational arrangements that condition later economic action while remaining open to reproduction, contestation, and change.

1.1.4 Economic Abstraction under Historical Constraints

The fourth analytical task concerns abstraction. Abstraction is constitutive of economic inquiry because comparison, aggregation, and explanation require some differences to be suppressed. The historical question concerns which abstractions become credible, operational, and institutionally consequential under particular conditions, together with the relations that disappear when those abstractions are generalized beyond their domain of adequacy.

Quantification provides a clear example. A numerical category can coordinate judgment across distance by replacing local variation with standardized comparison. Porter emphasizes that quantitative objectivity gained authority partly because it could support impersonal forms of decision under institutional conditions in which reliance on individual discretion was difficult or contested (Porter 1995). Desrosières shows that statistical reasoning depends on conventions of equivalence through which heterogeneous cases are classified and made comparable (Desrosières 1998). These accounts reveal abstraction as an institutional achievement. A statistical aggregate becomes useful because differences judged irrelevant to a task have been suppressed in a repeatable way.

Economic abstraction is constrained by the historical availability of such operations. A national aggregate presupposes classifications, territorial boundaries, reporting systems, institutional capacities, and conventions through which dispersed activities can be treated as commensurable. Mitchell's account of the emergence of "the economy" demonstrates how representation helped establish a national economic totality as an object of expertise and intervention (Mitchell 1998). The abstraction made aggregate economic management thinkable, and the gain depended on a selective boundary around the relations represented. Every successful abstraction therefore establishes an analytical field together with a remainder.

For GRE, the remainder has methodological importance. Entity-centered accounting can be highly effective for questions concerning ownership, liability, taxation, or the direct recipient of a transfer. The same abstraction can be insufficient when the research question concerns how a transfer changes trust, dependence, coordination, knowledge, or future relational capacity. A graph representation may reveal connectivity while suppressing legal meaning; an ethnographic reconstruction may recover meaning while offering weak estimates of prevalence; a macroeconomic aggregate may represent total activity while hiding the distribution of relational conditions that generated it. The appropriate response is explicit specification of the abstraction's object, excluded differences, and historical conditions of usability.

This perspective also changes the interpretation of theoretical disagreement. Two economic theories can appear to conflict because they abstract at different scales, stabilize different objects, or preserve different relations. A theory centered on individual choice and a theory centered on institutions may produce incompatible descriptions when each is treated as complete, while still identifying real structures at

different levels. GRE later develops translation among theories as a distinct research programme. The material point established here is prior: abstraction is historically conditioned, and theoretical categories should be evaluated partly by the relations they preserve and the relations they suppress.

1.1.5 Transformation of Economic Objects across Historical Periods

The final analytical task draws the preceding arguments together into a historical view of changing economic objects. Economic history includes changes in quantities and institutions, and it also includes changes in what can appear as an economic object in the first place. New forms of production, administration, measurement, and political organization can stabilize entities and aggregates absent from earlier analytical languages or differently organized within them. Hacking's account of historically emergent concepts and objects provides a general philosophical frame for this possibility (Hacking 2002). Mitchell's reconstruction of the twentieth-century emergence of "the economy" provides a specifically economic example in which a new bounded object of macroeconomic representation became available to expertise and intervention (Mitchell 1998).

This transformation concerns relational visibility and institutional coordination. Activities later assembled into a national economy existed before the aggregate became a dominant object of analysis. The historical change lay in the representational and institutional configuration through which those activities could be organized as one object, measured through common categories, and treated as a target of coordinated intervention. A similar caution applies to newer objects. Data, attention, platform intermediation, algorithmic labor, knowledge infrastructures, and artificial productive capacity can become increasingly salient to economics because productive relations and measurement systems make their economic effects more visible and more consequential. Their appearance as economic objects therefore reflects both underlying changes in relations and changes in the apparatus through which those relations are represented.

The historical transformation of objects has two consequences for GRE. First, the field should expect its own object list to remain open. Relations, capacities, constraints, value forms, and generative possibilities that are analytically peripheral today may become central under different productive and institutional conditions. Second, economic theory should preserve the historical provenance of its categories. A concept developed for industrial wage labor, territorially organized markets, or nationally bounded accounting may continue to be useful under digital and transnational conditions, yet its range of adequacy requires renewed examination when the relations denoted by the term change. Historical continuity of terminology can conceal transformation in the underlying relational structure.

The historical-material argument developed in this section therefore establishes a limited premise: economic categories and objects are historically conditioned, and transformations in productive forces, institutional relations, and representational capacities can change both the economy and the forms of knowledge through which it becomes intelligible. The subsequent sections examine how modern entity-centered economic structures were historically stabilized, how digitalization and artificial in-

telligence strain some inherited abstractions, and why contemporary scientific and computational conditions create a specific opening for relational and generative economic analysis.

1.2 Genealogy of Economic Problematics

This section reconstructs a selective genealogy of the problems that have organized modern economic inquiry. Its role is to show how the center of economic analysis has shifted as productive arrangements, institutions, and techniques of representation changed. The objective is analytical rather than encyclopedic: the discussion follows five recurring problem-fields—wealth and exchange, production and division of labor, labor and capital, allocation and welfare, and information and institutions—and examines how each made particular economic relations visible while placing others in the background. The method is genealogical and comparative. Canonical works are used as indicators of changing problem-spaces, without treating the history of economics as a linear succession in which one problematic simply replaces another. Earlier questions persist, are reformulated, and often return inside later frameworks with altered meanings.

A genealogy of problematics differs from a chronology of doctrines. Chronology asks which theory came first and which school followed. Genealogy asks what had to become practically consequential and analytically representable for a particular question to acquire disciplinary centrality. The relevant movement is therefore one of changing emphasis. Wealth remains relevant after production becomes central; production remains relevant after allocation is formalized; allocation remains relevant when information and institutions enter the analysis. What changes is the configuration of problems through which economic reality is rendered intelligible. This section prepares the later historical argument by showing that modern economics was repeatedly reorganized around newly salient relations rather than by a single permanent definition of its subject matter.

1.2.1 Wealth and Exchange

The first problematic considered here concerns the production, circulation, and composition of wealth. In early modern political economy, wealth was inseparable from questions of trade, money, revenue, taxation, and the conditions under which national production could expand. Adam Smith's *An Inquiry into the Nature and Causes of the Wealth of Nations* makes the scale of this problematic explicit in its title and organization. The opening books move from the productive powers of labor through division of labor, money, prices, wages, profits, and rent before extending the analysis to accumulation, trade, public revenue, and state expenditure (Smith 1776). The object called wealth was therefore already relationally distributed across production, exchange, class incomes, public institutions, and international commerce.

Exchange acquired analytical importance because it offered a visible interface among otherwise heterogeneous activities. Money prices, market transactions, and trade flows provided forms in which dispersed production could be compared and coordinated. Smith's analysis of money and market exchange did not reduce social

wealth to circulation alone, yet exchange supplied a tractable surface on which value, price, and distribution could be investigated. The practical importance of expanding markets reinforced this analytical role. Exchange connected local productive activity to wider systems of demand, specialization, taxation, and accumulation, making the relation between individual transactions and national prosperity a durable economic question.

Ricardo's *On the Principles of Political Economy and Taxation* sharpened this problematic by organizing analysis around value, rent, wages, profits, foreign trade, taxation, machinery, and the distribution of the social product (Ricardo 1817). The book's structure reveals a significant shift in emphasis. Wealth and exchange remain central, yet their analysis increasingly depends on the distributional relations among classes and on the conditions of production that determine rents, wages, and profits. A transaction can no longer be understood solely as an exchange between two owners; it participates in a wider distributional structure whose effects become visible only when production and class positions are included.

For GRE, the significance of this early problematic lies in the relation between visibility and abstraction. Exchange produces highly legible manifestations: prices, quantities, payments, debts, and transfers. These manifestations can be recorded, compared, and aggregated. They therefore provide a powerful analytical interface with economic reality. The same visibility can privilege relations that culminate in exchange over relations whose effects are indirect, delayed, or institutionally unpriced. Care, trust, knowledge formation, environmental reproduction, and the maintenance of social capacities may condition exchange while appearing only weakly within the transaction itself. The genealogy of wealth and exchange thus supplies an early example of a recurring theme in this book: analytically successful manifestations can organize a field of inquiry while leaving part of the generative structure outside the dominant representation.

1.2.2 Production and Division of Labor

The production problematic shifts attention from the circulation of finished goods toward the organization of productive activity. Smith's treatment of the division of labor is a canonical expression of this move. He attributes major improvements in the productive powers of labor to specialization and links the extent of specialization to the extent of the market (Smith 1776). Productivity, on this account, is already relational in a straightforward sense: the output of an individual worker depends on an organized division of tasks, the circulation of intermediate outputs, accumulated skills, tools, and a market large enough to sustain specialization.

The analytical importance of division of labor extends beyond the familiar claim that specialization raises productivity. It changes the unit through which productive capacity is understood. A worker's output cannot be read only from individual effort or skill because productivity is partly constituted by the position occupied within a differentiated productive arrangement. The pin factory is analytically important precisely because the productive effect appears at the level of coordination among tasks. Individual capacities matter, yet their economic effect depends on sequencing, complementarity, repetition, tools, supervision, and the relation between the workshop

and its market.

This transformation also introduces dependence as an economic fact. Greater specialization increases productive power while making participants more reliant on activities performed elsewhere in the system. The same relation that raises output can narrow self-sufficiency. A productive order therefore generates capacities and dependencies together. Classical political economy did not need the later language of networks or relational fields to identify this structure; division of labor made interdependence visible through the organization of production itself.

The problem of coordination follows immediately. Once production is divided, economic analysis must explain how differentiated activities become mutually compatible. Market exchange supplies one answer, managerial organization another, custom and institution others. The division of labor therefore sits at an intersection between production and coordination. It makes clear that an economy cannot be represented only as a collection of independent producers because the productivity of each participant depends on relations that organize the activity of others.

GRE later develops this point in stronger form by asking which relations generate capacities that cannot be assigned to any isolated participant. The present historical section makes a more limited claim. The rise of the production problematic already shifted economic inquiry toward arrangements in which outcomes are properties of organized relations. This prepared the ground for later theories of the firm, industrial organization, networks, institutions, and collective productive capacity.

1.2.3 Labor, Capital, and Industrial Production

Industrialization deepened the production problematic by stabilizing labor and capital as central analytical categories. Ricardo's analysis of wages, profits, and rent placed distribution among classes close to the center of political economy (Ricardo 1817). Marx's *Capital* subsequently reorganized the field around the production process of capital, including the purchase of labor-power, the labor process, surplus value, cooperation, manufacture, machinery, and modern industry (Marx 1867). The economic object under investigation became increasingly processual: capital was analyzed through accumulation and reproduction, while labor appeared both as human activity and as a socially organized relation within production.

The shift matters because industrial production makes the economic effect of institutional position difficult to ignore. The worker and the owner enter production with different claims over productive assets, different forms of dependence, and different capacities to appropriate the resulting output. These positions are sustained by property, contract, labor markets, organizational authority, and the material concentration of productive means. Industrial economic analysis therefore cannot remain at the level of exchange among formally equivalent owners. The exchange of a wage for labor-power is embedded within a productive structure that determines what each party can contribute, control, and claim.

Marx's analysis is especially important for the genealogy pursued here because it treats production relations as constitutive of the economic process rather than as external conditions surrounding exchange. Cooperation and machinery do more than raise a given worker's productivity. They reorganize the labor process, concentrate

control, alter skill requirements, and transform the relation between workers and the means of production (Marx 1867). Industrial production consequently generates new economic capacities together with new asymmetries. The productive effect of machinery belongs to a configuration involving capital investment, technical knowledge, labor organization, ownership, and markets; its distributional effects depend on the relations through which that configuration is governed.

This industrial problematic also strengthens the importance of reproduction through time. Capital must be maintained and accumulated; labor capacity must be reproduced; firms and institutions must persist; technical systems require replacement, learning, and coordination. Economic analysis therefore acquires an increasingly temporal object. Current output depends on inherited productive structures, and current investment changes the conditions under which later production occurs. The distinction between a present allocation and a future productive capacity begins to matter even before generativity is made explicit as a theoretical category.

GRE does not inherit any single classical or Marxian theory of value, class, or historical development as a complete account. The genealogical lesson is narrower and more durable. Industrial political economy made visible that economic outcomes arise within structured relations among labor, capital, technology, ownership, and organization. Those relations generate capacities and asymmetries that persist beyond the individual transaction. Later sections of this chapter examine how modern institutions stabilized these relations into recognizable economic subjects such as worker, owner, household, firm, and corporation.

1.2.4 Allocation, Distribution, and Welfare

The allocation problematic reorganizes economic inquiry around choice among alternative uses of scarce means, the distribution of resulting goods and incomes, and the evaluation of economic arrangements. Marshall's *Principles of Economics* retains the older language of production, distribution, exchange, and consumption while developing a more unified analysis around demand, supply, value, and marginal adjustment (Marshall 1890). His treatment illustrates a transition in which economic reasoning increasingly abstracts from the full historical structure of production in order to analyze choice and adjustment within a specified field of alternatives.

Robbins later gave the scarcity formulation a particularly influential methodological expression by defining the economic aspect of conduct in terms of ends and scarce means with alternative uses (Robbins 1932). The significance of this formulation for the present genealogy lies in its portability. Once the economic problem is specified through scarcity and alternative use, the same analytical grammar can travel across households, firms, public budgets, time allocation, and other domains. The gain is considerable: heterogeneous substantive problems can be represented through a common structure of constrained choice. The corresponding methodological question concerns what must already be specified before the allocation problem can be solved—the relevant ends, available means, feasible alternatives, boundaries of the decision, and the units whose welfare or claims enter the analysis.

Welfare economics made these evaluative conditions more explicit. Pigou's *The Economics of Welfare* links economic welfare to the national dividend and examines

situations in which private and social net products diverge, thereby making the relation between decentralized economic activity and social evaluation a central problem (Pigou 1920). Allocation consequently becomes more than the placement of scarce resources. It becomes a question about the criteria under which one arrangement is judged preferable to another and about the institutional conditions under which private decisions produce socially consequential effects.

This movement supplied economics with powerful tools for policy analysis because it made trade-offs expressible within comparatively standardized frameworks. Budgets could be allocated, marginal changes compared, and welfare effects discussed with greater analytical discipline. The abstraction also encouraged a recipient-centered representation of policy: resources are assigned to persons, households, firms, sectors, or jurisdictions, and evaluation asks how outcomes change for those units. Under many administrative conditions this is both necessary and effective. Legal responsibility, taxation, eligibility, accounting, and payment systems all require identifiable recipients.

The GRE problem begins where the consequences of allocation exceed the recipient representation. A transfer to a person can change household dependence, trust, mobility, bargaining power, or participation. Funding to an organization can alter internal authority, external alliances, knowledge flows, and future access to institutions. Infrastructure expenditure can generate option spaces for actors who were not direct recipients. These effects do not invalidate allocation analysis; they reveal an additional layer in which allocation acts through relational structure. The historical importance of the allocation problematic is therefore twofold. It created a highly general language for disciplined choice under scarcity, and it made increasingly visible the need to specify which consequences and relations enter the evaluative frame.

1.2.5 Information, Institutions, and Coordination

Twentieth-century economic inquiry increasingly treated information, organization, and institutions as central to coordination. Hayek's analysis of dispersed knowledge reformulated the coordination problem by emphasizing that the information required for economic adjustment is distributed across participants and is never available in fully concentrated form to a single decision-maker (Hayek 1945). The economic problem thereby acquires an epistemic dimension: coordination depends on how locally held and frequently changing knowledge enters practical adjustment.

Coase's theory of the firm introduced a complementary organizational question. If market exchange coordinates activity through prices, the existence of firms requires an account of why some transactions are organized through authority and internal direction. Coase's answer directs attention to the costs of using the price mechanism and to the boundary between market and organization (Coase 1937). The firm becomes more than a production function or legal owner of assets; it becomes an institutional arrangement that coordinates relations differently from a sequence of market contracts.

Institutional economics extends this shift by treating rules, norms, enforcement, and organizational arrangements as constitutive of economic performance. North characterizes institutions as humanly devised constraints that structure interaction

and argues that institutional change shapes economic performance through time (North 1990). This moves the coordination problematic beyond the instantaneous matching of decentralized choices. Economic action occurs within rule systems that shape incentives, transaction costs, expectations, learning, and the feasible forms of organization. History enters because institutional arrangements persist, change incrementally, and condition later choices.

The convergence of information and institutional problems expands the range of relations that economics must represent. Coordination depends on prices, yet also on authority, rules, conventions, trust, expertise, legal recognition, and infrastructures through which information can move. Different arrangements solve different coordination problems and distribute knowledge, discretion, and power differently. A price system can aggregate some dispersed information while leaving organizational knowledge local; a firm can coordinate complex tasks while concentrating authority; an institution can reduce uncertainty while stabilizing rules that later become costly to change.

This expanded problematic provides an important bridge toward GRE. The genealogy traced across this section shows successive enlargements of the economic field: from wealth and exchange, to organized production, to industrial relations among labor and capital, to allocation and welfare, and then to information, institutions, and coordination. The sequence is cumulative rather than substitutive. Contemporary economic life contains all of these problematics simultaneously, and each preserves analytical strengths developed under different historical conditions.

The implication for GRE is methodological and historical. A generative relational approach should enter this accumulated field as another language of inquiry rather than as a declaration that earlier economics studied the wrong objects. Its distinctive question concerns what becomes visible when relations are examined for the capacities, constraints, subjects, values, and future possibilities they generate. That question arises from the tensions internal to the inherited problematics themselves: exchange depends on production; production depends on coordination; allocation changes relations; institutions shape feasible action; and information is distributed through structures that themselves evolve. The remaining sections of Chapter 1 reconstruct the historical order in which these relations became increasingly consequential and increasingly difficult to treat as fixed background conditions.

1.3 Industrial Modernity and the Modern Economic Order

This section reconstructs the institutional architecture that made the modern economic order simultaneously productive, administratively legible, and analytically tractable. Its role in the chapter is to connect the genealogy of economic problematics developed in Section 1.2 with the later construction of recognizable economic subjects and entities. The objective is to identify the historical configuration in which industrial production, wage labor, property, firms, markets, and states became mutually reinforcing components of economic organization. The discussion proceeds through five dimensions: material production and scarcity, wage labor and social reproduction, property and productive assets, firms and administrative organization,

and the coordination of market and state. The method is historical and institutional. The section does not treat industrial modernity as a single globally uniform stage; it uses the term for a family of arrangements whose concrete forms varied across jurisdictions and periods while sharing several recurrent organizational features.

The central analytical point is that the modern economic order stabilized relations that could increasingly be represented through identifiable entities, contracts, accounts, incomes, assets, and administrative categories. Industrial production concentrated productive means and coordinated differentiated labor. Wage relations connected participation in production to monetary income. Property regimes stabilized claims over productive assets. Firms organized activities internally through authority and administration. States supplied legal, fiscal, infrastructural, and statistical conditions within which markets could operate at expanding scales. These arrangements did more than support production. They helped determine which economic subjects became visible, which claims could be administered, and which flows could be represented as movement among recognized units. The later entity-centered architecture of allocation emerged from this institutional history rather than from a purely methodological preference.

1.3.1 Industrial Production and Material Scarcity

Industrial production altered the relation between productive capacity and material organization by concentrating machinery, energy, fixed capital, labor, and technical knowledge within increasingly coordinated processes. Marx's analysis of machinery and modern industry treats mechanized production as a reorganization of the labor process rather than as a simple addition of more productive tools (Marx 1867). The relevant historical development for GRE is the growing dependence of output on combinations of assets and relations whose productive effect could not be assigned to isolated participants. Machinery required capital investment, maintenance, energy, technical knowledge, supplies, coordinated labor, and access to markets. Industrial capacity therefore existed in organized configurations before it appeared in the output attributed to a firm, sector, or worker.

Material scarcity remained a central organizing condition within this order. Productive assets, energy, land, raw materials, transport capacity, working time, and financial means could not be expanded without cost or delay. Industrial organization responded by concentrating resources, improving throughput, extending specialization, and creating institutions capable of coordinating larger stocks and flows. The economic importance of scarcity consequently attached not only to final consumption goods but also to access to the productive conditions through which future goods could be generated. A machine, factory site, transport connection, patent, or stock of working capital mattered because it conditioned later production. The industrial order therefore strengthened the distinction between current possession and productive capacity.

Scarcity also became increasingly mediated by infrastructure. Railways, ports, warehouses, energy systems, urban utilities, and communication networks changed the effective availability of resources by altering distance, timing, reliability, and scale. A material resource could be physically present while remaining economically

inaccessible because transport, finance, legal permission, or organizational coordination was absent. Conversely, infrastructure could transform distant resources into practically available inputs. The economic meaning of scarcity was therefore relational even where the scarce object was material: availability depended on the configuration connecting the resource to those capable of using it.

This configuration helps explain why industrial economics could profitably abstract toward measurable inputs and outputs. Factories, inventories, wages, investment, prices, and physical production created comparatively legible interfaces with economic activity. Accounting and administrative practices could attach costs and claims to recognizable organizational units. The resulting abstractions were historically powerful because they corresponded to material arrangements in which production was increasingly concentrated, standardized, and measured. Their usefulness did not require every generative relation to be visible. It required enough stability that productive resources, organizations, and recipients could be treated as identifiable over the horizon relevant to management and policy.

The GRE significance of industrial materiality lies in this combination of concentration and relational dependence. Industrial production made entities such as factories and firms appear increasingly substantial while simultaneously deepening the relations on which their productive capacities depended. The entity and the relational configuration developed together. Later economic analysis inherited the entity because it was legally and administratively useful; GRE returns to the surrounding configuration because the capacity attributed to the entity was generated through it.

1.3.2 Wage Labor and Social Reproduction

Wage labor supplied one of the principal institutional links between productive participation and access to livelihood in industrial economies. Marx's treatment of labor-power makes this relation explicit by distinguishing the worker's capacity to labor from the labor performed within production and by connecting the reproduction of labor-power to the means of subsistence required for its continued availability (Marx 1867). The analytical importance of the wage relation extends beyond the wage as a price. It connects production, income, household provisioning, time discipline, mobility, bargaining position, and future participation in the labor process.

Polanyi's account of market society provides a complementary historical perspective by emphasizing the institutional transformation involved when labor, land, and money are organized through market mechanisms (Polanyi 1944). Labor is especially revealing because the object transacted in a labor market remains inseparable from the person whose activity is organized. The labor relation therefore couples a market contract to domains that exceed the transaction itself: health, family life, residence, education, social membership, and the reproduction of the capacity to work. The wage can be recorded as a payment to an individual worker, while the conditions that make labor possible are distributed across households, communities, public institutions, and infrastructures.

This distributed structure gives social reproduction a direct economic relevance. Industrial production requires renewed labor capacity across days and generations. Food, housing, care, education, health, socialization, and periods outside paid em-

ployment contribute to that reproduction through arrangements whose institutional forms vary historically. Some are purchased in markets, some are provided within households, some are organized publicly, and some are sustained through community relations. The wage relation becomes especially consequential when access to these conditions depends heavily on employment income. Employment then mediates more than contribution to production; it mediates access to a wider field of material and institutional resources.

The resulting architecture stabilizes the worker as an economic subject. Payroll systems, labor contracts, taxation, social insurance, workplace rules, and household budgets can all identify the worker as a recipient of income and bearer of obligations. This administrative clarity is historically significant. It permits production costs to be assigned, income to be taxed, entitlements to be calculated, and labor supply to be represented in aggregate. The same clarity places part of the reproductive structure outside the immediate representation. A wage record identifies the payment while saying relatively little about the household relations, care arrangements, commuting infrastructure, education, health, or social supports through which the worker remains capable of participation.

For GRE, the wage relation is therefore an early example of a relation whose economic effects propagate beyond the nominal parties to a contract. Changes in wages, employment security, working time, or workplace authority can alter household dependence, geographic mobility, care burdens, learning opportunities, and future bargaining power. The historical prominence of wage labor helped make the individual worker a practical unit of economic administration, yet the capacity represented by that worker was reproduced through a wider relational system. The distinction between recipient and generative conditions later becomes central to GRE's treatment of allocation and value.

1.3.3 Property and Productive Assets

Property regimes stabilized claims over productive assets and thereby shaped who could decide how resources were used, who could exclude others, who could transfer claims, and who could receive returns generated through production. North's institutional analysis treats property rights and other formal rules as part of the institutional structure that shapes incentives and economic performance through time (North 1990). For the present argument, the important point is that a productive asset becomes economically consequential through a relation among material control, legal recognition, organizational use, and expectations concerning future returns.

Industrial production increased the importance of this stabilization because productive means became increasingly durable, specialized, and costly. Ownership of land, machinery, buildings, inventories, and financial claims could organize access to productive opportunities over horizons much longer than a single transaction. Property therefore linked present legal claims to future streams of decision-making and income. A productive asset was valuable partly because it could be inserted into an institutional environment in which exclusion, transfer, contracting, financing, and enforcement were sufficiently reliable for long-horizon organization.

The relation between property and productive capacity also clarifies why owner-

ship and control deserve analytical separation. A legal owner may delegate operational control to managers; creditors may constrain decisions without owning the asset; regulators may determine permissible uses; workers may possess indispensable knowledge; suppliers and platforms may control access to complementary infrastructure. Industrial organization consequently produces layered claims around the same productive object. Ownership remains economically important, yet its practical effect is mediated through a configuration of rights, contracts, dependencies, and institutional authorities.

Property also contributes to the stabilization of economic boundaries. Assets can be assigned to persons, firms, households, public bodies, or other recognized entities. Accounting systems can record acquisition, depreciation, liabilities, and returns relative to those boundaries. Contracts can specify transfers across them. This improves administrative legibility and supports the representation of economic activity as flows among units with identifiable holdings. The boundary is institutionally real because claims and obligations are enforced through it, even when the productive process itself crosses that boundary through labor relations, supply chains, shared infrastructure, finance, and knowledge flows.

GRE later develops a relational account of ownership, control, access, and allocation in greater detail. At this historical stage, the relevant result is that property helped make productive resources administratively attachable to entities while organizing the relations through which those resources could generate future value. The institutional success of entity-centered representation therefore rested on relational arrangements that stabilized entities sufficiently for ownership, contracting, and accounting to operate.

1.3.4 Firms and Administrative Organizations

The industrial firm gave durable organizational form to coordination that could not be represented adequately as a sequence of isolated exchanges. Coase's analysis begins from precisely this problem: market exchange coordinates through the price mechanism, while the firm coordinates some activities through internal direction because using markets also entails costs (Coase 1937). The firm therefore marks an institutional boundary across which the dominant mode of coordination changes. Prices remain important outside and within the organization, yet authority, routines, roles, schedules, budgets, technical standards, and managerial judgment coordinate many productive relations internally.

This organizational form expanded the range of activities that could be planned across time. Capital investment, hiring, training, procurement, production sequencing, inventory, quality control, sales, and finance could be coordinated through administrative structures that persisted beyond individual contracts. The firm became an economic subject because law, accounting, taxation, and organizational practice treated it as a continuing unit capable of owning assets, entering contracts, receiving revenue, bearing liabilities, and employing workers. Its continuity depended on relations among participants, yet the organization could be represented as an entity for many practical purposes.

Administrative organization also transformed information. A large productive pro-

cess requires knowledge to be distributed among specialized roles while remaining coordinated sufficiently for collective action. Records, reports, budgets, plans, technical specifications, and chains of authority create channels through which local knowledge is translated into organizational decisions. Some knowledge remains tacit or local, and some is formalized into procedures and indicators. The organization therefore does not merely collect information; it structures which information can travel, who is authorized to interpret it, and which representations acquire decision-making force.

This point links the firm to the broader genealogy of coordination developed in Section 1.2. Hayek's account of dispersed knowledge emphasizes the difficulty of concentrating the information relevant to economic adjustment (Hayek 1945). The firm does not eliminate that difficulty. It creates another coordination regime in which some decisions are internalized, some knowledge is formalized, and some authority is concentrated. Market and organization consequently represent different relational arrangements for coordinating heterogeneous knowledge and activity rather than mutually exclusive forms of economic order.

The GRE relevance of the firm lies in the contrast between entity manifestation and relational constitution. The firm is sufficiently stable to sign a contract, own an asset, receive funding, report profit, and appear as a node in administrative data. At the same time, its capacities depend on internal authority, cooperation, knowledge flows, routines, worker relations, supplier relations, finance, law, and infrastructure. Treating the firm as an entity is therefore often operationally indispensable. Treating the entity as analytically self-sufficient obscures the relations that generate its capacities and determine how an intervention directed at the firm propagates through the surrounding system.

1.3.5 State, Market, and Economic Coordination

Industrial modernity joined market coordination to a dense institutional architecture of law, public authority, infrastructure, taxation, monetary organization, administration, and social provision. Polanyi's historical account is especially useful here because it treats market society as institutionally produced and politically sustained rather than as the spontaneous expansion of exchange alone (Polanyi 1944). North similarly places economic performance within rule systems that structure incentives and reduce or redistribute uncertainty (North 1990). The modern market therefore operates through institutional conditions that define property, contract, legal personality, money, enforcement, and permissible forms of organization.

The state participates in this order through several analytically distinct roles. It recognizes and enforces legal claims; raises and spends revenue; builds and regulates infrastructure; produces statistics and administrative classifications; supplies or finances services; defines corporate, labor, and property forms; and intervenes in crises. These activities vary widely across historical periods and political systems. Their common relevance lies in the production of conditions under which dispersed economic actors can coordinate over scales that exceed local relations. State capacity can enlarge markets by standardizing rules, currencies, transport, information, and enforcement even when many transactions remain privately organized.

Market coordination addresses a different dimension of the same problem. Hayek's account of the price system emphasizes its capacity to communicate information relevant to adjustment when knowledge is dispersed among many participants (Hayek 1945). Prices can coordinate decentralized decisions without requiring a central actor to possess all local knowledge. Their informational economy is powerful precisely because the system does not attempt to reproduce every relation or circumstance in a complete representation. A price condenses some conditions into a signal useful for action while leaving many causal and normative dimensions outside the signal.

The institutional and market dimensions of coordination therefore operate through different forms of selective representation. Law translates heterogeneous social relations into rights, duties, persons, and claims. Administration translates them into categories, records, eligibility conditions, and budgets. Markets translate some dispersed conditions into prices and contracts. Firms translate productive complexity into organizational roles, accounts, and plans. Each representation supports coordination by reducing complexity, and each leaves a remainder that can become economically consequential when conditions change.

This selective structure is the historical bridge to the next sections of the chapter. Industrial modernity did not merely produce more goods or larger organizations. It stabilized a recognizable architecture of workers, owners, households, firms, assets, contracts, markets, and states. These units became economically real through persistent relations and institutionally powerful manifestations. They could be taxed, regulated, funded, counted, contracted with, and made responsible. The resulting order made entity-centered economic analysis unusually effective because economic administration itself increasingly operated through entities.

The same historical achievement establishes the limit that GRE later addresses. Coordination through entity boundaries and compressed representations works best when the relevant entities remain sufficiently stable and when the consequences of action can be assigned within the chosen boundary and horizon. As production becomes more networked, knowledge-intensive, transnational, platform-mediated, and dependent on distributed infrastructures, those conditions become less secure. The next sections therefore examine how modern economic subject positions and institutional entities were constructed before turning to the contemporary transformations that place increasing pressure on the architecture industrial modernity stabilized.

1.4 Historical Formation of the Economic Subject

This section reconstructs the historical formation of the principal subject positions through which modern economic life became administratively and analytically intelligible. Its role in the chapter is to move from the institutional architecture of industrial modernity to the actors that this architecture made recognizable as bearers of labor, property, consumption, responsibility, and organizational capacity. The objective is to show that the worker, owner, consumer, household, firm, and corporation acquired economic salience through historically specific relations and institutions rather than entering economic analysis as timeless units. The discussion proceeds

through five subject positions and uses a historical-institutional method: each position is examined through the relations that stabilize it, the capacities and claims attached to it, and the forms of representation through which economic analysis and administration can act upon it.

The term *economic subject* is used here in a deliberately limited sense. It designates a configuration that can occupy an economically consequential position, enter recognized relations, receive or control resources, bear claims or obligations, and become a unit of observation or intervention. The term therefore concerns economic standing rather than a complete theory of personhood or agency. A biological person may occupy several economic subject positions at once; an organization may acquire a durable economic position despite lacking the experiential properties associated with a human subject. This distinction permits the historical analysis to remain compatible with the ontological restraint developed later in the book.

Industrial modernity strengthened the stability of several such positions simultaneously. Wage labor made the worker legible through employment and remuneration. Property institutions stabilized the owner as a bearer of enforceable claims. Expanding markets and demand analysis strengthened the consumer as a distinct economic role. Household organization linked income, care, consumption, and reproduction. Firms and corporations condensed collective productive relations into continuing organizational subjects. These positions overlap in practice, yet their differentiation made modern economic administration unusually capable of assigning income, liability, entitlement, taxation, and policy effects to recognizable units.

1.4.1 Worker as Economic Subject

The worker became a particularly consequential economic subject through the institutional expansion of wage labor. Industrial production required large numbers of people to enter continuing relations in which labor capacity could be contracted, scheduled, supervised, remunerated, and coordinated with machinery and organizational routines. Marx's analysis of labor-power and the industrial labor process treats this relation as constitutive of capitalist production: productive activity is organized through a relation between those who control productive assets and those who sell labor-power within the production process (Marx 1867). Polanyi later emphasized the historical specificity of treating labor as if it were a commodity available to market coordination, while insisting that labor remains inseparable from the lives of the persons who supply it (Polanyi 1944).

The economic importance of the worker position lies partly in the forms of legibility that wage labor makes possible. Employment attaches income to a recognizable relation between worker and employer. Hours, wages, occupations, contracts, payrolls, and employment status create administrative traces through which labor can be taxed, regulated, insured, compared, and statistically represented. The worker can therefore appear as a unit of production and as a recipient of income at the same time. This dual standing helped make employment one of the principal institutional bridges between productive contribution and access to material resources in modern economies.

The worker position also illustrates the difference between an economic subject

and the whole person occupying that position. A person who appears in an employment relation as a worker may simultaneously be a household member, caregiver, consumer, owner of some assets, citizen, borrower, learner, or participant in a professional community. Economic administration frequently selects one of these relations because a particular institution requires a determinate role. Payroll systems need an employee; labor law needs parties to an employment relation; national accounts need categories of compensation and production. The resulting representation is operationally powerful precisely because it suppresses dimensions that are irrelevant to the immediate administrative task.

The relational constitution of the worker remains visible even within this compressed representation. Productive capacity depends on education, health, transport, care, technical infrastructure, organizational knowledge, legal protection, bargaining arrangements, and access to employment. The wage received by one worker may support several household members; a change in scheduling may alter care relations; a change in technology may reallocate authority and skill inside the workplace. The worker is therefore economically real as a stabilized subject position, while the capacities attached to that position remain generated and sustained through a wider relational field.

This historical construction becomes especially important later in the chapter when artificial intelligence and automation place pressure on employment as a mechanism of economic recognition and allocation. The relevant historical point at this stage is narrower. Modern institutions made the worker sufficiently stable and legible to serve simultaneously as a productive subject, an income recipient, a bearer of labor rights, and an object of economic measurement. That stabilization was an institutional achievement with a history, and its future transformation is therefore also historically possible.

1.4.2 Owner as Economic Subject

The owner position formed around enforceable claims to assets, resources, and the income streams associated with them. Property institutions identify a subject that may exclude others from specified uses, transfer claims, pledge assets, authorize access, and receive returns. The economic owner is therefore constituted through a relation among the claimant, the asset, other potential users, and the institutions that recognize and enforce the claim. North's institutional analysis is relevant because property and contracting arrangements operate within rule systems that structure incentives, expectations, and the security of exchange over time (North 1990).

Industrial development increased the importance of ownership by expanding the scale and durability of productive assets. Land, machinery, factories, inventories, financial claims, intellectual resources, and later corporate securities could be assigned to recognized owners and represented through accounts, registries, contracts, and balance sheets. Ownership thereby became a major interface between present control and future income. The owner could appear in economic analysis as a recipient of profit, rent, interest, or capital gain even when the productive process generating those returns depended on many relations extending beyond the owner's direct activity.

The position is internally differentiated. Ownership may coexist with delegated management, creditor claims, regulatory constraints, contractual commitments, shared ownership, or limited rights of use. An owner may hold legal title while another actor exercises operational control; several owners may share claims to the same organization; a lender may constrain asset use without becoming owner. These arrangements show that ownership is a structured bundle of recognized relations rather than a simple physical connection between a person and a thing. The stability of the subject position comes from institutional recognition of those relations and from the capacity to reproduce them through transfer, enforcement, and accounting.

Ownership also shapes the distribution of economic possibility. A productive asset can support future borrowing, investment, bargaining, mobility, inheritance, and access to organizational opportunities. The economic consequence of ownership therefore exceeds the current income attached to the asset. It can alter the owner's future action space while simultaneously affecting the access of others. This temporal dimension becomes central later in GRE's analysis of generative value, capability, and option-space transformation.

The owner position consequently provides an early example of a subject whose economic significance is relational and generative even when conventional representation is entity-centered. Administrative systems may record that an asset belongs to a named owner, and this representation is often indispensable. The effects of that ownership emerge through relations of exclusion, access, finance, production, inheritance, and institutional recognition. Section 1.5 develops the legal and administrative construction that makes these ownership relations increasingly durable and governable.

1.4.3 Consumer as Economic Subject

The consumer became a distinct economic subject as demand, choice, and the allocation of expenditure acquired greater analytical and practical importance. Marshall's synthesis of demand, supply, wants, value, and marginal adjustment gives consumption a systematic place within a unified account of economic coordination (Marshall 1890). The consumer in this framework appears as a chooser whose demands help organize production through market exchange. Later scarcity-centered formulations extended the same analytical grammar by representing economic conduct through the allocation of scarce means among alternative ends (Robbins 1932).

The rise of the consumer position depended on more than an intellectual shift in economic theory. Expanding markets, standardized goods, monetary income, retail infrastructures, advertising, credit, transport, and mass production increased the practical importance of household expenditure and individualized purchasing decisions. Prices and product categories made heterogeneous goods comparable within budgets, while market institutions provided repeated occasions on which persons could be addressed primarily through their role as buyers. The consumer therefore became both an analytical unit and an institutional target for pricing, marketing, credit, taxation, regulation, and later consumer protection.

This subject position has a characteristic abstraction. The consumer is represented through preferences, purchasing power, observed choices, or welfare effects, while

the relations that formed those preferences and capacities may remain outside the immediate model. Income depends on labor, ownership, transfers, or household relations; access depends on infrastructure and geography; preferences may be shaped by culture, information, social position, and commercial representation; credit can move purchasing power across time. A demand curve or expenditure record captures an economically meaningful manifestation while leaving many of its generative conditions unresolved.

The distinction becomes more important when consumption itself generates relations. Repeated purchases can sustain platforms and distribution networks; credit creates durable obligations; subscription models establish continuing dependence; digital consumption produces data that can be converted into commercial knowledge; consumption inside households redistributes access among members. These effects do not eliminate the analytical usefulness of the consumer. They reveal that the consumer is one stabilized position within a larger relational process.

The historical formation of the consumer therefore complements the formation of the worker and owner. Industrial modernity increasingly organized persons through several differentiated roles: contribution could be represented through work, command over assets through ownership, and access to goods through consumption. Economic policy could then act upon each role through different instruments. The later GRE problem is to understand how these roles interact, how they generate one another's capacities, and how contemporary digital systems increasingly blur their boundaries.

1.4.4 Household as Economic Subject

The household occupies a distinctive position because it joins economic subjecthood to a relational configuration that is visibly composite. Modern economic analysis and administration frequently treat the household as a unit of income, expenditure, taxation, welfare, housing, saving, and consumption. At the same time, the household contains relations of care, dependence, authority, contribution, inheritance, and intergenerational support that cannot be inferred from aggregate household resources alone. The household therefore makes especially clear how an entity-level representation can be administratively necessary while remaining analytically incomplete.

Industrial wage labor strengthened the household's role as a bridge between production and social reproduction. Wages and other incomes enter the household through members occupying positions in labor, ownership, or public transfer systems. Food, shelter, care, education, health, and time are then organized through internal relations that reproduce capacities required for future participation in economic and social life. Polanyi's account of market society is useful for locating this process historically because the expansion of labor markets placed livelihoods under market dependence while social institutions continued to mediate the reproduction of persons and communities (Polanyi 1944).

The household also became a practical allocation unit. Taxes, benefits, housing policy, social insurance, surveys, and consumption statistics frequently require a boundary within which income and need can be aggregated. Such aggregation enables public administration to compare households and distribute resources at scale.

The boundary acquires causal force because eligibility rules, tax liabilities, benefits, and legal responsibilities may depend on who counts as a member. Economic subjecthood is therefore partly generated by the institutional act of recognizing a household and assigning consequences to its boundary.

Aggregation can also conceal internal asymmetry. Two households with the same measured income may distribute time, care, consumption, control, and risk very differently. A transfer formally received by one member may alter bargaining relations among several members. Unpaid care can sustain labor-market participation without appearing as wage income. Intergenerational transfers can expand the future options of some members while limiting those of others. These possibilities show why the household is an important bridge from entity-centered economics toward relational analysis: the entity is empirically real and administratively consequential, yet the distribution of capacities within it depends on internal relations.

GRE therefore has reason to retain the household as an economic subject while refusing to treat its boundary as self-explanatory. Later chapters can ask how resources entering a household propagate through internal relations, how care and dependence generate capabilities, and how household membership affects access to institutions. The historical point developed here is that modern economic order increasingly stabilized the household as a recognizable recipient and decision unit, creating a powerful administrative representation whose relational interior remains economically consequential.

1.4.5 Firm and Corporation as Collective Economic Subjects

The firm and corporation extend economic subjecthood beyond the individual and household by stabilizing a collective organization as a continuing participant in economic relations. Coase's analysis of the firm identifies an organizational domain in which coordination occurs through internal direction rather than through a sequence of market exchanges, thereby making the boundary of the firm an economic problem in its own right (Coase 1937). The corporation adds greater durability through institutional forms that allow assets, contracts, liabilities, roles, and organizational purposes to persist across changes in particular participants.

Collective economic subjecthood depends on the capacity to act through organized relations. A firm can hire workers, purchase inputs, own or control assets, borrow, sell outputs, enter contracts, maintain accounts, and make investment decisions because internal authority and procedures translate distributed activity into organizational action. No single participant needs to perform every function. The organization acquires practical continuity through roles, routines, records, governance structures, and external recognition. Its economic agency is therefore generated through coordination among relations that are distributed across many persons and institutional interfaces.

The collective subject also produces a distinctive form of representation. Revenue, cost, profit, debt, assets, employment, and output can be assigned to the organizational boundary even though the processes generating these quantities extend through workers, suppliers, creditors, customers, regulators, infrastructures, and knowledge networks. Accounting and legal systems make the organization suffi-

ciently coherent to appear as one unit in contracts, taxation, statistics, investment, and policy. The unit is therefore neither fictitious in the ordinary sense nor analytically exhaustive. It is a stabilized manifestation of a more complex relational configuration.

This distinction matters for economic intervention. A subsidy paid to a firm may alter wages, investment, bargaining power, supplier dependence, market position, knowledge accumulation, or shareholder returns. A liability imposed on a corporation may be redistributed internally through prices, employment, contracting, or investment decisions. Entity-level policy therefore operates through collective subjects whose responses are generated by internal and external relations. The organization can remain the correct administrative recipient while relational analysis is required to understand the consequences of intervention.

The historical formation of the firm and corporation closes the section because it reveals the general pattern most clearly. Modern economic subject positions became powerful through institutional stabilization, selective representation, and repeated practical use. Worker, owner, consumer, household, firm, and corporation are heterogeneous kinds of subject, yet all can become economically real through durable participation in recognized relations. Section 1.5 turns from these subject positions to the legal, contractual, accounting, statistical, and administrative mechanisms that construct the entities through which modern economic systems allocate rights, resources, obligations, and responsibility.

1.5 Institutional Construction of Economic Entities

This section examines the institutional processes through which heterogeneous persons, organizations, assets, activities, and relations become recognizable as bounded economic entities. Its role in the chapter is to connect the historically formed economic subjects of Section 1.4 to the administrative architecture that permits modern economies to assign ownership, liability, income, taxation, reporting, eligibility, and responsibility to identifiable units. The objective is to show how legal personality, property, contract, accounting, statistics, and institutional membership jointly stabilize economic boundaries without requiring those boundaries to coincide with every relation that generates the entity's capacities. The discussion proceeds through five institutional mechanisms and uses a historical-institutional method: each mechanism is treated as a practical technology of recognition that makes an economic unit durable enough to enter law, administration, measurement, and allocation.

The term *economic entity* refers here to a recognized unit to which economically consequential attributes can be attached. Such attributes include assets, liabilities, income, expenses, rights, obligations, tax status, employment, eligibility, and reporting responsibility. This use remains compatible with the ontological restraint of GRE. Institutional recognition can make an entity relationally and causally consequential without settling the ultimate ontology of the person, organization, or collective concerned. The relevant historical achievement is the stabilization of boundaries that permit repeated action upon a unit across time.

Modern economic coordination depends heavily on this achievement. Credit re-

quires a debtor whose obligations can be identified. Property requires a bearer of enforceable claims. Contracts require parties. Accounting requires a reporting boundary. Statistics require units that can be classified and aggregated. Public administration requires membership criteria that determine who enters a category, receives a transfer, pays a tax, or bears a duty. These mechanisms operate differently, yet together they transform fluid relational configurations into operationally persistent entities. The resulting compression makes large-scale economic coordination possible while creating a recurrent analytical tension between the recognized unit and the wider relations on which its capacities depend.

1.5.1 Legal Personality

Legal personality supplies one of the strongest mechanisms for stabilizing an economic entity through time. Organizational law provides standardized legal forms through which an enterprise can hold assets, enter agreements, incur liabilities, and persist across changes in the individuals who participate in it. Hansmann and Kraakman's analysis of organizational law emphasizes asset partitioning: organizational law can separate a pool of entity assets from the personal assets and creditors of owners or managers, thereby creating a durable structure of claims around the organization (Hansmann and Kraakman 2000). This separation supports the practical treatment of the organization as a continuing economic unit.

The significance of legal personality for GRE lies in its capacity to stabilize relations into a recognizable locus of responsibility. A corporation, association, trust, or other recognized organization may contain many internal relations and participate in many external ones, yet legal form gives selected relations a persistent boundary. Contracts can be entered in the entity's name. Assets can remain attached to the organization when shareholders, managers, or employees change. Creditors can direct claims toward specified pools of assets. Courts and regulators can address the organization as a continuing bearer of rights and duties. Legal personality therefore creates temporal continuity that exceeds the continuity of any individual participant.

This institutional continuity should be distinguished from the complete economic reality of the organization. The legal entity identifies a powerful boundary, yet productive capacity may depend on workers, suppliers, public infrastructure, household reproduction, financing networks, tacit knowledge, and social trust that extend beyond that boundary. The legal unit nonetheless remains economically consequential because claims, liabilities, and decision authority are routed through it. Entity-centered analysis gains much of its practical force from this institutionally produced concentration of responsibility.

The relation between legal and economic entityhood becomes especially clear in systems of national accounting. The System of National Accounts treats institutional units as fundamental economic units capable of owning assets, incurring liabilities, engaging in transactions, and taking economic decisions on their own behalf (European Commission et al. 2009). Legal responsibility and accounting capacity are therefore closely connected to the statistical constitution of the economy. The institutional unit is useful because economic flows can be attributed to a recognizable bearer across repeated transactions and accounting periods.

Legal personality also demonstrates that economic entities can be generated through institutional recognition. The organization does not become economically significant merely because a legal label is attached to it; the label works because it reorganizes relations of ownership, liability, contracting, and enforcement. The legal form is therefore performative in an economically specific sense: recognition creates durable channels through which resources, obligations, and claims can circulate. Later GRE chapters return to this point when examining how institutional recognition can generate capacities and constraints beyond the immediate legal relation.

1.5.2 Property and Contract

Property and contract deepen entity stabilization by attaching resources and obligations to recognized parties. Property identifies who may hold, transfer, exclude, pledge, or authorize uses of an asset within a given institutional order. Contract identifies parties whose commitments can be interpreted, enforced, and carried forward through time. Together they create a relational grammar in which economically consequential claims can be assigned to named units and transferred among them.

North's account of institutions is relevant because property and contracting operate through rule systems that structure incentives, reduce some forms of uncertainty, and make repeated exchange more predictable (North 1990). Coase's analysis of the firm similarly shows that contracting and market exchange have costs and that organizations emerge partly through alternative arrangements for coordinating transactions (Coase 1937). These traditions differ in focus, yet both demonstrate that exchange depends on institutional structures that define who can commit, what can be transferred, and how agreements are sustained.

Property contributes to entity formation by linking a recognized subject to a durable set of claims over resources. Organizational law can intensify this effect through asset partitioning. Hansmann and Kraakman show that the ability to shield entity assets from the personal creditors of owners or managers supports the construction of large-scale organizations whose assets can remain committed to organizational purposes (Hansmann and Kraakman 2000). The entity thereby acquires a resource base whose continuity is institutionally protected.

Contract contributes a complementary temporal structure. An agreement links present recognition to future performance. Parties can coordinate production, finance, labor, supply, insurance, and exchange across time because obligations have a recognized bearer and an enforceable form. Contractual relations therefore extend the temporal horizon of economic organization. They also connect entity boundaries: one firm's obligation becomes another firm's claim, one household's debt becomes another unit's asset, and one employment contract links a worker position to an organizational position.

The resulting architecture makes economic activity legible as relations among entities with identifiable holdings and commitments. This architecture is analytically powerful because many economically important questions genuinely concern the distribution and transfer of recognized claims. The same architecture also compresses relational complexity. A contract records selected obligations, while leaving many

background relations unstated. Property identifies a recognized claimant, while the asset's productive use may depend on wider infrastructures and collective conditions. GRE therefore treats property and contract as real institutional structures whose analytical boundaries remain narrower than the total field of relations sustaining economic activity.

1.5.3 Accounting and Organizational Boundaries

Accounting converts organizational continuity into a recurring representational boundary. Assets, liabilities, equity, income, and expenses are recorded relative to a reporting entity, allowing economic activity to be summarized across a period and compared across periods. The reporting boundary makes a heterogeneous organizational process appear as a unit with a balance sheet, flows, and a calculable financial position. This representation supports investment, lending, taxation, governance, and organizational decision-making.

The IFRS Conceptual Framework makes the constructed character of this boundary explicit. A reporting entity can be a single legal entity, a portion of an entity, or a group of entities, and the reporting boundary therefore need not coincide exactly with legal personality (IFRS Foundation 2018). Consolidated accounts may represent a parent and its subsidiaries as one reporting entity even though several legal entities remain in existence. Combined accounts can likewise gather economic activities across organizational units when the reporting purpose requires a wider boundary.

This flexibility reveals an important methodological point for GRE. Economic entityhood is partly representation-dependent because different institutional practices may draw different boundaries around the same relational field. Legal personality, managerial control, accounting consolidation, statistical sectoring, and productive coordination can produce overlapping rather than identical entities. A corporate group may be many legal persons, one consolidated reporting entity, several operational divisions, and part of a wider supply network at the same time. Each boundary serves a different analytical and institutional function.

Accounting nonetheless gives these boundaries substantial causal force. Budgets, performance measures, debt covenants, taxation, capital allocation, and managerial evaluation are frequently organized around reported units. Once a reporting boundary is stabilized, internal and external flows are classified differently depending on which side of the boundary they occur. A transfer between subsidiaries may disappear in consolidated reporting while remaining visible in the accounts of each subsidiary. The representational boundary therefore changes which economic relations appear as internal coordination and which appear as transactions between entities.

This point provides a direct bridge from institutional construction to later GRE analysis. The entity represented in accounts is neither arbitrary nor exhaustive. It is selected for an institutional purpose, sustained through conventions and control relations, and capable of shaping decisions once established. Accounting therefore participates in the economic reality it represents: it defines operational units, channels attention, and conditions how resources are compared and allocated. The relational question is consequently not only whether the accounts are accurate, but also which relations become internal, external, visible, or invisible under the chosen boundary.

1.5.4 Statistics and Administrative Legibility

Statistical systems extend entity construction from organizations to entire economies. Large-scale administration requires units that can be counted, classified, compared, and aggregated. Households, corporations, government units, workers, industries, sectors, residents, and non-residents become statistical categories through definitions that specify membership and delimit the observations that belong together. Desrosières' history of statistical reasoning shows that classification and quantification depend on conventions that make heterogeneous cases comparable, while Porter emphasizes the institutional role of standardized quantitative procedures in producing impersonal forms of judgment (Desrosières 1998; Porter 1995).

The System of National Accounts provides a particularly clear example. It organizes macroeconomic accounting around institutional units and sectors, treating units capable of owning assets, incurring liabilities, entering transactions, and making economic decisions as the building blocks of the statistical economy (European Commission et al. 2009). Corporations, government units, nonprofit institutions, and households are then grouped according to functions and institutional characteristics. This statistical architecture permits production, income, saving, investment, assets, and liabilities to be aggregated into coherent macroeconomic accounts.

Administrative legibility emerges through similar operations. Tax systems define taxable persons and entities. Social insurance systems define contributors and beneficiaries. Business registries identify organizations. Labor statistics classify employment status and occupation. Regulatory systems distinguish sectors, ownership forms, and reporting obligations. Each system draws a boundary around the unit relevant to its task and attaches standardized attributes to that unit. The economy becomes governable partly because actors and activities can be entered into interoperable categories.

These classifications have practical consequences. Eligibility, tax liability, regulatory burden, access to programs, statistical visibility, and policy targeting can depend on categorical membership. The category therefore becomes more than a passive description. Hacking's historical work on classification is useful for understanding how classificatory practices can participate in the formation of the objects and kinds they describe (Hacking 2002). In economic administration, classification can alter incentives, organizational forms, reporting behavior, and the distribution of resources.

GRE inherits both the analytical power and the caution implied by this history. Statistical units are indispensable for large-scale comparison and coordination. Their usefulness depends on abstraction: a household or corporation must be treated as sufficiently coherent for aggregation to work. The same abstraction can conceal internal relations, boundary disputes, informal activity, cross-border structures, and dependencies that do not fit the chosen classification. Administrative legibility therefore increases the capacity to act on an economy while narrowing the dimensions that remain visible within the administrative representation.

1.5.5 Economic Recognition and Institutional Membership

Economic recognition completes the institutional construction of entities by determining which units count as members of particular economic categories and which rights, duties, resources, and observations follow from that membership. Recognition occurs through law, registration, accounting, statistics, employment, taxation, licensing, residence, organizational affiliation, and many other institutional practices. The resulting membership conditions establish who is visible to a system and in what capacity.

Institutional membership is rarely singular. A person may simultaneously be recognized as worker, taxpayer, household member, shareholder, resident, borrower, student, beneficiary, and citizen. An organization may be recognized as employer, corporation, taxpayer, regulated firm, statistical unit, contractor, or recipient of public support. Each membership relation attaches a different set of capacities and obligations. Economic subjecthood therefore becomes layered through multiple institutional recognitions rather than exhausted by one universal status.

The SNA illustrates this layering at the macroeconomic level. Institutional units are assigned to sectors and to residence categories so that transactions and balances can be organized consistently (European Commission et al. 2009). The classification is analytically productive because it creates stable membership rules for statistical aggregation. Similar logics operate in administrative systems: participation in a program or regulatory regime depends on satisfying criteria that determine whether an actor belongs inside or outside the relevant category.

Recognition can also generate economic capacity. Registration may permit an organization to open accounts, contract, receive funds, employ workers, or incur debt. Employment status may provide access to wages, insurance, pensions, or legal protections. Residence may determine access to public services or tax obligations. Institutional membership thus changes the action space available to an actor. North's treatment of institutions as constraints structuring interaction helps clarify why recognized status can alter incentives and feasible conduct (North 1990).

The generative consequence is important for the chapters that follow. An entity becomes economically durable when several systems converge in recognizing it: law attaches rights and duties, accounting draws a reporting boundary, statistics assign a category, administration records membership, and counterparties organize expectations around the resulting unit. These recognitions reinforce one another and make the entity increasingly actionable. Once stabilized, the entity can receive resources, bear obligations, appear in models, and become the target of intervention.

This institutional success explains much of the historical power of entity-centered economics. Modern economies created entities that were genuinely useful for administration because institutional systems repeatedly acted through them. The limit appears when economic effects propagate through relations that cross the recognized boundary or when important participants remain weakly recognized by the institutions that allocate resources and visibility. Section 1.6 therefore turns from the construction of entities to the historical logic of allocating scarce resources through administratively identifiable recipients.

1.6 Entity-Centered Allocation in Historical Context

The institutional construction of economic entities described in Section 1.5 made a particular form of allocation historically practical: resources could be assigned to recipients represented as persons, households, firms, corporations, public bodies, or other administratively identifiable units. This section examines the historical conditions under which recipient-centered allocation became a powerful economic abstraction. Its objective is explanatory rather than dismissive. The analysis proceeds through five steps: the formation of administrative recipients, the relation between material scarcity and allocation, the role of employment in connecting productive participation to livelihood, the relation between competitive capability and resource claims, and the limits that appear when evaluation stops at the recipient boundary. The method is historical and institutional. Entity-centered allocation is treated as an achievement of modern economic organization whose usefulness depends on the social and administrative conditions that made recipients sufficiently stable, comparable, and actionable.

1.6.1 Administrative Recipients

Allocation requires a recipient that an institution can identify before resources can be transferred, taxed, credited, insured, subsidized, or otherwise assigned. Modern economic administration therefore depends on categories that answer a practical question of membership: which unit is entitled, liable, responsible, or eligible within a given scheme. The institutional units of national accounting provide one explicit example. The System of National Accounts organizes production, income, saving, assets, and liabilities around units capable of owning assets, incurring liabilities, making economic decisions, and entering transactions (European Commission et al. 2009). Similar recipient structures appear in taxation, social insurance, business registration, corporate finance, public procurement, and household-based benefit systems.

The administrative recipient is consequently a historically stabilized interface between a relational economy and an allocative act. A transfer rarely reaches an abstract individual in isolation. It reaches a legally or administratively recognized unit whose identity has already been produced through registration, residence, employment, ownership, household membership, organizational status, or another institutional relation. The recipient category compresses these relations into a unit upon which an administrative system can act.

This compression yields substantial practical advantages. A public authority can assign a benefit to a registered household without reconstructing every relation within the household. A bank can lend to a corporation whose legal and accounting boundaries are sufficiently stabilized for liability and repayment to be represented. A firm can pay wages to an employee whose contractual status identifies both the payer and the recipient. Large-scale allocation becomes feasible because institutional systems can repeatedly address the same kinds of units without reproducing the whole relational history that makes those units possible.

Recipient construction also standardizes accountability. An allocation can be recorded as having been made to a defined unit; the unit can be asked to report,

repay, comply, or demonstrate eligibility. The reporting-entity logic discussed in the preceding section illustrates how flexible such units can be: accounting may construct a reporting boundary around one legal entity, part of an entity, or several entities when the institutional purpose requires it (IFRS Foundation 2018). Administrative allocation operates through the same general principle. The actionable unit is selected according to the function of the allocative regime.

The success of this architecture explains why recipient-centered analysis became deeply embedded in economic reasoning. Once recipients are legally, statistically, and administratively stabilized, flows among them can be represented with exceptional clarity. Income is received by households, investment is made by firms, taxes are collected from persons and organizations, transfers are paid to beneficiaries, and assets are assigned to owners. The representation is institutionally grounded rather than merely convenient. Modern economies developed extensive infrastructures that made entity-level flows real objects of administration.

1.6.2 Scarce Resources and Allocation

The allocative significance of stable recipients increased under conditions in which material resources, income, productive assets, public budgets, and institutional opportunities were treated as scarce relative to competing claims. Robbins' influential formulation of economics around scarce means with alternative uses made this structure explicit at the disciplinary level (Robbins 1932). Scarcity does not by itself determine who should receive a resource, yet it creates the recurrent requirement to choose among possible uses and recipients.

Entity-centered allocation offered a tractable response to that requirement. Once a scarce resource could be represented as a quantity and potential recipients could be represented as discrete units, allocation could be organized through prices, wages, contracts, budgets, eligibility rules, credit decisions, taxation, transfers, or administrative assignment. The institutional problem acquired a common form even when the mechanisms differed: a bounded quantity was distributed among recognized claimants.

This form was especially compatible with the accounting and statistical infrastructures of industrial modernity. Monetary valuation allowed heterogeneous resources to enter common ledgers; property rules identified control; organizational accounts located assets and liabilities; state statistics aggregated households and firms; and administrative records linked claims to recognized recipients. Allocation could therefore be represented through flows that entered and left defined units. The entity-centered picture matched the operational needs of institutions that had to decide, record, compare, and audit distributions at scale.

Welfare economics extended the allocative problem from private choice to the evaluation of social arrangements. Pigou's analysis of economic welfare connected economic assessment to the national dividend and to divergences between private and social net product (Pigou 1920). Whatever normative criterion is adopted, such analysis presupposes some representation of who receives benefits and bears costs. Recipient categories thereby enter both administrative action and evaluative reasoning.

The historical importance of this architecture should be separated from a claim

of timeless necessity. Material scarcity remains economically consequential, and recipient-level distribution remains indispensable in many domains. A household requires income, a firm requires financing, and a public program requires rules for eligibility. The historical question concerns the scope of the abstraction. Recipient-centered allocation became powerful because the major resources and institutions of modern economic organization could often be represented through identifiable owners, workers, firms, taxpayers, and beneficiaries. The same abstraction becomes less complete when the economic consequence of an allocation depends heavily on relations that extend beyond the recipient unit.

1.6.3 Employment and Access to Livelihood

Employment became one of the central institutional relations connecting productive participation to command over resources. Under wage labor, the employment relation links the contribution of labor to a monetary claim that can be exercised elsewhere in the economy. Marx's analysis of labor-power and the wage relation places this institutional form within the production process of capital, while Polanyi's historical account emphasizes the broader social transformation involved in organizing labor through markets (Marx 1867; Polanyi 1944). The importance of employment for allocation follows from its position between production and livelihood.

For the worker, wage income supplies purchasing power. For the firm, employment identifies a recognized contributor within an organizational structure and a recurrent claim on organizational resources. For public administration, employment status can become an observable category used in taxation, insurance, pensions, labor regulation, and statistical classification. The employment relation therefore coordinates several institutional systems at once. Productive participation, monetary income, legal status, organizational membership, and administrative recognition become partially coupled through one relation.

This coupling makes employment more than a production arrangement. In societies where access to many goods and services is mediated by monetary income, labor-market position influences the practical ability to secure housing, food, mobility, education, care, and other conditions of life. The strength of the connection varies across welfare regimes, households, property structures, and public institutions, yet the general architecture remains significant: employment often provides a major route through which productive participation is converted into an individual or household resource claim.

The recipient-centered form is visible in the way the wage appears. A complex production process involving technologies, infrastructures, organizations, legal protections, accumulated knowledge, suppliers, customers, and public institutions results in a payment assigned to an identifiable worker. The wage is real and materially consequential, while the recipient unit abstracts from the wider relations that made the productive process possible. The same structure appears on the employer side, where revenues and profits are attributed to legally and organizationally bounded entities even when production depends on extended relational networks.

Employment therefore helped stabilize a broader social expectation: participation in production could function as a legitimate basis for access to income. This expec-

tation never exhausted the sources of livelihood, since property income, household transfers, public provision, informal production, inheritance, and many other mechanisms also mattered. Its analytical significance lies in how effectively it connected three institutional domains that might otherwise remain separate: production, recognition, and allocation. Later sections will examine why artificial intelligence and changing productive capabilities place pressure on this historically powerful connection.

1.6.4 Competitive Capability and Resource Claims

Market allocation frequently connects resource claims to capabilities that can be exercised within recognized exchange and production relations. Labor earns income when a worker's capacities can be supplied under an employment relation; property generates claims when an owner controls an asset that can be leased, sold, financed, or used productively; firms obtain revenue when organizational capacities produce goods or services that counterparties purchase. Competitive capability therefore matters because institutions convert certain capacities into claims over resources.

The conversion is mediated rather than automatic. A capability has economic consequence only within a structure that recognizes, prices, contracts, or otherwise enables its exercise. The same skill may command a high wage in one labor market and little income in another. An asset may generate revenue under one property regime and remain economically inactive under another. Organizational knowledge may become valuable when complemented by finance, infrastructure, legal permission, and market access. Resource claims consequently depend on the relation among capability, institution, and opportunity rather than on capability considered in isolation.

Sen's entitlement analysis offers a particularly clear formulation of the distinction between aggregate availability and a person's command over resources. His analysis of famine shifts attention from total food supply toward the legally available means through which persons can command food, including production possibilities, trade opportunities, and state entitlements (Sen 1981). The argument is narrower than a general theory of allocation, yet its structural lesson is important here: the existence of a resource in an economy does not establish an actor's effective claim upon it. Claims are mediated by ownership, exchange, production, public provision, and other institutional relations.

This perspective clarifies the historical connection between competitive capability and allocation. Markets can translate productive or exchange capabilities into monetary claims when institutions recognize the relevant relations. The resulting claims can then be exercised against other resources. A worker's labor capacity, a firm's organizational capacity, an owner's asset, or a creditor's contractual right enters an allocative system through a different institutional channel, yet each channel links a recognized position to a claim.

The architecture also generates asymmetry. Differences in productive capability, asset ownership, bargaining position, institutional recognition, and access to markets can become differences in resource command. Once resource command changes, it can alter future capabilities by affecting education, health, mobility, technology, finance, networks, and institutional access. Recipient-centered allocation therefore

contains a dynamic dimension even when the immediate transaction is represented as a transfer between fixed entities. Present claims influence the conditions from which future claims can be made.

The historical relevance of this mechanism becomes especially important when capabilities change rapidly. If productive capacity is increasingly concentrated in artificial systems, platforms, capital-intensive infrastructures, or organizations that control them, the inherited connection between individual productive contribution and resource claims may weaken. Chapter 1 develops this problem later. The present point is preparatory: modern allocation systems often rely on institutional pathways that translate recognized capabilities and positions into claims, and those pathways have histories rather than universal form.

1.6.5 Historical Limits of Recipient-Centered Evaluation

Recipient-centered evaluation is strongest when the principal question concerns the immediate distribution of a resource among identifiable units. It can show who received income, credit, property, benefits, or public expenditure; it can compare quantities across households or firms; and it can support accountability for decisions made under scarcity. These capacities remain indispensable. The limitation emerges when the evaluative object extends from receipt to the relational and generative consequences of receipt.

The first limit concerns internal structure. Two households receiving the same transfer may contain different dependency relations, care obligations, decision structures, and access conditions. Two firms receiving the same investment may organize labor, knowledge, ownership, and external suppliers differently. A recipient-level measure records the transfer accurately while leaving the internal relational configuration unresolved. The resulting abstraction is often appropriate for administration, although it cannot by itself establish how the resource changes relations within the recipient unit.

The second limit concerns external structure. A resource assigned to one entity may alter other actors through prices, employment, bargaining, supply relations, debt, care obligations, network access, or institutional precedent. These effects cross the administrative boundary used to record the allocation. The same nominal transfer can therefore generate different economic consequences depending on the recipient's position within wider relational configurations.

The third limit concerns effective command. Sen's entitlement analysis demonstrates, in an especially stark domain, that aggregate resource availability does not determine who can command the resource (Sen 1981). Recipient-centered evaluation can likewise become incomplete when formal receipt and effective access diverge. A formally allocated resource may be unusable without complementary infrastructure, knowledge, legal status, time, mobility, or relational support. The allocative event and the realized capability can therefore differ substantially.

The fourth limit concerns temporal extension. Immediate receipt is an event; its consequences may unfold through a trajectory. An educational grant can alter later capabilities and networks. Credit can enable production while also creating dependence. Infrastructure can change future market access. A transfer to an organization

can reshape internal authority or external bargaining power. Evaluating only the first recipient and the first period captures a real part of the process while omitting the later relations generated by the allocation.

These limits establish the historical transition that motivates GRE without retroactively invalidating entity-centered economics. Modern law, accounting, statistics, markets, and public administration created stable recipients because large-scale allocation required them. Economic theory developed abstractions that corresponded closely to this institutional architecture. The contemporary challenge arises as increasingly important economic effects depend on networks, platforms, knowledge infrastructures, institutional access, heterogeneous capabilities, and long-horizon transformations that cross recipient boundaries.

Recipient-centered allocation therefore remains a valid analytical layer within a wider relational account. GRE's later allocation theory will retain the administrative recipient while asking additional questions about the relations through which resources become usable, the configurations altered by transfer, and the future capacities and constraints generated afterward. Before that theory can be developed, Chapter 1 must first reconstruct how capital, labor, and knowledge became historically differentiated sources of economic power. Section 1.7 takes up that task.

1.7 Capital, Labor, Knowledge, and Economic Power

The preceding sections reconstructed the institutional conditions that made economic subjects legible and recipient-centered allocation administratively tractable. This section turns to the historically differentiated capacities through which economic subjects could command resources, participate in production, and influence the conditions of later action. Its objective is to clarify how capital, labor, and knowledge became distinct yet convertible sources of economic advantage and how their institutional conversion contributed to economic power. The discussion proceeds through five steps: capital as productive control, labor as the material basis of social reproduction, knowledge as a productive resource whose scarcity differs from that of material goods, expertise as an institutionally organized hierarchy of epistemic capability, and the conversion among capability, resources, and power. The method is historical and relational. Each source of advantage is treated through the relations that make it effective rather than as an isolated substance possessed independently of institutions, organizations, and other economic subjects.

1.7.1 Capital and Productive Control

Capital acquired historical significance through more than the accumulation of valuable objects. Productive assets become economically consequential when ownership, finance, organization, and law permit their holders to determine how production is initiated, combined, expanded, or withheld. The distinction matters because the same physical object can occupy very different economic positions according to who controls it, what claims are attached to it, and which organizational relations it enables. A machine incorporated into a firm, a parcel of land pledged as collateral, and

a financial claim that can be mobilized for investment all participate in productive control through different institutional arrangements.

Marx's analysis of capital emphasized this relational dimension by locating capital within a production process in which money, means of production, and purchased labor-power are organized toward the production of surplus value (Marx 1867). Whatever theoretical commitments are adopted regarding value, the historical insight is broader: control over productive assets can organize the labor of others, determine access to productive opportunities, and shape the technical form of production. Capital therefore carries a capacity to structure relations in addition to representing stored wealth.

Modern organizational law strengthened this capacity by creating durable arrangements through which assets could be partitioned, committed to organizational purposes, and insulated from some claims against owners or managers (Hansmann and Kraakman 2000). Productive control could thereby persist beyond the lifespan or immediate decisions of particular individuals. Corporations, banks, partnerships, and other organizational forms stabilized pools of assets and claims that could hire labor, purchase technology, enter contracts, and accumulate further resources. Capital increasingly operated through organizations rather than through isolated proprietors alone.

Financial institutions added another layer. Access to credit allows claims on future income to be converted into present productive capacity, while collateral and creditworthiness determine which subjects can perform that conversion on favorable terms. Productive control can consequently expand without prior possession of the full material resources required for production. The institutional ability to mobilize claims, pledge assets, and coordinate investment becomes part of the effective content of capital.

This historical structure created a recursive advantage. Control over productive assets can generate income; income can be retained or invested; investment can expand productive capacity; expanded capacity can strengthen bargaining position and access to finance. The recursion is neither automatic nor uniform, because markets, crises, regulation, competition, technological change, and collective organization can interrupt it. The important point for the present chapter is structural: capital can reproduce its economic effectiveness through institutional channels that connect present control to future control.

Economic power begins to appear within this recursion. At this stage, the term refers provisionally to an actor's capacity to influence access to productive conditions, the organization of production, or the feasible economic actions of other participants. A firm controlling essential infrastructure, a lender controlling access to finance, or an owner controlling a productive asset can affect choices available to subjects who depend on those conditions. Later chapters develop a fuller theory of power. The historical task here is to identify the material and institutional channels through which productive control became one of its recurrent economic sources.

1.7.2 Labor and Material Reproduction

Labor occupies a different position because productive activity is inseparable from the reproduction of the persons and households that perform it. Wage labor links these domains by converting participation in production into income through which food, shelter, care, mobility, education, and other conditions of continued life are acquired. The employment relation therefore connects the organization of production to the material reproduction of economic subjects.

Marx's treatment of labor-power made this connection explicit by distinguishing labor from the capacity to labor and by locating the reproduction of labor-power within the material conditions required for its continued availability (Marx 1867). Polanyi's historical account likewise emphasized the social transformation involved in subjecting labor to market organization, since labor is inseparable from the human beings whose lives are affected by the conditions under which it is bought and sold (Polanyi 1944). These traditions differ in theory and purpose, yet both illuminate the historical dependence of wage labor on arrangements extending beyond the immediate labor contract.

The worker's productive capacity depends on relations that precede the employment encounter. Health, education, care, household support, transportation, legal status, social networks, and public infrastructure all condition whether labor can be offered and under what terms. The wage relation makes only part of this supporting structure visible in monetary form. A firm pays for labor according to institutional and market conventions, while many conditions that reproduce labor are provided by households, communities, public institutions, or earlier investments whose contribution is not represented in the wage itself.

Labor also generates capacities that can outlast particular employment relations. Skills are learned through practice; workers acquire knowledge of technologies, organizations, clients, procedures, and collective routines; occupational communities transmit standards and techniques. Employment can therefore reproduce and transform productive capability at the same time that it uses it. The distribution of learning opportunities becomes economically important because work positions differ in the degree to which they expand future capability.

The relation between labor and power follows from this dual character. A worker may depend on employment for livelihood while an organization depends on workers for productive continuity. The relative strength of these dependencies varies with labor-market conditions, legal protections, skill scarcity, collective organization, ownership structure, mobility, and the availability of alternatives. Labor power in the ordinary political-economic sense and productive capability in the present historical reconstruction meet at this point: the capacity to work becomes economically consequential through institutions that determine who can withhold, replace, coordinate, or reorganize that capacity.

This perspective also clarifies why labor cannot be reduced to a quantity of effort. Labor is situated within a relational infrastructure of reproduction and learning. Its economic effect depends on technical systems, organizational coordination, access to tools and information, household conditions, and institutional recognition. The material reproduction of labor and the productive use of labor are therefore connected

moments of one economic architecture. That architecture becomes especially important once knowledge and expertise begin to account for a larger share of differentiated productive capability.

1.7.3 Knowledge as a Scarce Productive Resource

Knowledge entered modern economic analysis through several routes that gradually made its productive importance more explicit. Industrial production had long depended on skill, scientific knowledge, technical design, and accumulated experience. During the twentieth century, economic theory increasingly represented education, training, information, and innovation as objects of investment and coordination in their own right. This development expanded the concept of productive resources beyond physical assets while also revealing that knowledge obeys a different scarcity structure from many material goods.

Human-capital analysis provided one influential formulation. Becker treated education and on-the-job training as investments that affect earnings, employment, and productivity, thereby representing acquired knowledge and skill as economically consequential capacities rather than as external cultural attributes (Becker 1964). This framework made differences in training and education analytically comparable with other forms of investment, while leaving open broader questions about the institutions through which learning is provided and recognized.

Hayek approached knowledge from the problem of coordination. His argument centered on the dispersion of incomplete and frequently local knowledge across separate individuals, emphasizing that economically relevant information is rarely concentrated in one mind or institution (Hayek 1945). Knowledge scarcity in this sense concerns location and access as much as aggregate quantity. A system may contain the relevant knowledge while no participant possesses a complete representation of it.

Arrow's analysis of invention introduced another important distinction. Information generated through inventive activity has economic properties that complicate ordinary commodity treatment, including uncertainty about its production and difficulties surrounding appropriation once information becomes available (Arrow 1962). The result is a productive resource whose cost of creation, cost of transmission, and cost of repeated use can differ sharply. A technical insight may require substantial investment to produce while becoming inexpensive to reproduce after codification. Knowledge can therefore be scarce at one stage and abundant at another.

These observations support a more differentiated historical account of knowledge scarcity. Scarcity may arise in discovery, acquisition, verification, interpretation, certification, access, or the ability to apply knowledge effectively. Codified information can circulate widely while the capacity to understand or operationalize it remains concentrated. Scientific knowledge can be publicly available while access to laboratories, data, compute, professional networks, or institutional authority remains restricted. The economically relevant unit is consequently broader than a stock of information.

Knowledge also has cumulative properties. Earlier discoveries provide inputs to later discoveries; education increases the ability to acquire further knowledge; or-

ganizations develop routines that preserve experience; scientific communities build infrastructures through which findings can be criticized and extended. These cumulative relations can generate increasing advantages for subjects already positioned within rich knowledge environments. The historical scarcity of knowledge therefore concerns both the content known and the relations through which further knowing becomes possible.

This distinction prepares an important transition in Chapter 1. Industrial modernity treated many forms of expertise as scarce because advanced knowledge required long training, specialized institutions, and limited access to technical infrastructures. Contemporary artificial intelligence alters parts of this scarcity structure by reducing the cost of producing certain symbolic and cognitive outputs. Section 1.11 develops that transformation. The present section first establishes the earlier architecture in which knowledge scarcity supported differentiated expertise and economic hierarchy.

1.7.4 Expertise and Epistemic Hierarchy

Expertise is knowledge placed within an institutional relation of recognized competence. An individual may know something without occupying an expert position, while an expert position usually depends on certification, organizational role, professional reputation, demonstrated performance, or another mechanism through which others are authorized to rely on that knowledge. Epistemic hierarchy arises when these recognition structures distribute unequal authority to interpret information, define problems, evaluate evidence, or make decisions whose consequences extend to other participants.

The economic significance of expertise follows from its connection to scarce productive and coordinative tasks. When training is costly and specialist knowledge is unevenly distributed, expertise can affect wages, occupational access, organizational authority, and bargaining position. Human-capital analysis captures part of this structure by linking education and training to productivity and earnings (Becker 1964). The wider institutional structure includes professional licensing, educational credentials, technical standards, internal promotion systems, and reputational mechanisms that determine which capabilities receive economic recognition.

Expertise also creates organizational dependence. Complex production requires decisions about design, maintenance, finance, medicine, law, logistics, software, research, and many other specialized domains. Organizations therefore allocate decision rights partly according to recognized competence. The resulting hierarchy can be productive because it concentrates responsibility where relevant knowledge is expected to be available. At the same time, dependence on specialized judgment creates asymmetry between those who possess or are recognized as possessing relevant knowledge and those who must act on their conclusions.

Hayek's account of dispersed knowledge places an important limit on epistemic hierarchy. Local participants often possess situational knowledge unavailable to centralized experts, and coordination problems arise when institutions fail to transmit or respond to such distributed information (Hayek 1945). The tension is structural. Specialized expertise may be indispensable for tasks requiring deep technical knowl-

edge, while economic systems also depend on dispersed, contextual, and practical knowledge that cannot be fully centralized.

The hierarchy of expertise is consequently shaped by both knowledge and recognition. Credentials can signal capability, yet they also determine access to occupations and decision arenas. Organizational roles can place experts close to resources and strategic information, which in turn expands their opportunities for further learning. Research institutions can accumulate instruments, data, and networks that make future knowledge production easier. Epistemic advantage can therefore become institutionally self-reinforcing even when the underlying knowledge remains contestable or distributed.

This structure matters for GRE because economic power can arise through control over interpretation as well as control over material resources. Subjects able to classify risk, certify quality, authorize technical claims, design information systems, or define admissible evidence can shape which actions appear feasible to others. Later chapters examine epistemic power more directly. The historical point here is that modern economies increasingly organized productive differentiation around recognized knowledge, thereby adding an epistemic dimension to the older relations of capital and labor.

1.7.5 Conversion among Capability, Resources, and Power

Capital, labor, and knowledge become most consequential when their economic effects are examined through conversion. Productive capability can generate income; income can purchase education, tools, mobility, or access; knowledge can attract finance; ownership can purchase expertise; organizational position can provide information; and institutional recognition can convert a capability into an authorized claim on resources. Economic advantage therefore develops through pathways that translate one form of capacity or resource into another.

The conversion from capability to resources is institutionally mediated. Becker's human-capital framework links acquired education and training to earnings and productivity, yet the strength of that link depends on labor markets, credentials, organizational demand, discrimination, bargaining arrangements, and other institutions (Becker 1964). A capability that lacks recognition, market demand, legal permission, or access to complementary resources may generate little income. Productive capacity and resource command therefore remain analytically distinct.

The reverse conversion is equally important. Income and wealth can finance training, relocation, health, experimentation, equipment, and time for learning. Capital can purchase access to expertise and technical infrastructure. Organizational resources can support research whose results create further capability. Resource inequality can consequently become capability inequality through cumulative investment, while capability inequality can become resource inequality through differentiated returns. These conversions create feedback across time.

Sen's entitlement analysis provides a related insight from a different problem-space: aggregate availability of resources does not determine what particular persons can command, because access depends on the entitlement relations through which resources are obtained (Sen 1981). The same principle applies more broadly

to capability conversion. Possessing a useful skill does not by itself establish access to the assets, institutions, markets, or rights required to exercise it. Resources become effective through relations, and capabilities become economically consequential through conversion structures.

Power enters when these conversions affect the feasible actions of others or the rules governing access. Control over capital can determine who receives finance; recognized expertise can determine which claims are accepted; organizational authority can allocate productive opportunities; ownership can restrict access to infrastructure; labor scarcity can strengthen the capacity to bargain or withhold participation. Economic power therefore often emerges through control of conversion points rather than through possession of a single resource considered in isolation.

The conversion structure also helps explain persistence. An actor with capital may purchase knowledge, hire labor, and expand organizational capacity. An actor with recognized expertise may gain income and authority, then use those resources to acquire further credentials, networks, or productive assets. A worker in a position rich in learning opportunities may accumulate capabilities that widen future options. Conversely, subjects lacking access to key conversion interfaces may experience cumulative disadvantage even when they possess valuable capacities. Historical inequality can therefore reproduce itself through unequal conversion conditions.

This synthesis provides the bridge to the next stage of Chapter 1. Capital, labor, and knowledge are distinct sources of productive capacity, yet their economic effects depend on relations that connect subjects across organizations, infrastructures, institutions, and markets. As production becomes more interdependent, the relevant unit of analysis increasingly extends beyond the isolated owner, worker, or expert. Section 1.8 develops this expansion by examining relational production through division of labor, organizations, production networks, knowledge infrastructures, and transnational economic relations.

1.8 Expansion of Relational Production

The preceding sections reconstructed the modern economic subject and the institutional mechanisms through which capital, labor, and knowledge became recognizable sources of productive capability and economic power. This section changes the scale of analysis. Its role is to show how production increasingly depended on relational configurations that extended beyond any single worker, owner, firm, or administrative recipient. The objective is to identify the historical forms through which productive activity became distributed across interdependent tasks, organizations, supply relations, knowledge infrastructures, and multiple territorial scales. The discussion proceeds from division of labor to organizations, production networks, scientific and knowledge infrastructures, and transnational relations. The method is historical and relational: each form of production is examined through the dependencies, coordination mechanisms, and infrastructures that make distributed activity productive as a configuration.

1.8.1 Division of Labor and Interdependence

The division of labor offers one of the clearest historical routes from entity-centered description toward relational production. Smith treated specialization as a source of increased productive power because repeated tasks permit greater dexterity, reduce time lost in switching activities, and encourage the development of specialized machinery (Smith 1776). The resulting productivity, however, belongs to a configuration of differentiated activities rather than to any isolated worker. Specialization increases output by making each participant more dependent on the complementary work of others.

This dependence changes the economic meaning of productive capability. A highly specialized worker may possess a narrow and valuable skill while being unable to produce a finished good independently. A specialized machine may be extremely productive within one production sequence while having little use outside it. A firm may excel at one stage of production while relying on logistics, suppliers, finance, standards, infrastructure, and downstream distribution. Productive capability therefore becomes increasingly positional: its value depends on how a capacity is connected to other capacities within an organized sequence.

The relation between specialization and interdependence is historically important because it expands the coordination problem at the same time that it expands productive capacity. Tasks must be sequenced, inputs must arrive at appropriate times, specifications must be compatible, and failures in one component can propagate to others. Market prices can coordinate some of these relations, while organizations, contracts, standards, routines, and long-term exchange relationships coordinate others. Hayek's account of dispersed knowledge captures one dimension of this problem by emphasizing that economically relevant knowledge is distributed across participants and cannot be fully concentrated in a single mind or office (Hayek 1945).

Interdependence also makes attribution more difficult. An observed output can often be assigned legally or administratively to a firm, yet the productive conditions of that output may include workers trained elsewhere, infrastructure financed publicly, suppliers operating under long-standing technical standards, scientific knowledge produced in universities, and demand coordinated through institutions beyond the firm. The administrative unit remains useful for accounting and responsibility, while the productive process exceeds it.

Granovetter's analysis of embeddedness sharpened this point by arguing that economic action is situated within ongoing structures of social relations rather than adequately represented by atomized actors alone (Granovetter 1985). For the historical argument developed here, the significance lies in the unit of explanation. Productive outcomes increasingly depend on the pattern of relations among specialized actors, and the stability, trust, information, and expectations carried by those relations can affect what the participants are able to accomplish.

Relational production therefore begins with a simple historical observation: specialization makes productive capacity increasingly distributed. The more extensive the division of labor, the less adequate it becomes to identify production solely with the attributes of a nominal producer. The relevant productive object begins to include the configuration through which differentiated capacities are connected.

1.8.2 Organizations as Relational Structures

Organizations provide one institutional response to the coordination demands generated by specialization. Section 1.5 examined the legal and accounting mechanisms that stabilize organizations as recognizable entities. The present subsection examines their internal productive structure. An organization can act as an economic unit because relations among roles, authority, information, assets, routines, and responsibilities are sufficiently stabilized to sustain coordinated action over time.

Coase's analysis of the firm framed the organizational question through the costs of using the price mechanism and the circumstances under which coordination is brought inside the firm (Coase 1937). That formulation remains important because it makes organizational boundaries economically consequential. Yet the boundary does not eliminate relational complexity. It reorganizes it. Activities that might otherwise be coordinated through repeated market transactions become connected through employment, managerial authority, internal procedures, budgeting, technical standards, and shared infrastructure.

The internal productive capability of a firm is consequently distributed across relations among positions. A design team depends on manufacturing knowledge; manufacturing depends on procurement and maintenance; sales depends on production and logistics; finance depends on information generated throughout the organization. The formal organization chart captures part of this architecture, while informal relations, professional communities, accumulated routines, trust, and tacit knowledge often carry coordination that the formal chart does not specify.

Network forms of organization make the relational character of production even more visible. Powell describes network forms as organized through reciprocal patterns of communication and exchange that differ from both discrete market transactions and hierarchical command (Powell 1990). Such arrangements can support collaboration where participants remain organizationally distinct yet require continuing coordination, mutual adjustment, and information exchange. Productive organization therefore admits more than a binary choice between market and hierarchy.

This plurality matters for economic analysis because the same nominal set of assets and workers can perform differently under different relational arrangements. A tightly centralized organization, a federated organization, a long-term alliance, and a project network distribute authority, information, learning, and risk differently. Productive capability is consequently partly a property of organizational architecture. Reorganization can alter output without changing the physical assets or formal skills initially available, because the relations through which those resources are combined have changed.

Organizations also accumulate relational memory. Routines preserve solutions to recurrent problems; reputations shape expectations; shared standards reduce coordination costs; informal communication channels accelerate problem solving; and prior collaboration changes the ease with which new collaboration can occur. These features make organizational history productive. Present capability depends partly on relations generated through earlier activity.

The firm remains a legitimate unit of economic analysis, especially where legal responsibility, financial reporting, and contractual control are concerned. Relational

analysis adds a second description: the firm is also a stabilized configuration of internal and external relations whose productive capacity depends on how those relations are maintained and transformed. This dual description becomes increasingly necessary once production extends across organizational boundaries.

1.8.3 Production Networks and Supply Chains

Production networks extend relational production beyond the boundaries of a single organization. Modern goods and services are frequently produced through sequences in which design, components, assembly, logistics, finance, certification, distribution, and after-sales support are distributed among legally distinct organizations. The resulting system cannot be understood only by adding the attributes of participating firms, because the pattern of dependence among them affects coordination, bargaining, learning, vulnerability, and the distribution of returns.

Supply relations differ in depth. Some transactions are relatively standardized and can be shifted among suppliers with limited reorganization. Others require dedicated equipment, jointly developed specifications, long-term learning, quality assurance, shared information systems, or repeated adaptation. The economic relation between buyer and supplier therefore ranges from relatively impersonal exchange to durable interdependence. These differences affect how productive knowledge moves and how risks are distributed across the network.

The global value-chain literature provides a developed account of such variation. Gereffi, Humphrey, and Sturgeon identify governance patterns ranging from market relations to modular, relational, captive, and hierarchical forms, with differences shaped by transaction complexity, codifiability, and supplier capabilities (Gereffi et al. 2005). Their typology is valuable here because it shows that formally separate firms can stand in relations with very different degrees of coordination and power asymmetry. A contractual boundary therefore provides limited information about the substantive structure of production.

Network position can also affect access to opportunity. A firm connected to technically demanding customers may receive information, standards, and incentives that support learning, while a supplier confined to narrowly specified tasks may have fewer opportunities to develop independent capabilities. The productive consequences of a relation can therefore extend beyond the immediate exchange. Repeated transactions may generate new competencies, lock in specialized investments, deepen dependence, or alter the set of future partners available to each participant.

This perspective clarifies why disruptions propagate. A production network can appear decentralized because ownership is distributed among many firms, while remaining operationally concentrated around a small number of critical nodes, standards, logistics routes, or technological interfaces. Failure at one point can interrupt production elsewhere even when downstream firms remain financially solvent and legally intact. The vulnerability belongs to the relational configuration through which production is organized.

Relational production also complicates the attribution of value creation. Final prices and accounting systems assign revenues to identifiable organizations, but

productive contribution may be dispersed across suppliers, infrastructure providers, workers, knowledge institutions, and complementary technologies. The question of how value generated through a network is recognized, converted, and distributed will become central in later GRE chapters. At this historical stage, the important development is the expansion of production beyond the boundaries used to identify economic recipients and owners.

Supply chains therefore provide a concrete transition from entity-centered production to relational architecture. Firms remain real and consequential economic subjects, yet their productive capacities are conditioned by positions within networks of dependence, learning, standards, and exchange. The unit of production increasingly spans relations among organizations.

1.8.4 Scientific and Knowledge Infrastructures

Knowledge-intensive production makes the relational basis of productive capacity especially visible because usable knowledge depends on infrastructures that no single organization normally creates by itself. Universities, laboratories, professional associations, journals, standards bodies, databases, patent institutions, training systems, public research agencies, and technical communities contribute to the production, verification, transmission, and preservation of knowledge. Firms and workers draw on these infrastructures even when the resulting commercial output is attributed to a particular organization.

Arrow's analysis of invention emphasized uncertainty and the distinctive appropriation problems surrounding information production (Arrow 1962). These features help explain why knowledge production has repeatedly relied on institutional forms that differ from ordinary commodity exchange. Public funding, professional norms, publication systems, intellectual-property regimes, collaborative research, and organizational secrecy create different arrangements for balancing dissemination, appropriation, and continued investment.

The productive importance of knowledge infrastructures extends beyond the stock of published information. Scientific and technical work depends on instruments, methods, repositories, standards, peer communities, credibility systems, and trained personnel able to interpret results. A published finding may be widely accessible while the capability to reproduce, evaluate, or apply it remains concentrated in institutions possessing complementary infrastructure. Knowledge abundance at the level of symbols can therefore coexist with scarcity at the level of effective participation.

Interorganizational collaboration provides one mechanism through which such capabilities are distributed. Powell, Koput, and Smith-Doerr's study of biotechnology located important innovation processes within networks of learning that crossed organizational boundaries (Powell et al. 1996). The broader lesson is not specific to biotechnology. Where relevant knowledge is dispersed and rapidly developing, productive capability can depend on access to relations through which organizations learn from one another, recruit expertise, interpret developments, and combine complementary resources.

Knowledge infrastructures are also cumulative. Training institutions reproduce specialist communities; standards allow artifacts produced in different places to in-

teroperate; archives and databases preserve earlier results; professional criticism filters claims; and shared technical vocabularies reduce the cost of future coordination. These infrastructures are products of earlier relations and conditions for later production. Their economic contribution is therefore temporally extended and difficult to assign to a single transaction.

This structure matters for the historical emergence of GRE because it weakens the correspondence between ownership of an output and generation of the conditions that made the output possible. A firm may own a patent or sell a product while depending on publicly financed science, professional standards, prior open knowledge, supplier learning, and collective technical infrastructures. The administrative attribution of revenue can remain precise even when the generative history of capability is distributed.

Knowledge-intensive production thus expands the economic object from information possessed by an actor to an infrastructure of relations through which knowing becomes possible, credible, applicable, and renewable. Later chapters will examine the implications for knowledge capital, epistemic economy, and generative return. The present section establishes the historical condition: productive knowledge increasingly operates through relational infrastructures whose boundaries exceed the firms that commercialize their outputs.

1.8.5 Transnational and Multiscalar Economic Relations

The expansion of relational production eventually exceeds both organizational and territorial boundaries. Production can be coordinated through relations among workers, firms, financial institutions, public authorities, standards bodies, logistics systems, and knowledge institutions located in different jurisdictions. The resulting architecture is multiscalar: local workplaces operate within organizations; organizations operate within production networks; networks depend on national institutions and transnational infrastructures; and changes at one scale can alter feasible actions at another.

This multiscalar structure changes the meaning of economic location. A plant is physically situated in one place while depending on financing, intellectual property, technical standards, intermediate inputs, software, demand, and managerial decisions distributed across other places. A worker's employment conditions can be affected by procurement decisions made elsewhere. A supplier's upgrading opportunities can depend on standards imposed by lead firms or regulatory regimes outside its jurisdiction. Territorial location therefore remains important while becoming only one coordinate of economic position.

Global value-chain analysis again illustrates the point. Governance patterns within transnational production can distribute coordination and power asymmetrically even where production is legally fragmented across independent firms (Gereffi et al. 2005). The economic significance of a firm consequently depends partly on its relation to lead firms, standards, technologies, logistics channels, and markets that operate at larger scales.

Multiscalar production also connects different institutional tempos. Employment law, industrial capacity, infrastructure, financial conditions, and technical standards

change at different rates. A rapid shift in procurement or finance can therefore encounter much slower changes in worker skills, transport systems, regulatory institutions, or regional productive structures. The historical consequences of production cannot always be understood on the timescale of the transaction that initiated them. This observation prepares the later GRE treatment of generative spacetime and fast–slow economic dynamics.

The expansion across scales also changes the distribution of responsibility. Economic benefits and harms may be generated through chains of relations in which no single participant controls the whole configuration. Lead firms may influence specifications without directly employing workers who implement them; investors may alter financing conditions without managing production; states may regulate entities within their jurisdiction while key dependencies lie elsewhere. Legal and administrative responsibility remains essential, yet causal and generative responsibility can extend across a wider relational field.

Section 1.9 develops globalization as a distinct historical transformation of these relations, including transnational production, capital flows, distributed labor, institutional interdependence, and economic relations beyond territorial boundaries. The present section establishes the prior analytical shift. Once productive activity is distributed across interdependent tasks, organizations, networks, knowledge infrastructures, and scales, the economy becomes increasingly difficult to represent as a collection of independently productive entities connected only by exchange. Relational production becomes part of the historical architecture of economic life.

1.9 Globalization and the Extension of Economic Relations

The preceding section showed how productive activity expanded from specialized tasks and organizations into interorganizational networks and knowledge infrastructures. This section extends the historical scale once more. Its role is to reconstruct globalization as an enlargement and densification of economic relations across territorial, organizational, and jurisdictional boundaries. The objective is to identify how production, capital, labor, institutions, and claims upon value became increasingly transnational while remaining embedded in unequal capacities, legal regimes, and historically specific forms of coordination. The discussion proceeds through transnational production, global capital flows, distributed labor and unequal exchange, global institutional interdependence, and economic relations whose operative structure exceeds a single territorial container. The method is historical and relational: globalization is treated as a reorganization of connections among economic actors and institutions rather than as a simple increase in the volume of international transactions.

1.9.1 Transnational Production

Transnational production extends the relational structure of production across territorial jurisdictions. A finished good, service, or technological system may combine design in one location, components from several others, assembly elsewhere, financing through another jurisdiction, and distribution through globally coordinated logis-

tics. The productive object presented to a final buyer can therefore be the terminal manifestation of a geographically dispersed system of relations among firms, workers, infrastructures, standards, and institutions.

Global value-chain analysis made this architecture analytically visible by distinguishing different governance forms through which lead firms and suppliers coordinate complex transactions. Gereffi, Humphrey, and Sturgeon show that transaction complexity, the codifiability of information, and supplier capabilities help shape governance arrangements ranging from relatively market-like relations to more captive and hierarchical forms (Gereffi et al. 2005). Their framework is useful here because it shows that geographic dispersion does not imply organizational dispersion in the same degree. Production can be territorially distributed while coordination, specification, intellectual property, market access, or strategic decision-making remains highly concentrated.

This distinction changes the meaning of location. A factory is located in a territory, yet its productive role may be defined by relationships extending far beyond that territory. Its output may depend on imported components, standards specified by a distant lead firm, credit provided through international financial networks, software maintained elsewhere, and demand originating in multiple markets. The economic significance of the local unit therefore cannot be inferred from territorial location alone. Position within a transnational production structure affects bargaining power, learning opportunities, vulnerability to substitution, and the share of downstream value that can be retained.

Transnational production also separates several forms of economic control that industrial organization had often joined within the same firm or national economy. Ownership may be located in one jurisdiction, production in another, technical authority in a third organizational center, and consumption across many territories. Contractual relations can coordinate these distributed elements without bringing them under a single legal person. The resulting architecture combines entity-level responsibility with relational dependence across entities.

The historical importance of this arrangement lies in the enlargement of the relevant economic system. A national economy remains a meaningful institutional and statistical object, yet many productive processes acquire conditions of reproduction that extend beyond national boundaries. Input availability, logistics, exchange rates, standards, foreign demand, and decisions by transnational firms can alter domestic production without originating within the domestic institutional field. Globalization therefore expands the set of relations that must be considered when explaining how a nominally local economic capability is generated and sustained.

This expansion does not erase territory. Infrastructure, labor law, taxation, education, energy systems, political authority, and physical logistics continue to be territorially organized to substantial degrees. Transnational production instead layers cross-border coordination upon territorial institutions. The result is a multiscalar productive architecture in which local, national, regional, and global relations jointly condition what any single economic actor can do.

1.9.2 Global Capital Flows

Global capital flows extend economic relations through claims on assets, liabilities, income streams, and future payments. Cross-border finance allows savings generated in one jurisdiction to support investment in another, firms to raise funds from foreign investors, states to issue debt internationally, and households or institutions to hold claims on assets located elsewhere. The relevant relation is therefore partly financial and partly temporal: present resources are connected to expectations about future returns across institutional and territorial boundaries.

The expansion of gross external positions illustrates how strongly these relations can exceed the scale suggested by net flows alone. Lane and Milesi-Ferretti constructed estimates of foreign assets and liabilities for a large set of countries and documented the growing scale and changing composition of international financial positions during the late twentieth century (Lane and Milesi-Ferretti 2006). For relational analysis, the importance of such data lies less in a single aggregate measure than in the multiplication of cross-border creditor, debtor, equity, reserve, and direct-investment relations that bind economic actors to developments outside their immediate jurisdiction.

Financial integration can redistribute both opportunity and exposure. Access to external capital may relax domestic financing constraints, support investment, and diversify risk. The same relational extension can transmit shocks through balance sheets, refinancing conditions, exchange-rate movements, and changing investor expectations. A financial relation that appears as an asset to one actor is simultaneously a liability or obligation within another balance sheet. Changes in one part of the system can therefore alter the conditions faced by actors connected through portfolios, credit lines, collateral structures, or payment systems.

Capital mobility also changes the relation between economic activity and institutional jurisdiction. Productive facilities remain materially situated, while claims on their earnings can circulate through financial centers and legal vehicles far from the site of production. Ownership, control, risk bearing, and income receipt can thus become geographically separated. These separations complicate any analysis that equates the location of productive activity with the location of economic benefit or decision power.

The same architecture creates asymmetry among participants. Actors with access to deep financial markets, reserve currencies, diversified portfolios, sophisticated intermediaries, or favorable legal jurisdictions can often manage cross-border exposure differently from actors dependent on a narrow set of external creditors or volatile financing channels. Global capital flows consequently create a relational field in which mobility itself becomes unequally distributed capability. The ability to enter, exit, hedge, refinance, or relocate a claim may matter as much as the nominal size of the resource being moved.

For GRE, the historical lesson is preparatory. Capital becomes increasingly intelligible as a set of mobile claims embedded in institutional relations, rather than only as a stock attached to a territorial owner. The later analysis of power, value circulation, and conversion will require this distinction because financial mobility can transform resources, obligations, and bargaining positions across scales without any

corresponding movement of the underlying productive activity.

1.9.3 Distributed Labor and Unequal Exchange

The globalization of production distributes labor across economies characterized by different wage structures, productivity levels, bargaining institutions, currencies, social protections, and positions within international production networks. This distribution generates a long-standing problem in political economy: similar productive interdependence can coexist with markedly unequal compensation, bargaining power, and capacity to appropriate the gains associated with international exchange.

The structuralist tradition formulated an early version of this problem through the center–periphery distinction. Prebisch's analysis of Latin American development emphasized asymmetries in productivity, industrial structure, and terms of trade between industrial centers and primary-exporting peripheral economies (Prebisch 1950). The analytical significance of this tradition lies in its insistence that participation in international exchange occurs from historically differentiated productive positions. Exchange connects economies whose capacities to innovate, set prices, absorb shocks, and alter the composition of production may differ substantially.

Theories of unequal exchange developed the argument in a more explicitly distributive direction. Emmanuel linked international exchange to persistent differences in wages and to the international organization of production, arguing that trade can reproduce transfers of value between differently positioned economies (Emmanuel 1972). This is a contested theoretical tradition, and the present chapter does not adopt its full value-theoretic apparatus. Its relevance to the historical argument is narrower: globalization made it increasingly necessary to ask how the distribution of labor across jurisdictions interacts with price formation, wage differentials, ownership, and the allocation of returns across the production process.

Global production networks sharpen the question because the physical contribution of labor and the capacity to command downstream returns can be institutionally separated. Workers and suppliers may perform indispensable stages of production while lead firms control design, standards, branding, finance, intellectual property, market access, or final distribution. The governance patterns identified in global value-chain research provide one way to describe these asymmetries without presupposing a single theory of value (Gereffi et al. 2005). Different positions in the chain carry different opportunities for learning, upgrading, substitution, and bargaining.

The term *unequal exchange* therefore names more than one possible mechanism and should be used carefully. Terms-of-trade dynamics, wage differentials, ownership structures, market concentration, technological dependence, currency hierarchy, and contractual governance can each contribute to unequal distributions of gains. Their relative importance is an empirical and theoretical question. A relational framework gains little by compressing them prematurely into one explanation.

The more durable insight is that labor mobility, capital mobility, and value appropriation need not move together. Capital and contractual authority can cross borders with relative ease in some settings, while workers remain subject to migration law, local labor institutions, family obligations, language, and other forms of territorial

embeddedness. The resulting asymmetry can alter bargaining positions across the global production system. Globalization therefore expands productive interdependence while also creating new sites at which differences in mobility, institutional protection, and control shape distribution.

This historical problem prepares a later GRE question concerning heterogeneous value and conversion. Labor performed in different institutional settings becomes comparable through prices, contracts, accounting systems, and exchange rates, yet those mechanisms of commensuration may also conceal relations that produced the observed distribution. Section 1.9 remains at the historical level; later chapters will return to the normative and power-theoretic consequences of such conversion structures.

1.9.4 Global Institutional Interdependence

Globalization depends on institutions that make cross-border relations sufficiently stable to support repeated economic activity. Trade agreements, customs rules, financial regulation, payment systems, accounting standards, investment regimes, central-bank arrangements, dispute procedures, technical standards, and private certification systems all contribute to the conditions under which transnational exchange can occur. Economic integration is therefore institutionally produced as well as commercially enacted.

Institutional interdependence creates a layered structure of authority. A firm operating transnationally may face domestic corporate law, foreign labor and environmental regulation, international trade rules, sectoral standards, contractual obligations, financial-market requirements, and private platform or certification rules at the same time. These rule systems differ in source and enforceability, yet jointly shape the feasible actions of the firm. The economic relation is consequently embedded in overlapping jurisdictions rather than contained by one institutional order.

This layering also reveals a persistent tension between economic reach and political jurisdiction. Rodrik emphasizes that deep international economic integration encounters constraints created by national jurisdiction and political organization (Rodrik 2000). The point is especially useful for relational analysis because the relevant boundaries do not coincide: production networks, capital claims, information flows, and market relations may extend globally while taxation, social protection, electoral accountability, and many regulatory capacities remain organized primarily through territorial states.

Institutional interdependence therefore changes the consequences of domestic decisions. A regulatory change in one major market can alter production standards elsewhere; a monetary or financial decision can affect external borrowers; a change in customs treatment can reorganize sourcing relations; a shift in certification requirements can redistribute access to markets. The causal chain often crosses several jurisdictions and organizations before reaching the affected actor.

The resulting structure can also redistribute institutional power. Actors capable of setting standards, providing settlement infrastructure, controlling market access, or defining widely adopted contractual forms can shape behavior beyond their formal territorial authority. Smaller jurisdictions and firms may retain legal autonomy while

adapting to rules generated elsewhere because access to a larger network depends on compliance. Such influence operates through relational position and dependence rather than through direct command alone.

Global institutional interdependence thus extends the economic field beyond trade volumes. It includes the rule-producing and rule-transmitting relations that allow transnational production and finance to remain coordinated. These institutional layers will become important later when GRE distinguishes resource ownership from access, capability from effective control, and formal sovereignty from relational dependence.

1.9.5 Economic Relations beyond Territorial Boundaries

The combined development of transnational production, global finance, distributed labor, and institutional interdependence produces economic relations whose operative boundaries differ from territorial boundaries. A production network may span several states; a financial position may connect balance sheets located on different continents; a technical standard may organize firms across many jurisdictions; and an ownership structure may separate the place of production from the place in which claims on its income are legally held.

Territory remains economically consequential because infrastructure, coercive authority, taxation, public services, labor regulation, and political membership are still extensively territorialized. Globalization adds relational structures that cut across these territorial containers. The same actor can therefore occupy several economic spaces simultaneously: a local labor market, a national legal order, a transnational supply chain, an international financial network, and a global market for knowledge or standards.

This multiplicity creates analytical problems for any unit of analysis treated as self-contained. National accounts can describe production and income according to carefully defined territorial and residence conventions, firms can report consolidated entities, and trade statistics can record cross-border transactions. These representations remain indispensable. Their boundaries, however, answer specific administrative and analytical purposes. They do not exhaust the relations through which productive capability, vulnerability, knowledge, risk, and bargaining power are generated.

A relational description therefore supplements territorial accounting with attention to connection, position, dependence, and cross-scale transmission. The relevant questions concern which actors are connected, which infrastructures mediate those connections, which institutions govern them, how easily relations can be substituted, and how effects propagate when one node or jurisdiction changes. Such questions become increasingly important as the same production process is divided among actors whose legal, financial, and political environments differ.

Globalization also changes the meaning of economic distance. Geographic separation can coexist with tightly synchronized production, while neighboring actors can remain weakly connected economically. Contractual standards, transport infrastructure, communication systems, legal compatibility, financial access, and organizational integration can reduce some forms of distance while preserving or enlarging

others. Economic proximity becomes partly relational rather than purely spatial.

The historical transition examined in this section therefore prepares the move to digital modernity. Once economic coordination already extends beyond territorial and organizational boundaries, digital infrastructures can intensify mediation, observation, matching, and algorithmic coordination across those relations. Section 1.10 develops that next stage. The globalization considered here establishes the preceding transformation: economic activity becomes increasingly organized through multiscalar relations whose effective boundaries exceed the entities and territories through which they are administratively represented.

1.10 Digital Modernity and Relational Intermediation

This section locates digital modernity within the historical expansion of relational production developed in Sections 1.8 and 1.9. Its role is to identify how digital infrastructures alter the conditions under which economic relations are formed, observed, coordinated, and concentrated. The objective is to show that digitalization changes more than the speed or scale of existing transactions: it creates new infrastructures of information, inserts platforms between previously more direct relations, increases the frequency and granularity of observation, delegates parts of coordination to algorithmic systems, and changes the returns associated with network position. The discussion proceeds through information as productive infrastructure, platforms as mediators, data-intensive observation, algorithmic coordination, and the concentration dynamics associated with network effects. The method is historical and relational. Digital technologies are treated as institutional and technical arrangements that reorganize connections among economic actors rather than as a separate economy detached from earlier productive structures.

1.10.1 Information as Productive Infrastructure

Digitalization changes the economic role of information by making its storage, processing, replication, transmission, and recombination available at scales and speeds that earlier organizational forms could not sustain. Information has always mattered to production, exchange, administration, and coordination. Digital infrastructures deepen that dependence by embedding information-processing capacities directly into productive systems, logistics, finance, communication, and organizational decision-making.

Goldfarb and Tucker characterize digital economics through reductions in several costs associated with digital activity, including search, replication, transportation of information, tracking, and verification (Goldfarb and Tucker 2019). This formulation is useful for the present historical argument because each cost reduction modifies a relation. Lower search costs alter how buyers, sellers, workers, firms, and information sources find one another. Lower replication and transmission costs change the circulation of symbolic and informational goods. Lower tracking costs expand the observability of interactions. Lower verification costs can reorganize the institutional arrangements through which claims are authenticated.

Information therefore becomes infrastructural in a stronger sense than simply being an input possessed by an organization. Digital production depends on shared protocols, databases, cloud services, communication networks, identifiers, software standards, application interfaces, payment rails, and security systems. These infrastructures establish conditions under which geographically distributed actors can coordinate actions that remain intelligible to one another. A transaction recorded in one system can trigger inventory updates, logistics instructions, payment processes, compliance checks, and subsequent recommendations across several organizational boundaries.

The productive significance of such infrastructure often appears indirectly. A database or protocol may generate little value as an isolated object while enabling a large number of downstream relations. Its economic importance can therefore reside in the range of interactions it makes possible, the compatibility it establishes, and the future actions it renders easier or harder. This is an early instance of a distinction developed later in GRE between possession of a resource and the generative conditions supported by that resource.

Digital infrastructure also changes the temporal structure of coordination. Information that previously arrived through periodic reports can be transmitted at much shorter intervals. Inventory, demand, prices, locations, payments, and user interactions may be updated in near real time. Decisions can consequently respond to changing conditions before slower administrative routines would have registered them. The historical consequence is a tighter coupling between observation and action, a theme that becomes central in the later discussion of data and algorithmic coordination.

The expansion of information infrastructure does not remove the material basis of economic activity. Data centers require energy and equipment; communication networks require physical infrastructure; software systems depend on organizations and trained labor; digital records rely on institutional conventions that make identifiers, permissions, and categories operational. Digital modernity therefore adds a dense informational layer to material production while also making many productive relations increasingly dependent on that layer.

1.10.2 Platforms and Mediated Relations

Platforms reorganize economic relations by becoming durable intermediaries between groups whose interactions were previously arranged through more fragmented markets, organizations, or bilateral channels. Search platforms connect users and information providers; marketplaces connect buyers and sellers; payment systems connect merchants, consumers, and financial institutions; labor platforms connect clients and workers; application ecosystems connect developers, device owners, advertisers, and infrastructure providers. The platform's economic object is therefore frequently a configuration of relations among several participant groups.

The economics of two-sided markets provides an established account of this structure. Rochet and Tirole analyze platforms whose viability depends on bringing multiple sides of a market into participation and on choosing a price structure that reflects interactions across those sides (Rochet and Tirole 2003). Their formulation shows

that the platform cannot be understood adequately by examining a single bilateral transaction in isolation. Participation on one side changes the attractiveness and economic possibilities available on another.

Relational mediation gives the platform several forms of influence. It can determine conditions of entry, specify contractual terms, rank or recommend participants, standardize interfaces, collect fees, define permitted forms of interaction, and alter which information is visible to whom. These functions need not be exercised uniformly, and their institutional significance varies across platform types. The common feature is positional: the platform occupies an interface through which other actors reach one another.

This interface position can reorganize the distinction between internal and external economic relations. A seller may remain legally independent while depending on a platform for discovery, payment, reputation, and access to demand. A worker may formally contract as an independent provider while task allocation, evaluation, and visibility are mediated by platform rules. A developer may own an application while access to users depends on an operating system, store, or technical interface controlled elsewhere. Legal independence can therefore coexist with substantial relational dependence.

Platforms also transform market boundaries. The relevant market may become partially constituted by technical standards, ranking systems, identity protocols, and participation rules maintained by the intermediary. Changing an interface or recommendation policy can alter demand allocation without changing the underlying legal status of participants. Economic coordination increasingly occurs through modifications to the architecture of mediation itself.

For GRE, the historically significant development is the emergence of intermediaries whose productive role consists partly in organizing relations among others. This does not make the platform external to the economy it mediates. The platform becomes one participant within the relational configuration, while its position gives it unusual capacity to alter the conditions under which other relations form and persist.

1.10.3 Data and Continuous Observation

Digital mediation produces data as a recurrent by-product of economic interaction. Searches, purchases, clicks, payments, movements, communications, ratings, inventories, delivery events, and work activities can generate machine-readable traces as they occur. Economic observation consequently shifts from periodic description toward increasingly granular and high-frequency recording in domains where digital infrastructures are present.

Einav and Levin describe the growing use of large-scale administrative and private-sector data in economics and emphasize that such data can provide granular and increasingly timely views of economic activity (Einav and Levin 2014). Their discussion concerns economic research, yet the same historical transformation extends beyond research. Firms, platforms, governments, and other organizations can use transaction-level or interaction-level data as operational inputs to pricing, logistics, risk assessment, advertising, fraud detection, performance evaluation, and service

design.

The reduction of tracking costs identified by Goldfarb and Tucker is especially consequential here (Goldfarb and Tucker 2019). Observation becomes woven into the transaction itself. A purchase records demand; a delivery records location and timing; a recommendation records exposure and response; a digital workflow can record sequence, duration, completion, and evaluation. The distinction between conducting an activity and producing a record of that activity narrows in systems designed around continuous data capture.

This increased observability changes economic power because visibility is distributed unevenly. A platform may observe interactions among many participants while each participant sees only a narrow local portion of the system. A firm operating a digital marketplace can possess information about aggregate demand, search behavior, conversion rates, and seller performance that individual sellers cannot reconstruct independently. Data concentration can therefore produce epistemic asymmetry even where the underlying transactions involve formally independent parties.

Data also depend on categories. A recorded event becomes usable only after a system defines what counts as a user, transaction, impression, conversion, task, defect, risk, or successful outcome. Continuous observation therefore increases the importance of classification rather than eliminating it. What can be optimized depends on what has been rendered observable, and what is observable depends on technical and institutional decisions embedded in the data infrastructure.

The resulting expansion of evidence has an ambivalent historical character. Granular observation can reveal heterogeneity, improve coordination, detect failures, and make previously opaque processes available for analysis. The same infrastructure can intensify surveillance, concentrate informational advantage, and encourage action toward what is easiest to record. Later chapters examine these epistemic and normative consequences directly. At this stage, the central transformation is that economic relations increasingly generate traces that can feed back into the organization of those relations at short temporal intervals.

1.10.4 Algorithmic Coordination

The accumulation of machine-readable data creates conditions for algorithmic coordination. Rules encoded in software can match participants, rank alternatives, set prices, route deliveries, detect anomalies, recommend actions, schedule labor, allocate attention, and update decisions in response to incoming information. Economic coordination thereby acquires a computational layer operating between observation and action.

Algorithmic coordination differs from simple automation of a fixed task when the system continually mediates relations among multiple actors. A recommendation system affects which producers become visible to which users. A dispatch system allocates work across drivers and locations. A pricing system changes incentives and demand across a marketplace. A ranking system redistributes attention among competing participants. In each case, the algorithm operates upon a relational configuration and can alter that configuration through repeated decisions.

Organizational research has documented this development in the workplace. Kellogg, Valentine, and Christin synthesize research on algorithmic control and identify mechanisms through which employers can use algorithms to direct, evaluate, and discipline work (Kellogg et al. 2020). Their account is relevant beyond labor control because it demonstrates a broader institutional change: observation, classification, recommendation, evaluation, and sanction can be integrated into computational systems that operate repeatedly and at scale.

The economic significance of algorithmic coordination depends on both the rule and the information available to it. A technically sophisticated allocation rule produces little if the relevant state of the system is poorly observed. Conversely, extensive data can have limited operational effect until a decision process translates them into rankings, predictions, or actions. Digital infrastructures therefore join observation and coordination through feedback: records generated by interaction become inputs to later decisions, and later decisions generate new records.

Such feedback can make coordination highly adaptive while also producing path dependence. Ranking based on prior activity can direct attention toward already visible participants; recommendation based on accumulated behavior can reinforce established patterns; performance metrics can induce workers or firms to adapt toward measured criteria. The resulting economic order is partly generated through repeated interaction between participants and the computational procedures that mediate them.

Algorithmic coordination remains institutionally situated. Objectives, permissible actions, data access, error tolerances, review procedures, and accountability structures are supplied by organizations and legal systems. The algorithm is therefore neither an autonomous economic subject by default nor a neutral technical layer. It is part of an institutional relation through which some actors obtain the capacity to coordinate the actions of others at increased scale and frequency. The later treatment of artificial intelligence will examine what changes when computational systems acquire substantially greater productive and epistemic capabilities.

1.10.5 Network Effects and Digital Concentration

Digital intermediation can generate concentration through the interaction of network effects, accumulated participation, data, standards, and control of interfaces. The mechanism begins from a relational property: the usefulness of some systems depends partly on how many other participants, complementary products, or compatible services are connected to them.

Katz and Shapiro analyze systems markets in which compatibility and network effects make popular products more valuable and influence adoption dynamics, competition, and standardization (Katz and Shapiro 1994). Platform markets add cross-group effects: participation by one side can increase the value of the platform to another side, creating feedback across participant populations (Rochet and Tirole 2003). These mechanisms do not guarantee monopoly, yet they can make installed participation and interface control economically consequential assets.

Concentration can arise through several mutually reinforcing channels. A larger participant base may attract more complementary suppliers; greater activity may

generate more data; more data may improve matching or prediction; improved coordination may attract further participation; and wider adoption may increase incentives for complementary products to conform to the platform's standards. The result is a feedback structure in which relational position contributes to future capacity.

This process changes the meaning of capital and competitive advantage. Productive assets remain important, yet control of a widely used interface, identity system, communication network, data repository, technical standard, or application ecosystem can become a durable source of economic power. The value of such an asset may depend less on its isolated technical properties than on the relations already organized through it and the costs participants face when moving elsewhere.

Digital concentration also creates asymmetry between scale and jurisdiction. A platform can mediate relations across many territories while regulation, labor law, taxation, consumer protection, and public accountability remain divided among jurisdictions. The multiscalar tension developed in Section 1.9 therefore persists within digital modernity, now combined with technical mediation and high-frequency observation. Concentrated intermediaries can coordinate relations at a scale larger than many institutions responsible for governing their effects.

The historical importance of digital concentration lies in the coupling of relational centrality with productive and epistemic capability. A central intermediary can influence access, visibility, standards, data collection, and coordination simultaneously. Economic power consequently becomes increasingly difficult to infer from ownership of conventional productive assets alone. Position within a digital relational architecture can itself generate capabilities that reinforce that position.

Digital modernity thus intensifies several tendencies developed across this chapter: production becomes more relational, observation becomes more continuous, coordination becomes more mediated, and economic power becomes increasingly connected to control over interfaces and infrastructures. Section 1.11 turns to artificial intelligence, where these digital conditions support a further transformation in cognitive production, symbolic generation, knowledge production, and comparative productive capability.

1.11 Artificial Intelligence and Productive Transformation

This section identifies the transformation that artificial intelligence introduces into the productive conditions established by digital modernity. Its role is to distinguish the economic significance of contemporary AI from the preceding expansion of information infrastructure and algorithmic coordination. The objective is to show how artificial systems increasingly participate in tasks historically performed through human cognitive labor, generate symbolic outputs at very low marginal cost, enter organized processes of knowledge production, alter comparative productive capability across workers and organizations, and concentrate important forms of productive capacity in the infrastructures that make advanced models possible. The discussion proceeds from cognitive-task automation to symbolic generation, machine-mediated knowledge production, comparative capability, and concentration. The method is

historical and economic. Artificial intelligence is treated here through the productive relations it changes rather than through a claim about machine consciousness, intelligence in the philosophical sense, or the ontological status of artificial systems. Those questions remain open and are addressed only where their economic consequences require them.

1.11.1 Automation of Cognitive Production

Earlier waves of mechanization transferred portions of physical production from human labor to machines. Contemporary artificial intelligence extends automation into tasks whose outputs were historically associated with human cognitive labor: drafting, classification, prediction, translation, coding, summarization, pattern recognition, search, recommendation, and parts of analytical work. The economic novelty does not lie in the appearance of automation itself. It lies in the widening range of tasks for which computational systems can produce outputs that enter ordinary organizational workflows.

A task-based perspective provides a useful starting point. Acemoglu and Restrepo distinguish automation from productivity improvement in already assigned tasks by emphasizing changes in the allocation of tasks between labor and capital (Acemoglu and Restrepo 2019). In their framework, automation creates a displacement effect when capital substitutes for labor in tasks previously performed by workers, while the creation of new tasks can generate a reinstatement effect that expands domains in which labor retains comparative advantage. The framework is deliberately more precise than a binary contrast between "jobs lost" and "jobs created." Production is decomposed into tasks, and technological change alters who or what can perform them.

Generative AI extends this task reallocation into forms of work whose intermediate products are symbolic. A worker drafting a memorandum, preparing a customer response, writing code, summarizing a document, or producing a first-pass analysis can now combine human judgment with machine-generated candidate outputs. This arrangement does not imply complete substitution. It alters the sequence of production. Human effort can move away from some acts of initial generation toward specification, selection, correction, verification, integration, and responsibility for the final result.

Experimental evidence already demonstrates that this reorganization can be economically consequential in bounded tasks. Noy and Zhang randomly assigned college-educated professionals to complete occupation-specific writing tasks with or without access to ChatGPT and found substantial reductions in completion time together with improvements in evaluated output quality (Noy and Zhang 2023). Brynjolfsson, Li, and Raymond study the staggered introduction of a generative-AI assistant among customer-support workers and report an average productivity increase, with especially large gains among less experienced and lower-skilled workers (Brynjolfsson et al. 2025). The studies concern particular tasks and organizational settings, yet they establish a point needed for the historical argument: systems generating language can already change the productive performance of human workers rather than merely serving as experimental demonstrations outside production.

The resulting transformation is therefore relational. Productive capability no longer resides only in the worker or only in the model. It can arise from a configuration involving the worker, the model, the interface through which prompts and outputs are exchanged, the organization's proprietary information, evaluation procedures, and the institutional rules determining which outputs may be used. A model that performs impressively in isolation may contribute little where data access, workflow integration, or verification is absent. Conversely, a modest model embedded in a well-designed process may alter productivity substantially. The productive object is increasingly the human–machine arrangement rather than either component taken alone.

This reorganization also changes the meaning of skill. Some skills remain directly productive because the worker performs the task. Others become supervisory or evaluative because the worker judges machine-generated candidates. Still others become more valuable because AI lowers the cost of complementary activities. The historical transition is therefore better understood as a redistribution of productive functions than as the simple removal of human cognition from production. Section 1.13 later examines the allocation consequences when such redistribution creates persistent asymmetries in comparative capability.

1.11.2 Machine-Generated Symbols

Generative models also alter the material conditions of symbolic production. Text, software code, images, audio, structured summaries, translations, synthetic examples, and other representational outputs can be produced at scales and speeds that differ sharply from earlier human-only processes. Digitalization had already lowered the cost of storing, copying, transmitting, and searching symbols. Generative AI lowers the cost of producing new symbolic arrangements in response to instructions and context.

This distinction matters because symbolic production had historically remained constrained by human time even after reproduction became cheap. A digital document can be copied almost without limit, yet drafting the first document still required someone to produce it. Generative systems weaken that bottleneck. Once a model is available, additional candidate texts, images, code fragments, classifications, or reformulations can be generated at low marginal cost relative to the human labor that would have been required to produce each candidate independently.

The resulting abundance should be interpreted carefully. Symbolic output is not identical with meaning, truth, or knowledge. Bender, Gebru, McMillan-Major, and Mitchell emphasize that large language models operate over linguistic form and warn against attributing understanding merely from the fluency of generated text (Bender et al. 2021). Their argument is particularly useful for GRE because it separates an economic fact from an epistemic conclusion. The economic fact is that systems can generate symbols that are usable within many production processes. The epistemic standing of those symbols depends on their relation to evidence, context, interpretation, verification, and subsequent use.

Machine-generated symbols therefore create a new selection problem. When candidate production becomes cheap, the scarce activity can migrate toward speci-

fication, evaluation, authentication, and attention. A writer facing one blank page confronts a production problem. A writer facing hundreds of plausible machine-generated drafts confronts a different problem: selecting, interpreting, checking, and integrating among abundant candidates. The productive constraint shifts from generation alone toward orientation and judgment.

The same shift occurs in organizations. Marketing teams can generate many variations of copy; software teams can generate multiple code suggestions; researchers can generate candidate summaries or hypotheses; administrative systems can generate draft classifications and reports. In each case, the volume of symbolic material can expand more quickly than the institutional capacity to evaluate its accuracy, relevance, provenance, or consequences. Symbolic abundance can therefore increase the demand for trustworthy filters even while reducing the direct cost of producing symbols.

This transformation provides the immediate historical background for the representational crisis examined in Section 1.14. Economic institutions depend on symbols: prices, reports, contracts, classifications, credentials, ratings, applications, records, and claims about states of the world. When symbol generation becomes abundant, the old inference from costly production to evidential significance becomes less reliable. The problem moves from whether a representation can be produced toward how its relation to a referent is established and maintained.

1.11.3 Machine-Mediated Knowledge Production

Artificial intelligence enters knowledge production through a more demanding pathway than symbolic generation. Knowledge is an institutional and epistemic achievement: claims must be related to evidence, methods, prior work, standards of justification, and communities capable of criticism and revision. A fluent output becomes economically useful knowledge only when it is incorporated into relations that establish why it should be relied upon.

AI can nevertheless alter those relations materially. Systems can search large information spaces, retrieve and reorganize documents, generate code for analysis, propose candidate explanations, identify patterns, produce simulations, and translate material across technical or linguistic boundaries. These functions can shorten the path between a question and a set of candidate answers. They can also make forms of expertise available to workers who would previously have required longer training, specialized assistance, or access to a more experienced colleague.

The productivity evidence from generative AI illustrates this knowledge-transfer function without establishing that the model itself possesses knowledge in the same sense as a person or institution. Brynjolfsson, Li, and Raymond find especially large gains among less experienced customer-support workers and present evidence consistent with the system disseminating practices associated with stronger workers (Brynjolfsson et al. 2025). The economically important mechanism is relational: information distilled from prior interactions becomes available through the model to workers who did not personally accumulate the same experience.

This possibility changes the historical scarcity of expertise. Expertise traditionally combined knowledge with the time required to learn, practice, encounter rare cases,

and gain entry to communities and institutions where such learning occurs. AI can reduce some of these access costs by placing codified or statistically reconstructed regularities into an interface available during performance. The result may narrow capability differences in some tasks, as the heterogeneous productivity effects in experimental and workplace studies suggest (Noy and Zhang 2023; Brynjolfsson et al. 2025).

The transformation remains partial. Tacit knowledge, situated judgment, responsibility, domain-specific interpretation, and the recognition of novel or misleading circumstances may remain difficult to externalize. AI outputs can also be incorrect, weakly grounded, or inappropriate to the local context. The epistemic problem therefore changes rather than disappears. A worker may gain access to a larger candidate knowledge space while simultaneously acquiring a new burden of verification.

Knowledge production also becomes more recursive. Human-generated records train or condition models; models generate outputs that enter human workflows; those workflows produce new records; and later systems may be trained, evaluated, or adapted using traces of the resulting activity. The boundary between knowledge infrastructure and productive activity therefore becomes increasingly porous. What an organization knows can be partly embodied in databases, models, prompts, retrieval systems, evaluation procedures, and the accumulated interaction between artificial systems and human participants.

For GRE, the important historical consequence is that knowledge can become both more abundant and more infrastructurally concentrated at the same time. Access to a general-purpose model can diffuse capabilities widely, while the production, training, adaptation, and control of the most capable systems may remain concentrated. Section 1.12 examines the corresponding transformation of scarcity, while Section 1.17 later returns to the economic organization of knowledge and epistemic capacity.

1.11.4 Transformation of Comparative Productive Capability

The economic significance of AI becomes sharper when productive capability is treated comparatively rather than absolutely. A worker can become more productive after adopting AI and simultaneously lose relative scarcity if similar or greater capability becomes available to many others at low cost. Conversely, a worker whose domain expertise complements AI effectively may become more productive and more valuable even though the technology performs parts of the underlying task. The relevant transformation concerns the distribution of comparative capability across participants.

Task-based automation already provides the structure for this analysis. When technology performs tasks previously assigned to labor, the task content of production shifts. New tasks, complementary skills, or organizational roles can partly counterbalance displacement (Acemoglu and Restrepo 2019). Generative AI makes this reallocation unusually visible in cognitive and symbolic tasks because the same system can assist drafting, coding, classification, summarization, translation, and other activities across occupations rather than being confined to one narrowly engineered physical process.

Evidence from current deployments suggests that the effect can be heterogeneous

across prior capability levels. Noy and Zhang report larger gains among initially weaker performers in professional writing tasks (Noy and Zhang 2023). Brynjolfsson, Li, and Raymond similarly find larger improvements among less experienced and lower-skilled customer-support workers, while effects for the most experienced workers are smaller (Brynjolfsson et al. 2025). These findings do not establish a universal equalizing effect. They demonstrate that AI can change the shape of a productivity distribution rather than simply shifting every participant upward by the same amount.

This transformation can alter the economic value of accumulated experience. Some experience is encoded in routines that a model can reproduce or make available to newcomers. Other experience becomes more valuable because it supports verification, problem framing, exception handling, or judgment in cases where machine output is unreliable. Comparative advantage therefore moves within the task structure. A capability that once differentiated an expert may become common, while a previously secondary capability becomes the new bottleneck.

The same logic applies at the organizational level. Firms differ in proprietary data, complementary software, workflow design, managerial capacity, domain expertise, computing infrastructure, and the ability to redesign production around new tools. Access to the same general-purpose model can therefore yield different productive effects. AI capability is not a scalar resource added uniformly to every organization; it enters a pre-existing relational architecture and combines with other capacities.

Comparative productive capability also has distributive consequences because modern institutions connect productive contribution to wages, profit, bargaining position, investment, access, and organizational authority. A technology that changes comparative capability can therefore alter resource claims even before aggregate output changes dramatically. The later sections on scarcity, allocation, and subjecthood examine the resulting tension: an economic order historically organized around comparative productive necessity encounters artificial systems capable of performing an expanding range of tasks at potentially much lower replication cost.

1.11.5 Concentration of Artificial Productive Capacity

The diffusion of AI-generated outputs coexists with concentration in the infrastructure that produces frontier artificial capability. This combination is historically important. A service can be accessible to millions of users while the training, deployment, and strategic control of the underlying systems remain located in a relatively small number of organizations and technical infrastructures.

The Stanford AI Index documents this concentration at the frontier. Its 2026 report states that industry produced more than 90 percent of notable AI models in 2025 and records rapid growth in global AI compute capacity together with substantial concentration in advanced hardware and hyperscale infrastructure (Stanford Institute for Human-Centered Artificial Intelligence 2026). These observations do not imply that useful AI is available only from a few firms. Open-weight models, smaller systems, local adaptation, and falling inference costs can diffuse access widely. The relevant distinction is between diffusion of use and control over the resources required to create or operate the most capable systems.

Artificial productive capacity depends on several complementary layers: specialized chips, data centers, energy, network infrastructure, model architectures, training data, engineering talent, capital, and organizational experience in large-scale deployment. Bottlenecks at any layer can shape who can develop frontier systems. The productive asset is therefore not the model file alone. It is a relation among computational, financial, informational, organizational, and infrastructural capacities.

Concentration at these interfaces can create economic leverage beyond conventional ownership of a single productive asset. An organization controlling model access can influence prices, usage conditions, permissible applications, data retention, technical compatibility, and the pace at which downstream users receive new capabilities. Cloud providers and hardware suppliers can shape the cost and feasibility of model development. Organizations possessing proprietary data or distribution networks can combine those assets with models in ways that new entrants cannot easily reproduce.

The structure is therefore double-sided. AI can decentralize capability by allowing a small organization or individual worker to perform tasks that previously required a larger team or specialized expert. The same technological system can centralize upstream productive power by increasing dependence on compute, model providers, data infrastructure, and technical standards. Decentralized use and centralized capacity are compatible because they occur at different layers of the productive architecture.

This layered concentration complicates conventional measures of economic power. Ownership of factories, machinery, or financial assets remains relevant, yet control of artificial productive capacity may depend on infrastructure positions that organize access for many downstream actors. A user can possess no share of the model provider while becoming deeply dependent on the provider's interface. A firm can own its data while lacking the compute or model capability needed to extract comparable productive value from them. Relational position becomes increasingly important to effective command.

Artificial intelligence therefore intensifies the historical tendencies developed in Sections 1.7 through 1.10: knowledge becomes a productive resource, production becomes distributed across networks, digital interfaces mediate access, and informational advantage can become economic power. AI adds the capacity to generate cognitive and symbolic outputs at scale and to reorganize comparative capability. The next section turns to the resulting transformation of scarcity: abundance in some forms of production can coexist with new scarcities in attention, trust, institutional access, infrastructure, and meaningful opportunities to participate in generative economic relations.

1.12 Transformation of Economic Scarcity

This section consolidates the productive changes described in Sections 1.10 and 1.11 into a historical account of changing scarcity. Its role is to clarify that technical abundance in one domain can redistribute scarcity across the wider economic system. The objective is to distinguish continuing material scarcity from the rapid expansion of

symbolic and codified informational output, then identify the growing importance of attention, trust, institutional access, and opportunities for consequential participation. The discussion proceeds from material constraints to symbolic abundance, qualified knowledge abundance, emergent relational scarcities, and generative opportunities. The method is historical and economic. Scarcity is treated as a relation between available means, institutional arrangements, technological capacities, and the uses through which those means become consequential; no claim is made that contemporary economies have entered a general condition of abundance.

1.12.1 Material Scarcity

Material scarcity remains a constitutive condition of economic organization. The digitalization of information and the automation of cognitive tasks alter the cost structure of production, yet they continue to depend on energy, land, physical infrastructure, computing equipment, logistics, human time, and access to productive assets. The historical transformation therefore concerns the composition and location of scarcity as much as its aggregate level. A task can become cheap in one dimension while becoming more dependent on scarce complementary resources in another.

The classical economic language of scarce means retains its relevance here. Robbins's influential formulation treated economics as concerned with human behavior under conditions in which means are scarce relative to alternative uses (Robbins 1932). Contemporary digital production changes which means are scarce and which alternatives compete for them. Storage and replication costs can fall sharply while advanced computation, energy, specialized hardware, skilled maintenance, and infrastructure access become more economically consequential. The relevant scarcity therefore shifts across the production system rather than simply receding.

Artificial intelligence makes this redistribution especially visible. Frontier systems can generate symbolic outputs at very low marginal cost once a model has been trained and deployed, yet the capacity to build and operate such systems remains materially intensive. The 2026 AI Index documents continued growth in the scale and concentration of advanced AI compute and infrastructure, alongside broader diffusion of downstream use (Stanford Institute for Human-Centered Artificial Intelligence 2026). The coexistence of cheap generated output and concentrated upstream capacity illustrates the central point: abundance at the output interface can rest on scarcity and concentration in the infrastructure that makes the output possible.

Material scarcity also persists through bottlenecks that lie outside the immediate production process. A digitally abundant service may still depend on limited transmission capacity, electricity supply, physical distribution, regulatory permission, or geographic access. Similarly, an organization may possess abundant information while lacking the personnel, time, or institutional authority required to act upon it. The economic significance of scarcity therefore depends on the relations linking resources to use. A resource can be physically present and economically unavailable when the institutional or relational conditions of access are absent.

This historical persistence of material constraint prevents a simple narrative in which digital technology replaces scarcity with abundance. The more precise development is a differentiation of scarcity. Some forms of production become increas-

ingly reproducible and automatable, while other inputs become relatively more decisive because they remain difficult to reproduce, difficult to access, or concentrated in a small number of institutional locations. This differentiation prepares the analysis of symbolic abundance, where the cost of producing representations falls much faster than the cost of interpreting, validating, and acting upon them.

1.12.2 Symbolic Abundance

Symbolic production has undergone one of the sharpest scarcity transformations in the contemporary economy. Digital technologies reduced the costs of copying, transmitting, searching, and storing information, while generative AI extends the cost reduction to the production of new symbolic arrangements. Goldfarb and Tucker characterize digital technologies through reductions in several economic costs associated with search, replication, transportation, tracking, and verification (Goldfarb and Tucker 2019). Generative systems add another layer by lowering the cost of producing candidate texts, images, software code, classifications, and other representations.

The economic consequence is a rapid expansion in the supply of symbols relative to the human time required to inspect them. Section 1.11 distinguished this expansion from knowledge production in the stronger epistemic sense. That distinction remains essential. Bender and colleagues caution against inferring understanding from fluent language output and thereby provide a useful boundary between symbolic competence and epistemic warrant (Bender et al. 2021). Symbolic abundance therefore describes an observable productive condition: representations can be generated at scales that no longer require proportional human authorship. It does not establish that truth, justification, or understanding have become correspondingly abundant.

This shift alters the location of economic effort. When symbolic generation is expensive, production itself absorbs time and skill. When candidate production becomes cheap, selection, comparison, verification, interpretation, provenance assessment, and integration become relatively more important. The scarcity problem moves downstream. An organization may be able to generate hundreds of reports, designs, or strategic options while lacking the attention required to evaluate them. A researcher may generate many plausible hypotheses while still facing the harder task of determining which ones merit sustained inquiry. A consumer may face abundant recommendations while remaining uncertain which sources deserve trust.

Symbolic abundance also changes the strategic value of visibility. When publication or generation costs fall, the ability to enter an informational environment no longer guarantees that an output will be noticed. Search ranking, platform position, reputational signals, institutional endorsement, and network location become increasingly important in determining which symbols reach consequential audiences. The problem of scarcity therefore reappears through channels of selection and recognition.

The expansion of machine-generated symbols further increases the importance of provenance. When many outputs can be produced rapidly and with similar stylistic plausibility, the economic value of knowing where a representation came from, which process produced it, and what evidential relations support it can rise. Section 1.14 develops this issue as a representational crisis. The present section records

the prior economic condition: production of symbols can become abundant faster than the institutional capacity to authenticate, rank, and absorb them.

1.12.3 Knowledge Abundance

Knowledge abundance requires a more qualified interpretation than symbolic abundance. Modern economies possess unprecedented capacities to store, reproduce, retrieve, and recombine codified knowledge. Digital networks make scientific articles, technical documentation, educational materials, software, data, and institutional records available across distances at costs far below those of earlier print and archival systems. Artificial intelligence can further reduce the effort required to search, summarize, translate, and reorganize such materials. These developments expand the effective availability of codified knowledge even when the production of justified knowledge remains demanding.

The economic properties of information help explain this transformation. Arrow's analysis of invention emphasized that information differs from ordinary commodities because its production involves uncertainty and its use can be difficult to appropriate exclusively once the information exists (Arrow 1962). Digital reproduction strengthens the practical significance of this distinction by making many informational objects cheap to copy and distribute. The marginal cost of another reader, user, or software instance can become very small relative to the original cost of discovery, design, or verification.

Expanded availability, however, does not eliminate the dispersed and situated character of economically relevant knowledge. Hayek's analysis of knowledge in society emphasized that knowledge of particular circumstances remains distributed among many actors and cannot be treated as if it were centrally given (Hayek 1945). Contemporary data systems and AI can aggregate and mediate some of this knowledge, yet they do so through representations, classifications, and institutional access arrangements. Tacit knowledge, local judgment, practical familiarity, and context-sensitive interpretation remain difficult to detach from the relations in which they are formed.

The phrase *knowledge abundance* therefore refers here to an expansion in the accessible stock and recombinability of codified knowledge rather than to a disappearance of epistemic scarcity. Several complementary scarcities can intensify as codified material proliferates. Verification remains costly. Provenance must be established. Contradictory sources require adjudication. Questions must be selected. Relevance must be judged relative to a concrete problem. The scarce activity increasingly concerns orientation within a large possibility space of available information and candidate explanations.

AI-mediated work illustrates this redistribution. Brynjolfsson, Li, and Raymond find evidence consistent with generative AI helping less experienced workers access and apply patterns embodied in the practices of more experienced workers (Brynjolfsson et al. 2025). Such diffusion can reduce certain knowledge asymmetries inside an organization. At the same time, the organizational value of the system depends on who can access the tool, what proprietary knowledge it can retrieve, how its outputs are checked, and which institutional processes accept those outputs as actionable.

The scarcity of codified know-how can decline while the scarcity of trustworthy interpretation, authorized access, and responsibility for judgment becomes more salient.

This distinction is important for GRE because an economy with abundant informational artifacts can still distribute epistemic capability very unequally. Access to a large corpus differs from the capacity to formulate worthwhile questions, discriminate among explanations, connect knowledge to a local situation, or persuade an institution to act. The later analysis of epistemic economy will treat these differences directly. At the historical level, the relevant transition is already visible: economic scarcity moves from possession of information alone toward the relations that make information interpretable, credible, and practically consequential.

1.12.4 Attention, Trust, and Institutional Access

As symbolic and informational supply expands, several relational conditions become more economically scarce. Attention is the clearest case. Simon's analysis of information-rich organizations argued that an abundance of information creates a scarcity of the attention required to receive and process it (Simon 1971). The proposition becomes increasingly important in digital environments where both human and machine systems can produce outputs continuously. The cost of producing another message may approach zero while the time available to read, interpret, compare, and act upon messages remains bounded.

Attention scarcity is relational because visibility depends on competition among claims upon finite recipients. A document can exist without being read, a recommendation can be generated without being considered, and an opportunity can be technically available without entering the decision horizon of the relevant actor. Search systems, ranking algorithms, professional reputation, institutional position, and social networks therefore influence which signals obtain scarce attention. Abundance in production can increase the economic value of selection mechanisms.

Trust becomes consequential through a related mechanism. Economic relations frequently involve commitments whose quality cannot be fully established before action. Arrow's discussion of gifts and exchanges emphasized the pervasive role of trust in commercial and social transactions (Arrow 1972). In information-rich environments, the number of potential counterparties, claims, and representations can expand faster than the capacity to verify each one independently. Trust, reputation, certification, and institutional assurance then perform a filtering function. Their economic importance grows when direct verification is expensive relative to the abundance of available claims.

Trust should not be treated here as a homogeneous stock. It is generated and sustained within particular relations, histories, institutions, and repeated practices. Trust in a person, trust in a profession, trust in a platform, and trust in a public institution arise under different conditions and can fail in different ways. The scarcity relevant to economic coordination is therefore the limited availability of credible relations through which actors can rely on information, promises, identities, and standards without reproducing the entire verification process themselves.

Institutional access forms a third scarcity. Institutions organize entry to resources, credentials, markets, finance, scientific communities, legal protections, and decision

procedures. North's institutional analysis emphasizes that rules and organizations structure incentives and transaction possibilities rather than merely recording choices after they occur (North 1990). In a digital economy, information about an opportunity can be abundant while actual access to the institution controlling that opportunity remains constrained. Knowing that a funding programme exists differs from being eligible to apply; knowing that a model exists differs from having compute access; knowing that a scientific field exists differs from possessing the credentials, language, networks, or institutional affiliation through which participation becomes possible.

The capability perspective provides a useful bridge from resource possession to effective opportunity. Sen's account of development as freedom emphasizes substantive opportunities and the institutional conditions through which people are able to pursue valued ways of living (Sen 1999). For the present historical argument, the important point is analytical: equal information or nominal resources can coexist with unequal effective access because conversion depends on social, institutional, and personal conditions. Scarcity can therefore reside in the relation between a subject and an institution even when the informational description of the opportunity is widely available.

Attention, trust, and institutional access share a common structural feature. They mediate the conversion of abundant possibilities into consequential action. Symbolic abundance produces many candidate claims; attention determines which are considered; trust influences which are treated as credible; institutional access affects which can be acted upon. Their growing importance marks a transformation in scarcity from possession alone toward relational gateways.

1.12.5 Generative Opportunities and Meaningful Participation

The final scarcity considered in this section concerns opportunities to participate in relations that can generate further capacities, knowledge, projects, recognition, and future options. The term *generative opportunity* is used here in a preliminary sense. It denotes access to a relational configuration in which participation can contribute to outcomes that extend beyond immediate consumption or transfer. Examples include entry to a research community, participation in an organization where skills can develop, access to collaborators and infrastructure, involvement in a public institution, or membership in a network through which new projects become possible. The full theory of generative value and generative opportunity is developed later in the book; the present section identifies the historical conditions that make the category increasingly relevant.

This perspective extends the analysis of scarcity beyond the ownership of goods. A person may possess material resources and still lack access to relations in which those resources can be converted into capability. A worker may possess skill yet lack organizational entry. A researcher may possess knowledge yet lack collaborators, infrastructure, or recognition. A community may possess local knowledge yet lack institutional channels through which that knowledge can alter decisions. In each case, scarcity resides in a missing relation or a constrained pathway of conversion.

Sen's capability approach provides an important precedent for shifting attention

from resources to substantive opportunity (Sen 1999). GRE carries the question further into the structure of relations that generate later possibilities. The distinction is analytical rather than competitive: capabilities concern what a person is effectively able to do or be, while generative opportunities direct attention to the relational processes through which new capacities and future option spaces may emerge. The two can overlap, and their exact relation remains an open theoretical problem for later chapters.

Artificial intelligence intensifies the relevance of this issue because productive abundance can weaken the historical link between human participation and material necessity. If machines can perform a growing range of cognitive and symbolic tasks, economic inclusion cannot be understood only through the scarcity of labor required for production. Access to livelihood remains crucial, yet another problem becomes visible: whether people possess opportunities to participate in relations where their judgment, curiosity, care, creativity, or responsibility can become consequential. Section 1.15 examines the resulting pressure on the modern economic subject, and Section 1.17 develops relational and generative conditions of subjecthood more directly.

Meaningful participation is therefore introduced here as an economic object whose scarcity cannot be inferred from unemployment statistics or income measures alone. Its empirical specification requires caution. Meaningfulness varies across persons and contexts, and GRE does not assume a single universal content. The economically relevant issue is whether institutional arrangements provide plural pathways through which participants can enter, sustain, and transform consequential relations. Scarcity appears where such pathways are narrow, heavily gated, or concentrated among actors already possessing relational advantage.

The transformation of scarcity described across this section can now be stated in historical terms. Material scarcity persists, while digitalization and AI produce relative abundance in selected symbolic and informational domains. This abundance raises the importance of attention, trust, institutional access, and generative opportunity as mediating scarcities. Economic analysis organized only around the possession and allocation of material goods therefore captures a declining share of the constraints that determine who can convert resources into consequential participation. Section 1.13 turns next to allocation under radical capability asymmetry, where these new scarcities interact with increasingly unequal productive capacities.

1.13 Allocation under Radical Capability Asymmetry

This section examines a historical allocation problem created when productive capability becomes highly unequal across human and artificial participants. Its role in the chapter is to connect the changing scarcity structure of Section 1.12 to the institutional mechanisms through which income, access, and economic participation are distributed. The objective is to distinguish five elements that are often conflated: employment as an allocation channel, comparative capability as a condition of competitive access, automation as a transformation of task demand, productive abundance as distinct from broad resource access, and capability asymmetry as a possible source of

economic power. The discussion proceeds historically and institutionally rather than as a forecast of aggregate employment. Artificial intelligence is treated as a contemporary case in which productive capability may become radically asymmetric while the allocation of livelihood and participation remains organized through institutions formed under earlier productive conditions.

1.13.1 Employment-Based Allocation

Wage employment became one of the central allocation mechanisms of industrial economies because it linked productive participation to command over resources. A worker supplied labor through an employment relation and received wages or salary that could be converted into food, housing, services, savings, and other goods. The arrangement also frequently mediated access to benefits, credentials, professional networks, legal status, and forms of institutional recognition. Employment therefore functioned as more than a contract for a discrete productive task. It connected a position within production to a wider bundle of claims upon economic resources.

The historical character of this arrangement is important. Polanyi's account of market society emphasizes the institutional construction required to treat labor as something organized through markets and contracts (Polanyi 1944). Sen's entitlement analysis makes a related point from the side of command over resources: access to goods depends on the entitlement relations through which a person can transform endowments, production possibilities, trade, and public transfers into effective command (Sen 1981). Wage employment is one such entitlement relation. Its importance arises from the way institutions connect labor contribution to purchasing power rather than from any timeless identity between work and livelihood.

Employment-based allocation also packages several relations together. The employer receives access to labor under organizational authority; the worker receives income; public institutions may attach taxation, insurance, pension rights, immigration status, or social protection to the employment relation; and households organize consumption and care around the resulting income stream. The economic significance of losing a job therefore depends on the institutional bundle attached to employment. Two economies with similar productive technologies can generate very different consequences from the same reduction in labor demand when healthcare, housing, social insurance, or legal membership are connected to employment in different ways.

This bundling made employment an efficient administrative recipient for allocation in periods when productive systems required extensive and continuing human labor. Income could be distributed through organizations already responsible for coordinating production, while participation in production supplied a socially legible basis for claims on output. The arrangement also created vulnerability because access to livelihood became dependent on continued inclusion in productive organizations. Historical labor politics, social insurance, and public provision can be read partly as responses to this vulnerability rather than as departures from an otherwise self-sufficient labor market.

Artificial intelligence makes the contingency of the employment-allocation linkage more visible. If a growing range of tasks can be performed with less human labor, the

economic question extends beyond the number of jobs created or destroyed. It concerns whether institutions continue to use employment as the primary route through which people receive income, institutional access, and opportunities for participation. The issue is therefore one of allocation architecture: a productive system can change faster than the institutions that connect productive contribution to resource claims.

1.13.2 Comparative Capability and Competitive Access

Competitive allocation depends on relative as well as absolute capability. Where access to jobs, contracts, finance, education, or professional positions is limited, applicants are compared against one another under institutionally defined criteria. Improvements in one person's productive capacity can therefore alter the competitive position of others even when their own abilities remain unchanged. The scarcity lies in the number and quality of positions, while capability influences who can enter them.

Human-capital theory formalized one important part of this structure by treating education and training as investments that can raise productivity and earnings (Becker 1964). The approach helps explain why individuals invest in capabilities that improve access to scarce economic positions. A relational analysis adds the competitive environment in which those capabilities are evaluated. The return to a skill depends on the distribution of comparable skills, the technologies with which the skill is combined, the institutions controlling entry, and the criteria by which organizations recognize productive contribution.

The capability perspective further distinguishes possession of resources from effective opportunity. Sen emphasizes that people differ in their ability to convert resources into substantive freedoms because personal, social, and institutional conditions differ (Sen 1999). In labor and professional markets, the corresponding conversion problem includes credentials, networks, geographic access, legal status, organizational membership, and technological complements. A person can possess knowledge without possessing a recognized pathway through which that knowledge becomes economically consequential.

Artificial intelligence alters comparative capability in a complex way. Experimental and workplace studies have found that generative AI can raise performance in selected writing and customer-support tasks, with especially large gains for some lower-performing or less-experienced workers (Noy and Zhang 2023; Brynjolfsson et al. 2025). In such settings, AI can compress certain within-task performance differences by diffusing practices or supplying assistance. This equalizing effect at the task level can coexist with wider inequalities in access to frontier systems, proprietary data, compute, organizational authority, and the ability to redesign work around the technology.

Comparative capability therefore remains institutionally mediated. The relevant economic unit is rarely a human capability considered in isolation or an artificial capability considered in isolation. Competitive access depends on combinations of persons, tools, organizations, infrastructures, and recognized claims. Radical capability asymmetry becomes economically significant when some actors can assemble these combinations more effectively than others or control the institutional inter-

faces through which combinations are admitted into competition.

1.13.3 Artificial Intelligence and Employment Scarcity

Artificial intelligence introduces a new form of uncertainty into employment-based allocation because it can substitute for selected cognitive and symbolic tasks while also complementing workers and generating new tasks. The task-based literature on automation distinguishes displacement effects from reinstatement effects: technologies can reduce labor demand in tasks they automate while new tasks and activities can restore labor demand elsewhere (Acemoglu and Restrepo 2019). The historical record therefore offers no basis for treating task automation as mechanically equivalent to aggregate technological unemployment.

The relevant problem for GRE is narrower and more structural. Employment scarcity can increase for particular groups, occupations, or periods when the number of positions capable of providing stable income and institutional membership grows more slowly than the number of people seeking such positions. AI can contribute to this condition when organizations reorganize production around machine performance and require fewer workers for tasks that previously justified large employment structures. New tasks, new industries, or increased demand can offset the effect, yet the offset depends on the speed, location, accessibility, and institutional form of the new opportunities.

Korinek and Stiglitz analyze AI and worker-replacing technological progress through distributional channels that include innovation rents, changes in factor prices, and possible forms of technological unemployment under specified conditions (Korinek and Stiglitz 2019). Their analysis is useful here because it separates greater productive capacity from the distribution of the resulting gains. A technology can increase aggregate output while changing bargaining positions, income shares, and the allocation of surplus. The distributive consequences depend on ownership, substitution patterns, policy, and institutional design rather than on productivity alone.

Current evidence also counsels against a simple capability hierarchy in which AI uniformly replaces weaker workers first. Brynjolfsson, Li, and Raymond find substantial productivity gains from an AI assistant in customer support, with larger gains among less-experienced and lower-skilled workers in their setting (Brynjolfsson et al. 2025). Such evidence suggests that AI can operate as a capability-diffusion mechanism inside organizations even while reducing the scarcity of some human task-specific skills. The same technology can therefore complement workers at one margin and weaken the market value of previously scarce expertise at another.

Employment scarcity should consequently be understood as a relational outcome rather than a direct property of AI capability. It depends on how quickly tasks are reorganized, which new roles appear, how income is connected to those roles, who can access complementary tools, and whether institutions create alternative routes to livelihood and participation. The historical significance of AI lies in its potential to weaken the inherited coupling between human productive necessity and resource allocation. Whether that potential is realized, and in which sectors or populations, remains an empirical question.

1.13.4 Productive Abundance and Resource Concentration

Greater productive abundance does not determine how control over productive assets or resulting income is distributed. A production system can generate rapidly expanding quantities of output while ownership of capital, infrastructure, intellectual property, market access, or organizational decision rights remains concentrated. The distinction becomes especially important when the marginal cost of selected outputs falls faster than the cost of building or controlling the systems that generate them.

Digital and AI production display this asymmetry clearly. Section 1.11 noted that frontier AI development remains concentrated in large organizations with access to substantial compute, data, engineering capacity, and financing, even as downstream use diffuses more widely (Stanford Institute for Human-Centered Artificial Intelligence 2026). The result is a layered productive structure: symbolic and cognitive services can become cheaper and more abundant at the user interface while the infrastructure capable of producing frontier systems remains scarce and institutionally concentrated.

A broader empirical precedent is provided by the literature on superstar firms. Autor and colleagues document rising sales concentration in several industries and find that industries with larger increases in concentration experienced larger declines in labor's share, consistent with reallocation toward highly productive firms with relatively low labor shares (Autor et al. 2020). The analysis does not establish an AI-specific causal mechanism. Its relevance here is structural: productivity growth, concentration, and changes in the distribution of income can coexist when technological and market conditions shift activity toward a small number of highly productive organizations.

Resource concentration can also persist through control of complementary assets. Access to an AI model may be widespread while valuable deployment requires proprietary data, customer relationships, legal permissions, computing infrastructure, distribution channels, or organizational authority. The productive capability of the model becomes economically consequential through these relations. Actors controlling scarce complements can therefore capture a larger share of value even when the immediate technological output is reproducible at low marginal cost.

This distinction complicates abundance narratives. Productive abundance can reduce prices, widen access to services, and create new opportunities, while simultaneously increasing the strategic importance of the remaining scarce complements. Economic analysis therefore needs to track both output abundance and the distribution of control over the conditions that make abundance possible. Section 1.18 later identifies this divergence as one reason entity-level measures of possession can miss changes in relational and generative structure.

1.13.5 Capability Asymmetry and Economic Power

Capability asymmetry becomes economic power through institutional relations that convert superior capacity into control over resources, options, or the conduct of others. A technically superior system does not automatically possess economic power. Power emerges when capability is connected to ownership, organizational authority,

infrastructure control, bargaining position, institutional recognition, or the ability to determine access to scarce complements. The distinction is central to GRE because it separates differences in what actors can do from differences in what actors can compel, withhold, authorize, or capture.

The institutional mediation can be seen in ordinary firms. Organizational law and asset partitioning help establish entities capable of owning assets, entering contracts, and separating pools of claims (Hansmann and Kraakman 2000). Institutions therefore determine which actors can legally command productive resources and which claims are recognized when conflicts arise. Similar mediation applies to artificial capability. An AI system's productive capacity is exercised through the organization that owns, operates, licenses, deploys, or integrates it. The economically relevant power may reside in the relation among model capability, organizational control, and institutional recognition rather than in the model considered by itself.

Radical human–AI capability asymmetry makes this mediation especially important. The economic value of advanced AI partly arises because its performance can exceed human performance in selected tasks. Eliminating every capability difference would also eliminate much of the productive reason for deploying the technology. The practical problem is therefore not the existence of asymmetry alone. It is the structure through which asymmetry is converted into dependency, bargaining power, exclusion, or concentrated control over future opportunities.

Several conversion pathways are possible. An organization that controls scarce AI infrastructure can convert technical capability into lower production costs, then into competitive advantage, market access, revenue, and further investment. A platform can convert informational and computational capability into control over ranking, matching, or access. A worker equipped with an AI assistant can convert machine capability into higher individual productivity when organizational rules permit use and recognize the resulting output. Different institutional arrangements can therefore produce different power distributions from similar underlying technologies.

The same logic applies in the opposite direction. Humans and institutions can retain substantial power over technically superior systems through ownership, legal authority, access controls, energy supply, deployment permissions, and the design of organizational objectives. Capability and power can therefore diverge in both directions. The degree of divergence is a property of the relational architecture connecting subjects, institutions, and productive systems.

This distinction completes the section's historical argument. Employment-based allocation, competitive access, AI-mediated task transformation, resource concentration, and institutional conversion together create a setting in which productive capability can become radically asymmetric without determining a single distributive outcome. Economic consequences depend on the relations that connect capability to claims, resources, institutions, and participation. Section 1.14 turns next to symbolic abundance and representational crisis, where expanding productive capacity changes the reliability of the symbolic interfaces through which those relations are recognized and coordinated.

1.14 Symbolic Abundance and Representational Crisis

This section examines a second consequence of contemporary productive transformation: the expansion of symbolic production changes the conditions under which economic actors rely on representations of persons, organizations, transactions, risks, assets, claims, and states of the world. Its role in the chapter is to connect the symbolic abundance introduced by digitalization and artificial intelligence to a problem of economic coordination. The objective is to distinguish five layers of that problem: the scale of symbolic production, the relation between symbols and referents, the institutional effects of classification, the growing importance of provenance and epistemic trust, and the consequences of representational instability for coordination. The discussion is historical and institutional. It treats representations as economically consequential interfaces whose reliability depends on practices of classification, verification, authorization, and interpretation.

1.14.1 Expansion of Symbolic Production

Modern economies have long depended on symbolic production. Contracts, accounts, prices, reports, ratings, certificates, legal identities, statistical indicators, inventories, forecasts, and organizational records allow dispersed actors to coordinate without direct access to every underlying event or relation. Digital infrastructures greatly expanded the volume, speed, and granularity of these representations. Section 1.10 described how platforms, continuous observation, and algorithmic systems intensified the production and use of data. Section 1.11 added a further change: generative systems can now produce linguistically and visually plausible symbolic artifacts at very low marginal cost.

The economic significance of this expansion lies in the changing ratio between symbolic production and the resources required to evaluate it. A report, explanation, image, recommendation, summary, classification, or synthetic record can be generated quickly. The work required to determine provenance, contextual adequacy, factual support, relevance, and institutional standing may remain costly. Symbolic abundance therefore enlarges the set of representations available to actors while also increasing the burden placed on selection and verification.

The distinction between symbolic output and knowledge is essential. Language models can generate fluent text whose surface form resembles ordinary human communication, yet fluency alone does not establish understanding, reference, evidential grounding, or truth. Bender and colleagues emphasize this gap in their critique of large language models, warning against treating statistical success in language generation as equivalent to semantic understanding (Bender et al. 2021). The relevance for economics extends beyond debates about artificial intelligence. Economic coordination increasingly proceeds through representations whose production cost can fall much faster than the cost of establishing their epistemic status.

This asymmetry changes the practical meaning of abundance. A larger supply of symbols can improve access to explanation, translation, drafting, visualization, and administrative communication. The same expansion can also increase duplication, low-quality synthesis, strategic fabrication, and competition for attention. The result-

ing problem concerns the institutional relation among production, filtering, verification, and use. Symbolic production becomes economically productive only when actors can establish which representations deserve reliance within a particular decision context.

The contemporary transformation therefore adds a new layer to scarcity. Section 1.12 argued that abundant information can increase the relative scarcity of attention. Symbolic abundance also increases the relative importance of infrastructures that authenticate sources, preserve context, establish responsibility, and connect representations to the relations they purport to describe. These infrastructures become part of the productive conditions of knowledge-intensive economic coordination.

1.14.2 Symbols and Referents

A representation becomes economically useful through a relation to something beyond its own symbolic form. A balance sheet refers to an organization's financial position; a credential refers to an institutional status; a price refers to a transactionally recognized valuation; a risk score refers to an inferred probability or classification; a written claim refers to an event, object, or relation that may be investigated independently. The relevant economic question therefore concerns the stability of the relation between symbolic form and referent.

That relation has never been automatic. Documentary practices, accounting rules, legal procedures, statistical classifications, professional standards, audits, and institutional routines have historically supplied the conditions under which a representation acquires standing. A monetary figure in an audited statement, for example, carries a different institutional status from the same numeral written in an unauthenticated message. The visible symbol may be identical while its relation to evidence, authority, and responsibility differs.

Artificial symbolic production increases the importance of this distinction because surface plausibility can be generated independently of a corresponding referent. A text can describe an event that did not occur; an image can depict a scene that was never captured; a synthetic profile can imitate the ordinary markers of an institutional identity; a generated citation can possess the form of scholarship without referring to an existing publication. The representational problem therefore concerns the mapping from sign to referent and the institutional conditions under which that mapping can be trusted.

The problem is broader than deception. A representation can be sincere and still detach from the structure it is meant to summarize. Statistical categories may lag behind changing economic relations. Administrative records may preserve a legal identity while control has shifted elsewhere. Organizational reporting may describe formally bounded entities whose productive processes depend on external networks. A model can continue to produce internally coherent outputs after the relations that once justified its parameters have changed. Representational instability therefore includes both fabricated symbols and historically outdated or structurally incomplete mappings.

GRE later develops a more explicit distinction between relational reality and manifestational reality. The historical purpose of the present section is narrower. It estab-

lishes why the distinction becomes economically urgent under contemporary productive conditions. When institutions coordinate through increasingly abundant representations, the quality of economic action depends increasingly on the reliability of the relations connecting those representations to the subjects, processes, assets, and events they mediate.

1.14.3 Classification and Administrative Reality

Economic representations frequently take classificatory form. Persons are classified as employed, unemployed, self-employed, insured, resident, eligible, creditworthy, skilled, dependent, or vulnerable. Organizations are classified by legal form, sector, industry, size, ownership, reporting status, and jurisdiction. Assets, liabilities, expenditures, incomes, transactions, and risks are likewise organized through standardized categories. Classification makes complex relations administratively tractable by assigning them to recognized types.

The historical sociology of quantification shows that these categories are institutional achievements. Desrosières traces how statistical conventions construct comparability by defining categories, coding rules, and procedures of aggregation (Desrosières 1998). Hacking's work on historical ontology likewise emphasizes that classifications participate in the historical formation of the objects and kinds through which institutions organize knowledge (Hacking 2002). The relevant implication for GRE is that administrative representation can participate in constituting the economic reality upon which later decisions operate.

The System of National Accounts provides a concrete example. Its concept of an institutional unit identifies entities capable of owning assets, incurring liabilities, making economic decisions, and entering contracts, and uses those units to organize sectoral accounts (European Commission et al. 2009). Such classifications are indispensable for macroeconomic observation. They also establish a particular resolution at which economic activity becomes visible. Relations that cross recognized units or operate through informal, distributed, or hybrid arrangements can be less visible within the same framework.

Classification acquires performative force when eligibility, taxation, reporting duties, access, benefits, or regulatory treatment depend on category membership. An employment classification can affect social insurance and labor protections. A credit category can alter borrowing conditions. A platform's ranking category can affect discoverability. A statistical category can shape which population is recognized as a policy target. The representation therefore enters the relation it describes by altering the conditions under which actors are treated.

This feedback makes classification economically generative in a limited but important sense. A category can stabilize expectations, coordinate institutions, and support large-scale administration. It can also redirect behavior toward the criteria used for classification. As categories become integrated into automated systems, the speed of this feedback can increase. Classification, decision, and subsequent data generation can occur in a repeated loop, allowing an administrative representation to shape the future observations from which it is later updated.

The resulting issue is neither a rejection of classification nor a preference for un-

structured description. Complex economies require abstractions. The analytical task is to identify the relations that an abstraction preserves, the relations it suppresses, and the institutional consequences produced when the abstraction becomes an operational category. Representational crisis emerges when categories remain administratively powerful while their fit with changing relational structures becomes increasingly uncertain.

1.14.4 Authenticity, Provenance, and Epistemic Trust

Symbolic abundance increases the economic importance of authenticity and provenance. Authenticity concerns the standing of an artifact or claim as the artifact or claim it purports to be. Provenance concerns the history of its production, modification, custody, and transmission. Epistemic trust concerns the willingness to rely on a representation within a decision process. These dimensions interact, yet each answers a different question.

The distinction is visible in contemporary provenance standards. The C2PA Content Credentials specification defines technical mechanisms for binding signed provenance assertions to digital assets, recording creation and editing information, and validating whether those assertions remain associated with the underlying content (Coalition for Content Provenance and Authenticity 2026). The specification also draws an important boundary: validation of provenance data does not by itself determine whether the represented claim is true or normatively acceptable. Provenance supplies evidence about source and transformation history; interpretation remains necessary.

This separation has direct economic significance. A cryptographically verified document can still contain a mistaken forecast. An authenticated identity can make a false statement. A valid model output can be based on inappropriate assumptions. Conversely, an artifact without machine-verifiable provenance can still be accurate. Reliable coordination therefore depends on several layers of trust: confidence in source identity, confidence in chain of custody, confidence in the procedure that generated the claim, and confidence in the claim's adequacy to the decision at hand.

Porter's history of quantitative objectivity shows that impersonal procedures and standardized measures became important partly because institutions required forms of judgment that could travel across distance and survive disputes over personal authority (Porter 1995). Digital provenance infrastructures can be understood as a contemporary extension of the same organizational problem. Where direct familiarity is unavailable, institutions construct portable signals through which strangers can coordinate. The contemporary difference lies in the scale and speed of symbolic production, which increase the number of artifacts for which such signals may be demanded.

Provenance itself can therefore become an economic resource. Actors able to establish trusted identity, verified histories, recognized credentials, and auditable production chains may obtain advantages in markets where surface form is easy to imitate. Verification infrastructures can also become sites of dependency when a small number of institutions control identity, certification, reputation, or access to trusted channels. The problem of epistemic trust thus connects symbolic abundance to the

power questions developed later in the book.

The historical shift is consequently double. Artificial systems reduce the cost of producing persuasive symbolic form, while institutions respond by increasing investment in provenance, authentication, audit, reputation, and trusted intermediation. Economic coordination moves toward a regime in which the ability to produce symbols is widespread, while the ability to establish their standing remains institutionally differentiated.

1.14.5 Economic Coordination under Representational Instability

Economic coordination depends on representations because actors routinely decide in the absence of direct access to the underlying relations they seek to govern. Firms rely on accounts and forecasts; creditors rely on identities, histories, and risk measures; consumers rely on labels, reviews, and reputational signals; governments rely on administrative records and statistical indicators; platforms rely on profiles, rankings, and behavioral traces. Representational instability therefore becomes an economic problem when actors can no longer assume that the cost and reliability of these interfaces remain roughly stable.

Several consequences follow. Verification becomes a larger component of transaction and coordination costs. Organizations may devote more resources to authentication, audit, provenance, identity management, model validation, and source assessment. Trusted intermediaries can gain strategic importance because they reduce uncertainty for participants who cannot verify every claim independently. At the same time, concentration around trusted intermediaries can create new dependencies and bottlenecks. The infrastructure that restores trust can itself become a source of economic power.

Representational instability also affects temporal coordination. Decisions are often made before verification is complete. A false or poorly grounded representation can influence prices, hiring, credit, procurement, or public response before correction arrives. Later correction may fail to reverse the relational consequences already produced. The economic effect of a representation therefore depends partly on the speed with which it is produced, circulated, believed, acted upon, challenged, and revised.

Classification feedback adds a further layer. Once an institution acts on a representation, the action changes subsequent data. A risk classification can alter access to credit; altered access changes later repayment histories; those histories then become inputs to subsequent classification. A ranking can redirect attention; redirected attention changes observed popularity; popularity then reinforces the ranking. These loops make representational systems participants in the processes they measure.

The resulting crisis is best understood as a problem of alignment among symbolic production, referential reliability, institutional classification, and practical trust. The term *crisis* refers here to intensified instability in that alignment rather than to universal collapse of representation. Many representations remain highly reliable, and digital systems can improve traceability, consistency, and access. The historical change lies in the simultaneous expansion of symbolic productive capacity and the growing economic importance of institutions that determine which representations

can be trusted, acted upon, and converted into recognized claims.

This shift prepares the next problem in the chapter. Economic subjects themselves are partly stabilized through representational systems: occupational titles, employment records, credentials, income categories, organizational roles, legal identities, and measures of contribution all participate in defining how persons and organizations appear within economic institutions. When productive relations and representational systems change together, established subject positions can lose part of the institutional support that previously made them stable. Section 1.15 therefore turns from representational instability to the destabilization of the economic subject.

1.15 Destabilization of the Economic Subject

This section examines how contemporary productive transformation unsettles the institutional relations through which modern economic subjects have been stabilized. Its role in the chapter is to connect the preceding transformations of production, scarcity, allocation, and representation to a problem of subject formation. The objective is to identify the historical relations among economic roles, work, social recognition, productive necessity, and participation, and then to clarify why artificial intelligence places pressure on arrangements that have tied material access and social standing to comparative productive contribution. The discussion proceeds historically and institutionally. It first reconstructs economic roles as socially organized positions, then examines work as a source of recognition and membership, distinguishes productive contribution from productive necessity, analyzes the possibility of productive redundancy, and closes by identifying forms of economic participation that need not depend on productive superiority.

1.15.1 Economic Roles and Subject Formation

Modern economic institutions do more than allocate resources among pre-existing persons and organizations. They also assign recognizable positions through which participants become legible as workers, employers, owners, consumers, creditors, debtors, taxpayers, dependants, professionals, and members of organizations. Section 1.4 reconstructed these positions as historically formed economic subjects, while Section 1.5 showed how law, accounting, statistics, and administrative classifications stabilize the entities to which those positions attach. The present subsection develops the further implication that repeated participation in such roles can become part of the practical continuity through which persons understand their place in economic life.

An economic role carries a bundle of expectations, rights, obligations, resources, and relations. Employment connects a worker to wages, working time, organizational authority, occupational identity, social insurance, and often a trajectory of promotion or skill formation. Ownership connects an actor to control, exclusion, residual claims, and asset-based security. Professional status connects expertise to credentials, jurisdiction, reputation, and access to specialized work. Household positions connect provision, care, dependence, and intergenerational transfer. These arrangements differ across legal systems and historical periods, yet they share a general structure:

economic subject positions are reproduced through institutional relations that make some forms of participation recognizable and consequential.

This relational formation does not imply that persons are exhausted by economic roles. A person can remain a parent, friend, citizen, learner, creator, believer, neighbor, or participant in many other relations whose meaning exceeds economic classification. The analytical point concerns the historical importance of economic roles for access and recognition. In industrial and post-industrial societies, employment status, occupation, income, property, organizational affiliation, and professional credentials have often affected where a person can live, which institutions become accessible, how risk is borne, and which forms of contribution become publicly visible. Economic roles therefore participate in the stabilization of subject positions even though they never constitute the whole of subjectivity.

Polanyi's historical account of market society is useful here because labor, land, and money became increasingly organized through market institutions that restructured the relation between livelihood and social organization (Polanyi 1944). Marx's analysis of wage labor likewise places labor-power inside a historically specific relation in which access to the means of livelihood is mediated through the sale of labor capacity and the organization of production under capital (Marx 1867). The theoretical traditions differ substantially, yet both make visible a common historical fact: participation in production became deeply connected to the institutions through which subjects acquired income and occupied recognizable social positions.

The contemporary problem arises when the relations that stabilize those roles change faster than the categories through which subjects remain institutionally recognized. A person can retain knowledge, experience, responsibility, and the capacity for meaningful action while the labor market value of a previously recognized role declines. An organization can retain formal identity while its productive function is redistributed across platforms, contractors, automated systems, and external infrastructures. A credential can continue to certify a competence even as the task structure associated with that competence changes. Subject destabilization therefore begins as a mismatch between historically stabilized roles and changing productive relations.

The economic subject is consequently vulnerable to transformations that leave the underlying person or organization intact. The worker can persist while the job disappears; the professional can persist while the exclusive jurisdiction of a profession erodes; the firm can persist while productive control migrates toward infrastructure providers; the household can persist while the employment structure supporting its income becomes less stable. This distinction prepares the analysis of recognition in the next subsection. What becomes unstable is often the relation through which a subject is economically recognized, rather than the existence of the subject itself.

1.15.2 Work and Social Recognition

Work has historically supplied more than output. It can connect persons to income, routine, organization, skill formation, collective membership, reciprocal dependence, and publicly recognizable contribution. The relative importance of these dimensions varies widely across occupations and societies, and many forms of socially necessary activity remain unpaid or weakly recognized. Even so, the institutional centrality

of employment means that changes in work can affect both material access and the social recognition attached to participation.

The material relation is direct. Section 1.6 described employment as a major channel through which households receive claims on resources. Wages can determine access to housing, credit, insurance, savings, mobility, and many forms of consumption. Employment can also serve as an administrative gateway to benefits and legal protections. Where these arrangements are strong, work becomes one of the principal institutional bridges between productive participation and livelihood.

The recognitional relation operates differently. A role becomes socially recognizable when institutions and communities possess a vocabulary for identifying its contribution. Occupational titles, credentials, organizational positions, portfolios, rankings, and professional standards make contribution visible in standardized ways. Recognition can therefore depend on representation as well as performance. Section 1.14 showed that representational systems participate in economic coordination; they also participate in subject formation by stabilizing the categories through which contribution is noticed and attributed.

This dependence creates asymmetries among forms of work. Market-mediated labor often leaves records of hours, wages, outputs, contracts, and titles. Care, informal coordination, emotional support, household maintenance, community work, mentoring, and many forms of relational labor may generate substantial capacities while remaining weakly represented in conventional accounts. The economic subject produced through employment institutions therefore reflects a selective architecture of recognition. Activities become more visible when they enter established categories of paid contribution, while other relations can remain economically consequential without receiving equivalent institutional standing.

Sen's capability approach helps clarify the stakes because material resources matter through the substantive opportunities they enable rather than through possession alone (Sen 1999). Participation in work can be valuable partly because it supports income, but also because it can expand capabilities through learning, association, mobility, voice, and institutional membership. The same perspective also permits a distinction between work and the broader capabilities work sometimes supports. If technological change weakens the employment channel, the relevant loss cannot be assessed adequately by asking only whether income can be replaced. The consequences may concern access to relations, routines, opportunities for contribution, and forms of recognition previously carried by employment.

This point gives subject destabilization a wider scope than unemployment. A person may remain employed while experiencing reduced autonomy, weaker occupational jurisdiction, diminished bargaining power, or increasing dependence on algorithmic systems. Conversely, a person outside paid employment may possess rich capacities and participate in relations of care, learning, creation, and community life. Economic subjecthood therefore becomes unstable when inherited institutions continue to use employment as a privileged signal of contribution while productive and socially valuable activity becomes more heterogeneous.

Artificial intelligence intensifies this problem because it can alter the informational basis on which professional recognition rests. When generative systems assist writ-

ing, coding, analysis, design, diagnosis, or customer interaction, observed output becomes increasingly co-produced by persons, models, organizations, datasets, and infrastructures. Brynjolfsson, Li, and Raymond find that generative-AI assistance can increase worker productivity while producing heterogeneous gains and forms of knowledge diffusion (Brynjolfsson et al. 2025). The broader implication is that contribution becomes more relational: the performance attributed to an individual may depend increasingly on access to shared artificial capabilities. Recognition systems organized around isolated individual productivity may therefore become less informative about the relations that actually generate performance.

The historical role of work in social recognition should consequently be separated into its component relations. Employment can provide income, status, routine, membership, learning, bargaining position, and visibility of contribution. Technological transformation can affect these components differently. A future institution may preserve income while weakening membership, preserve work while changing autonomy, or expand productive capacity while concentrating recognition in those who control infrastructures. The economic problem concerns the reorganization of these relations rather than a single binary distinction between employment and unemployment.

1.15.3 Production and Social Necessity

The relation between production and subjecthood becomes especially important when productive capability grows faster than the need for particular forms of human contribution. This subsection distinguishes productive contribution from productive necessity. A person can contribute to production without being indispensable to it, and a society can possess the technical capacity to produce more output while reducing the number of human tasks required for a given production process. The distinction matters because modern allocation and recognition systems have often tied access to resources to the continuing demand for labor.

Industrial production already contained this tension. Mechanization increased output while reorganizing the demand for particular skills and tasks. The task-based framework developed by Acemoglu and Restrepo describes technological change through a balance between displacement, in which capital or automation performs tasks previously assigned to labor, and reinstatement, in which new tasks create new domains for labor demand (Acemoglu and Restrepo 2019). This framework is useful for GRE because it avoids treating technical capability as a direct forecast of employment. Productive transformation changes the task structure, while institutions, demand, complementary innovations, and new activities shape the resulting labor relation.

Artificial intelligence extends the same problem into domains of cognitive and symbolic production discussed in Section 1.11. The relevant change is the widening set of tasks for which machine systems can provide useful substitutes or complements. Writing, translation, coding, search, classification, planning, image production, and analytic support can increasingly be performed through human–AI configurations. The resulting productivity gains can expand output, lower costs, generate new demand, and create new roles. They can also reduce the amount of human labor re-

quired for some existing outputs. Both directions are compatible with the same technological advance.

The concept of social necessity adds another layer. A task may cease to be technically necessary for producing a given output while remaining socially meaningful. Human teaching, care, artistic performance, deliberation, companionship, craftsmanship, or face-to-face service can retain value even when some associated informational or productive functions are automatable. The persistence of such activity depends on institutions of valuation and participation as much as on comparative technical efficiency. Productive necessity and social desirability therefore belong to different analytical dimensions.

This distinction prevents a narrow interpretation of technological progress. If machine systems can produce a report faster than a person, the technical relation concerns the production of the report. The economic and social relation also concerns who learns through producing it, who is recognized for judgment, who bears responsibility for its consequences, who retains access to the relevant institution, and which capabilities are reproduced through repeated practice. An output-equivalent substitution can therefore change the relations surrounding production even when the immediate product appears unchanged.

The implications for subject formation are substantial. Modern societies have often connected the worth of economic participation to productive necessity: a worker receives income because an organization requires the worker's labor, and the need for that labor supports bargaining position and recognition. As artificial productive capacity expands, that connection can weaken in some domains. Technical abundance may make a person's participation less necessary for output without making the person's experience, judgment, relationships, or potential contribution meaningless. A tension then emerges between the organization of production and the organization of subject recognition.

Korinek and Stiglitz emphasize that the distributional effects of artificial intelligence depend on how technological change affects factor returns, innovation rents, ownership, and labor demand (Korinek and Stiglitz 2019). The implication for the present argument is institutional. Productive capability alone does not determine who receives resources or recognition. The connection between production and livelihood is mediated through property, employment, bargaining institutions, taxation, public provision, and other mechanisms of allocation. Productive necessity can therefore decline before the institutions built around it have been replaced or reconfigured.

The resulting subject problem is historically specific. Industrial modernity stabilized a powerful chain linking work, contribution, income, and social position. Contemporary artificial productive capacity can loosen individual links in that chain at different rates. Economic theory therefore needs concepts capable of distinguishing output production from capability formation, necessity from participation, and technical substitution from the broader relational functions historically carried by work.

1.15.4 Productive Redundancy and Subjective Instability

Productive redundancy names a condition in which an actor's participation becomes less necessary for achieving an established productive objective because comparable or superior output can be generated through other configurations. The term refers to a relation between an actor and a production system, rather than to a judgment about the actor's intrinsic worth. This distinction is central to the section. An economic system can treat a contribution as redundant while the person remains fully capable of experience, learning, care, judgment, creation, and participation in other relations.

Redundancy can arise gradually. A task may first receive machine assistance, then become standardized, then shift toward supervision, and eventually require little direct human production. It can also arise unevenly across workers. Access to artificial tools may allow some employees to perform a wider range of tasks, reducing demand for specialized positions elsewhere. Organizational redesign can redistribute tasks among workers, models, platforms, and external contractors. The resulting instability therefore concerns the configuration of productive relations rather than a uniform technological shock.

The subjective consequences depend on how strongly a person's economic continuity has been organized around a productive role. Where income, professional identity, daily routine, social network, institutional membership, and perceived contribution are concentrated in employment, the weakening of that role can produce several forms of instability at once. Material insecurity may be accompanied by a loss of recognized position, reduced opportunities for skill use, and uncertainty about the relation between personal capability and social need. These effects can occur even when aggregate production rises.

The concept should remain analytically restrained. Productive redundancy is a possibility generated by changing task relations; it is not a forecast that human labor as a whole will become unnecessary. Acemoglu and Restrepo's displacement–reinstatement framework explicitly leaves room for new tasks and new forms of human comparative advantage (Acemoglu and Restrepo 2019). Artificial intelligence may also create complementary roles whose content cannot yet be specified. GRE therefore treats redundancy as a local and historically variable relation that can expand, contract, or transform as institutions and production systems evolve.

Even a local form of redundancy can expose a deeper problem in allocation. If access to income and social resources depends heavily on being competitively necessary to production, a decline in necessity can become a decline in material command. Section 1.13 described the institutional channels through which capability asymmetry can affect allocation. Subjective instability adds the consequence that the same institutions also influence how persons understand their place in economic life. A system can therefore preserve productive abundance while generating insecurity among participants whose recognized roles weaken.

Income replacement addresses only part of this structure. Transfers, social insurance, public provision, or asset ownership can protect material access when employment falls. Such arrangements may be indispensable, yet the relations previously carried by work can remain unresolved. A person can possess income while lacking a recognized field of contribution; possess leisure while lacking access to commu-

nities of practice; possess consumption opportunities while lacking participation in decisions that shape shared institutions. The difference between material security and relational participation is therefore analytically important.

This distinction also constrains simplistic claims about a post-work economy. Reduced labor requirements can expand freedom from undesirable work, create time for care and learning, and weaken forms of domination tied to economic necessity. The same reduction can intensify exclusion if institutions continue to allocate recognition, voice, and access through employment. The consequences depend on which relations replace the employment nexus and how those relations distribute opportunities for meaningful participation.

The historical significance of artificial intelligence therefore lies partly in the possibility that productive abundance and subjective insecurity can coexist. A society may become technically capable of producing more with less human labor while retaining institutions that interpret reduced labor demand as reduced social claim. The tension arises from the lag between productive transformation and the institutional forms through which subject positions are recognized. This lag motivates the final subsection's focus on participation beyond productive superiority.

1.15.5 Economic Participation beyond Productive Superiority

The destabilization of inherited subject positions creates a positive analytical task: economic participation needs to be distinguished from productive superiority. Modern institutions have often rewarded actors who possess scarce capabilities, control productive assets, or occupy roles that organizations require. These mechanisms remain important, yet they provide an incomplete basis for subjecthood when artificial systems can exceed human performance across expanding sets of tasks. A relational economy therefore requires concepts of participation that remain intelligible even when contribution cannot be justified by superior output alone.

Sen's capability perspective offers one foundation because it evaluates substantive opportunities rather than reducing well-being to resource possession or commodity command (Sen 1999). Applied to participation, the relevant question concerns which relations persons are effectively able to enter, sustain, and shape. Access to education, public institutions, collaborative work, culture, care, research, community life, and collective decision-making can matter because these relations expand what persons are able to become and do. Their value need not depend on proving that human performance exceeds the best artificial alternative.

Economic participation can therefore be analyzed through several distinct dimensions. Material participation concerns access to resources and infrastructures required for life. Productive participation concerns contribution to the production and maintenance of goods, services, organizations, and shared capacities. Epistemic participation concerns access to inquiry, learning, interpretation, and the production of knowledge. Institutional participation concerns membership, voice, and the ability to influence rules. Relational participation concerns access to durable relations through which trust, care, identity, cooperation, and future opportunities can be generated. These dimensions can overlap while remaining analytically separable.

The distinction matters because technological systems affect them differently. Arti-

ficial intelligence may reduce the labor required for a productive task while increasing opportunities for learning, experimentation, or collaborative creation. It may improve access to knowledge while concentrating control over computational infrastructure. It may enable small organizations to perform functions previously requiring large staffs while increasing dependence on a few platform providers. Evaluation therefore requires tracing which forms of participation expand, which contract, and which become conditional on new intermediaries.

Participation also has a temporal dimension. A relation can be valuable because it generates later capabilities that were unavailable at the moment of entry. Apprenticeship, education, research collaboration, caregiving, community membership, and participation in institutions can produce skills, trust, confidence, reputation, and future opportunities. A purely output-centered account can undervalue such relations when their immediate productivity is modest. GRE later develops this problem through the concept of generativity. The historical point here is that the weakening of productive necessity makes these longer-horizon relational effects more visible as economic questions.

The same perspective changes the interpretation of artificial capability. If machine systems outperform humans on a task, the comparison answers a question about task performance under specified conditions. It does not determine whether humans should cease to participate in every relation organized around that task. Education offers the clearest example: a system may know more than a learner while the learner's engagement with a subject still generates human capability. Similar distinctions may arise in art, research, care, deliberation, and craftsmanship, where participation itself can transform the participant and the surrounding relational system.

This approach preserves the role of productive efficiency while limiting its jurisdiction. Efficiency remains relevant when a goal is well specified and output can be compared meaningfully. Subject formation, capability development, institutional membership, and relational continuity introduce additional objects of economic evaluation. A society facing radical artificial capability therefore confronts a problem of institutional design: how to organize access, contribution, recognition, and participation when comparative productive superiority no longer provides a stable general foundation for each of them.

The next section develops the relational basis required for that problem. Section 1.16 examines economic subjecthood as a relatively stable configuration generated and sustained through social and institutional relations. The move does not assign final ontology to the subject. It identifies the relational conditions under which subjects acquire sufficient persistence, recognition, and causal efficacy to become objects of economic analysis.

1.16 Relational Constitution of Economic Subjecthood

Section 1.15 identified a historical strain in the modern alignment among productive contribution, income, recognition, and subject position. The present section provides the conceptual bridge required by that diagnosis. Its role is to reconstruct economic subjecthood through the relations that generate, stabilize, and recognize an actor as

a participant in economic life. The objective is deliberately limited: the section develops a relational account sufficient for economic analysis while reserving stronger metaphysical questions for the ontological discussion in Chapter 4. The argument proceeds through five steps. It first locates subject formation within social relations, then examines the mechanisms that stabilize economic actors, turns to institutional recognition, states a minimal account of relational reality under ontological suspension, and finally considers how the framework applies to human and artificial economic subjects. The method is historical-institutional and analytical. It asks what practical conditions allow an actor to persist as a recognizable bearer of roles, resources, obligations, capacities, and consequences across time.

1.16.1 Social Relations in Subject Formation

Economic subjecthood becomes intelligible once the subject is approached through the relations in which economic capacities acquire determinate form. A worker is constituted economically through relations of employment, remuneration, authority, skill recognition, and social reproduction. An owner occupies relations of title, exclusion, transfer, inheritance, and control. A consumer appears through monetary access, market exchange, product classification, credit, and infrastructures of distribution. A household becomes actionable through membership, care, income pooling, taxation, welfare rules, and statistical recognition. These positions differ sharply in content, yet they share a structural feature: the economic subject is recognizable because a network of relations gives the position continuity and practical consequences.

This relational reconstruction extends the historical argument developed earlier in the chapter. Economic action has long been embedded in ongoing structures of social relations, and Granovetter's critique of atomized economic action remains useful precisely because it directs attention to the social structures through which apparently individual conduct becomes possible and consequential (Granovetter 1985). The relational point can be taken further without assuming that every feature of a person is socially produced. Economic subjecthood concerns a domain-specific position. The person who occupies that position exceeds it, while the position itself is formed through relations that make certain actions, claims, obligations, and resources available.

The distinction between bearer and position prevents two forms of analytical compression. One compression treats the subject as a self-contained unit whose economically relevant capacities are already present before interaction. The other treats the subject as fully exhausted by the relations currently observed. A relational account can preserve a practical identity while recognizing that the capacities attached to that identity are historically conditioned. Skills are acquired through education and work; creditworthiness is constituted through records and institutional judgment; ownership depends on recognized title; occupational identity depends on social classification and organizational demand; household responsibility depends on membership rules. These capacities become attributes of actors in practice even though their production is relational.

Historical categories participate in this formation. Hacking's historical-ontological work emphasizes that classifications, descriptions, and styles of reasoning can par-

ticipate in bringing into view kinds of persons and objects that become available for thought and action (Hacking 2002). In economic life, categories such as employee, unemployed person, shareholder, debtor, beneficiary, incorporated firm, or dependent household member do more than summarize pre-existing properties. They organize eligibility, obligation, comparison, and institutional response. Once repeatedly used, a category can become part of the relational environment through which actors understand their position and through which others act upon them.

Subject formation therefore has a recursive structure. Relations generate positions; positions organize expectations and conduct; conduct reproduces or modifies the relations that generated the positions. This recursion explains why economic subjects can appear stable while remaining historically transformable. A worker can persist as a recognizable subject across many transactions because employment law, payroll systems, occupational classifications, organizational routines, and social expectations stabilize the position. Changes in technology, law, family structure, or organizational form can later alter the same position without requiring the person occupying it to disappear.

The relational constitution of subjecthood also clarifies why new economic actors can emerge historically. Platform sellers, data workers, content creators, gig workers, cooperative members, algorithmic service providers, and other contemporary positions become economically salient when repeated relations stabilize distinctive expectations, flows, rights, risks, and forms of recognition around them. The emergence of a subject position can therefore be studied historically through the relations that make it durable enough to enter allocation, accounting, regulation, and collective interpretation.

1.16.2 Relational Stabilization of Economic Actors

Subject formation alone does not explain persistence. Economic analysis ordinarily requires actors that can be followed across transactions, held responsible for obligations, assigned resources, and recognized by counterparties. Relational stabilization names the process through which a changing configuration becomes sufficiently continuous to support those practices. The relevant stability is practical and historical. It can be strong enough for accounting, contracting, policy, and statistical analysis while remaining open to transformation.

Several mechanisms contribute to stabilization. Repetition is the most elementary. Recurrent interaction allows counterparties to form expectations about conduct, reliability, skill, payment, or role performance. Records extend repetition across time by making prior actions institutionally available. Contracts and property titles preserve obligations beyond the moment of agreement. Organizational routines preserve roles across personnel changes. Membership rules define who remains inside a household, association, cooperative, or firm. Trust lowers the need to renegotiate every relation from the beginning. Infrastructures such as payment systems, registries, identity systems, and digital platforms provide technical continuity across otherwise separate encounters.

Stabilization also depends on complementarity. A position becomes durable when other positions are organized around it. The worker position is sustained by employ-

ers, payroll systems, labor law, training institutions, tax systems, and household expectations. The firm is stabilized by workers, suppliers, customers, creditors, regulators, accounting practices, and legal recognition. The consumer position depends on sellers, money, distribution, standards, information, and rights of redress. The durability of an actor is therefore partly a property of the surrounding configuration. A subject can lose economic continuity when complementary relations dissolve even if the bearer remains materially unchanged.

This point is especially important for collective actors. A corporation may survive the departure of founders, managers, workers, investors, and customers because the relations composing the organization are reproduced through roles, records, procedures, assets, contractual continuity, and external recognition. Section 1.5 showed how organizational law and accounting provide institutional mechanisms for such persistence. Relational stabilization adds the wider economic condition: counterparties continue to orient their conduct toward the organization as one participant. The collective actor acquires continuity because many relations converge on a sufficiently stable reference point.

Stabilization admits degrees. Some subject positions are highly standardized and portable across institutions; others depend on a narrow local relation. An incorporated firm with registered assets, audited accounts, recurring contracts, and regulatory standing possesses stronger institutional continuity than an informal collaboration assembled for a single project. A household can be stable for purposes of taxation and unstable for purposes of care or resource sharing. A digital identity may be persistent within one platform and irrelevant outside it. Economic subjecthood therefore varies with the domain, scale, and relation under examination.

The degree structure matters for contemporary transformation. New technologies can produce economically consequential actors faster than legal and statistical systems can stabilize them. A software agent can repeatedly perform purchasing, pricing, recommendation, or coordination functions while formal responsibility remains assigned to a human or organization. A decentralized collective can coordinate resources before established law provides a clear organizational category. Relational stabilization can therefore precede full institutional recognition, creating a period in which practical economic agency and formal subject status diverge.

1.16.3 Institutional Recognition of Subject Positions

Institutional recognition converts relational stabilization into forms that large-scale economic systems can administer. Law, accounting, taxation, statistics, welfare systems, financial institutions, and organizational procedures require identifiable units to which rights, obligations, resources, liabilities, and observations can be attached. Recognition gives a subject position an address within these systems. It also changes the position by creating consequences that follow from being classified in one way rather than another.

Modern economic administration offers clear examples. The System of National Accounts defines institutional units through capacities such as owning assets, incurring liabilities, making economic decisions, and engaging in transactions in their own right (European Commission et al. 2009). Financial reporting similarly constructs re-

porting entities whose boundaries can include a legal entity, part of an entity, or several entities, depending on the informational purpose of the report (IFRS Foundation 2018). Organizational law stabilizes further distinctions by partitioning assets and creditor claims around recognized organizational forms (Hansmann and Kraakman 2000). These frameworks do not merely discover a universal natural boundary. They create standardized interfaces through which heterogeneous relational configurations become comparable and actionable.

Recognition has distributive consequences. Employment status can determine access to wages, insurance, leave, taxation, and legal protection. Household classification can alter benefit eligibility and tax liability. Corporate status can affect asset ownership, limited liability, financing, and continuity. Residency, citizenship, professional certification, and organizational membership can determine access to institutions and resources. Recognition therefore participates in the production of economic capacity. A subject position that enters an institutional category can acquire options unavailable to an otherwise similar actor outside it.

The same process can exclude. Relations that do not fit established categories may remain economically consequential while receiving weak institutional visibility. Informal care, unpaid collaboration, platform-mediated labor, collective knowledge production, or cross-border digital activity can generate value and obligations without aligning neatly with inherited administrative units. The mismatch does not make these relations unreal. It affects whether economic systems can see them, allocate to them, regulate them, or assign responsibility through existing procedures.

Institutional recognition is therefore performative in a bounded sense. A classification can change access, incentives, responsibility, and behavior because institutions act through it. Its efficacy still depends on relations beyond the classification itself. Declaring an organization independent does not produce suppliers, trust, productive capacity, or internal coordination. Recognizing a worker category does not determine the actual distribution of bargaining power or care burdens. Recognition becomes economically effective when classificatory rules connect to infrastructures, resources, expectations, and enforcement.

This bounded performativity provides a useful bridge to the later discussion of manifestation. Economic systems often encounter subjects through institutional representations: accounts, legal statuses, employment records, credit files, identifiers, statistical categories, or platform profiles. These manifestations can stabilize action while preserving only part of the underlying relational structure. The analytical task is therefore twofold: to take institutional recognition seriously as a causal component of economic subjecthood and to preserve the possibility that the recognized manifestation leaves economically relevant relations unresolved.

1.16.4 Relational Reality under Ontological Suspension

The preceding analysis permits a minimal ontological stance suitable for the historical argument of this chapter. An economic subject can be treated as relationally real when a configuration is generated and sustained through relations, persists sufficiently to support recurrent interaction, and exercises causal effects within the economic system. This criterion concerns analytical standing rather than ultimate meta-

physical substance. Chapter 4 develops the distinction more fully through ontological suspension, relational reality, and manifestational reality.

Ontological suspension is useful because the economic subjects considered in this chapter are heterogeneous. A person, household, corporation, cooperative, state agency, platform account, and software agent do not need to share one ultimate mode of being in order to participate in economically consequential relations. Economic analysis can ask how each is generated, recognized, stabilized, and causally effective while leaving deeper questions about consciousness, personhood, identity, or metaphysical composition open where the economic argument does not require their resolution.

Relational reality also guards against premature reification. A stabilized subject can be treated as a unit for a particular analytical purpose while its boundary, capacities, and continuity remain dependent on relations. The firm can be a real contracting and accounting subject even though its productive capacity depends on workers, suppliers, law, finance, infrastructure, and knowledge networks. The household can be a real administrative unit even though its internal distribution cannot be inferred from aggregate resources. A worker can be a real employment subject while occupational identity and earning capacity remain historically generated. Reality at the relational level therefore supports unit-level analysis without converting provisional boundaries into timeless essences.

The same stance preserves practical identity. Relational constitution does not require economic analysis to dissolve every subject into an unbounded network. Contracts, liabilities, rights, welfare claims, preferences, plans, and histories frequently attach to identifiable actors. The question is how those identities are sustained and what relations make them economically effective. A relational account can therefore move between levels: it can treat the subject as a unit where the unit is causally and institutionally stabilized, and it can reopen the unit when internal or external relations become necessary for explaining an outcome.

This level-sensitive stance is especially important for value and responsibility. Economic systems often need to know who receives a transfer, who owes a debt, who controls an asset, who bears a risk, or who is accountable for a decision. These questions require subjects. GRE later asks how resources and value move through the relations composing and surrounding those subjects. Relational reality allows both inquiries to proceed without forcing one level to replace the other.

Ontological suspension also supports theoretical pluralism. Different disciplines may describe the same economic participant through different ontological vocabularies. Law may focus on personhood and responsibility; sociology on role and recognition; psychology on agency and cognition; computer science on system architecture; economics on choice, production, and allocation. GRE can use relational criteria to compare these descriptions where they intersect economically while allowing each domain to retain questions that exceed economic analysis. This discipline becomes decisive when artificial systems enter the picture.

1.16.5 Human–Artificial Economic Subjecthood

Artificial intelligence intensifies the subjecthood problem because economically consequential activity can increasingly be produced by systems whose legal, moral, cognitive, and institutional status differs from that of human participants. Section 1.11 showed that contemporary AI systems already participate in cognitive production, symbolic generation, workplace assistance, and organizational coordination. The question here concerns the analytical conditions under which such participation supports an economic subject position.

Four dimensions should be separated. Productive agency concerns the capacity to perform economically relevant tasks or alter outcomes. Relational continuity concerns whether counterparties repeatedly orient their conduct toward the system or toward a stable role mediated by it. Institutional recognition concerns whether rights, liabilities, accounts, contracts, or administrative consequences can be attached to the position. Normative standing concerns questions such as welfare, rights, responsibility, consciousness, or moral consideration. These dimensions can vary independently. A system may possess substantial productive agency and relational continuity while institutional and normative standing remain assigned to the human or organizational actors surrounding it.

The distinction prevents economic efficacy from carrying an ontological burden it cannot bear. Current language models can generate fluent symbolic output, while fluency itself does not establish understanding or meaning in the strong sense cautioned against by Bender and colleagues (Bender et al. 2021). Economic analysis nevertheless has reason to follow the causal role of such systems when organizations change staffing, prices, workflows, search processes, or service provision in response to them. Productive and relational effects can therefore be studied without treating those effects as evidence of human-equivalent cognition.

Institutional mediation remains central. A software agent that purchases goods, schedules labor, executes trades, recommends credit, or negotiates within a platform usually acts through accounts, permissions, assets, and liabilities ultimately connected to recognized persons or organizations. The economic subject may therefore be layered: an artificial system can occupy an operational role, a firm can bear legal responsibility, workers and users can supply inputs, and platform owners can control the infrastructure. The relevant unit depends on the question being asked. Production analysis may focus on the artificial agent's task performance; liability analysis may focus on the organization; power analysis may focus on ownership and infrastructure; welfare analysis may focus on affected humans.

This layered structure also clarifies why human and artificial economic subjects should not be treated as automatically equivalent. Human economic subjecthood is embedded in embodiment, vulnerability, social reproduction, capability development, legal rights, and forms of recognition that exceed productive output. Sen's capability perspective is relevant because it locates evaluation in substantive opportunities and the institutional conditions under which persons can act and become (Sen 1999). Artificial systems may participate powerfully in economic production without sharing the same capability, welfare, or rights framework. A relational analysis can compare economically relevant functions while preserving these normative differ-

ences.

Artificial systems can nevertheless acquire increasingly stable subject-like positions within particular economic domains. Recurrent identity, persistent memory, delegated authority, autonomous task execution, access to resources, and counterparties that adapt to system behavior can create a durable operational position. Institutional evolution may later attach new forms of recognition to such positions. The trajectory is an empirical and legal question rather than a conclusion established by technical capability alone.

The wider significance for GRE is methodological. Economic subjecthood should be analyzed through the relations that generate and stabilize participation rather than through a single universal test of entity status. Human persons, collective organizations, and artificial systems may occupy different subject positions, with different degrees of persistence, recognition, agency, and normative standing. The framework therefore preserves heterogeneous subjecthood while retaining enough structure for allocation, production, power, and responsibility to remain analyzable.

Section 1.17 takes the next step. Once subjects are understood as relationally stabilized, the central question shifts from the persistence of a subject to the capacity of relations to transform subjects, generate capabilities, alter future possibilities, and reproduce or change the conditions under which later relations form. That movement introduces the generative dimension that distinguishes GRE from a purely relational economics.

1.17 From Relational Subjecthood to Generative Relations

This section develops the transition from relational constitution to generativity. Its role in the chapter is to show why identifying the relations that stabilize an economic subject is only the first stage of analysis. The objective is to examine how persistent relations can transform subjects, generate capacities, alter the range of future possibilities, and organize forms of participation whose effects extend beyond an immediate transaction. The discussion proceeds conceptually and historically, drawing on the relational insights established in Sections 1.8 and 1.16. It first distinguishes persistence from mere recurrence, then analyzes subject transformation and capacity formation, extends the analysis to future possibility, and closes by specifying the generative structure of economic participation.

1.17.1 Persistence of Relational Structures

A relation becomes historically consequential when it persists long enough to condition later action. Persistence can arise through repeated interaction, institutional recognition, durable expectations, shared infrastructure, accumulated knowledge, legal rules, organizational routines, or material dependence. The resulting structure can outlast the particular exchange in which it first appeared. Employment relationships can generate occupational identities and skill trajectories; credit relations can alter future borrowing conditions; supply relationships can create specialized productive capacities; educational relations can reshape later opportunities; and

platform-mediated relations can reorganize access to markets, audiences, and information. The economic significance of a relation therefore depends partly on the temporal structure through which its effects continue.

Persistence should be distinguished from simple repetition. A sequence of transactions can recur without producing a durable change in the participants or in the surrounding institutional environment. A persistent relational structure has a stronger property: earlier interaction affects the conditions under which later interaction occurs. Trust, reputation, contractual routines, shared standards, specialized assets, organizational memory, and accumulated expectations are familiar mechanisms through which past relations become active conditions of the present. Granovetter's account of embedded economic action remains useful here because it directs attention to ongoing social structures rather than isolated transactions (Granovetter 1985). For GRE, the further question concerns what these ongoing structures make possible over time.

The persistence of relations can be located at several scales. A dyadic relation between worker and employer may stabilize expectations about effort, compensation, learning, and advancement. Repeated relations among firms can create interorganizational routines and shared technical standards. Relations among research institutions can stabilize channels through which knowledge, personnel, and equipment circulate. Financial relations can become embedded in clearing systems, regulatory arrangements, and expectations about liquidity. The relevant unit of analysis therefore expands as persistence becomes distributed across multiple participants.

Institutionalization is one important mode of persistence. A relation becomes institutionally durable when rules, classifications, legal forms, accounting practices, credentials, or administrative procedures reproduce it beyond the memory or intention of particular participants. Section 1.5 showed how modern economic entities are stabilized through precisely these mechanisms. The same mechanisms can stabilize relations among entities. A professional credential reproduces a relation between certified expertise and institutional access; a property title stabilizes a relation of exclusion and control; a standard contract reproduces a recognizable pattern of obligation across many interactions. Persistence can therefore be carried by symbolic and administrative infrastructures as well as by repeated personal contact.

Material complementarity can also make relations persistent. Specialized productive systems often create capacities that have value only within a wider configuration. A supplier investing in a highly specific component, a worker acquiring organization-specific knowledge, or a laboratory developing equipment around a shared protocol may become increasingly connected to a particular relational environment. The relation persists partly because the capacities generated within it are difficult to redeploy elsewhere without loss. This structure can support coordination and learning while also creating dependence and switching costs.

Persistence is normatively ambiguous. Durable relations can support trust, learning, care, coordination, and collective capacity. They can also reproduce dependency, exclusion, hierarchy, or unequal bargaining positions. The analytical importance of persistence lies in its generative potential rather than in any presumption that durability is beneficial. Once a relation modifies the conditions of later interaction, economic analysis must attend to the trajectory it produces and to the distribution of the

capacities and constraints that accumulate within it.

This temporal perspective prepares the move from relational stability to subject transformation. A subject stabilized by relations can also be changed by those relations. Persistence therefore provides the medium through which economic participation becomes formative rather than merely connective.

1.17.2 Relations and Subject Transformation

Economic subjects enter relations with histories, capacities, expectations, and institutional positions, and participation can modify each of these. The relevant transformation may concern skill, preference, identity, reputation, bargaining position, access, trust, obligation, or the practical categories through which a subject understands available action. Relations thereby participate in the production of later subjects. A relational account of economic life becomes generative when it follows this transformation across time.

Work provides a familiar example. Employment can alter a worker through training, occupational socialization, access to colleagues, exposure to organizational routines, and participation in professional communities. Human-capital theory captures one component of this process by treating education and training as investments that alter productive capacity (Becker 1964). A generative relational perspective widens the object. Skill formation occurs through relations with instructors, coworkers, institutions, technologies, standards, and bodies of knowledge. The capacity that later appears to belong to an individual can therefore have a distributed history of generation.

Organizations undergo analogous transformation. Repeated collaboration can produce routines, trust, shared vocabularies, coordination practices, and collective memory that are unavailable to participants acting separately. Powell, Koput, and Smith-Doerr's study of biotechnology is important because innovation appears within networks of interorganizational learning rather than inside fully self-sufficient firms (Powell et al. 1996). The productive subject in such settings changes through its relations: a firm's effective knowledge base and opportunity structure depend on the collaborations through which it learns and combines capabilities.

Relational transformation also occurs through institutions that classify and recognize subjects. Credentials can transform access to occupations; credit scores can change financing conditions; legal statuses can alter eligibility and responsibility; platform ratings can influence future matching and visibility. These representations can become part of the causal environment in which later subject positions are formed. Section 1.14 described the representational instability associated with symbolic abundance. The present point is temporal: once a representation affects later relations, it participates in the trajectory through which a subject is transformed.

Transformation can be cumulative and path dependent. Two subjects with initially similar resources can acquire different capacities because they enter different relational environments. Early access to strong mentors, well-connected institutions, trusted collaborators, stable employment, or high-quality infrastructure can generate later advantages that compound through subsequent relations. Conversely, exclusion from these environments can limit the opportunities through which capacities

would otherwise develop. The distribution of present resources therefore provides only a partial account of future economic position when the relations through which resources are converted into capacities differ systematically.

This dynamic also complicates the usual separation between preference and constraint. Participation can alter what subjects value, what they can imagine, which goals appear attainable, and which forms of activity become meaningful. Economic relations can therefore affect both the feasible set and the orientation of the subject within it. GRE does not require a universal theory of preference formation at this stage. It requires only the weaker historical observation that economic participation can modify the subject who later chooses, works, invests, cooperates, or withdraws.

Artificial intelligence introduces a new set of formative relations. A worker who repeatedly relies on an AI system may acquire new capabilities through augmentation, lose others through reduced practice, reorganize attention around system outputs, or become dependent on infrastructures controlled elsewhere. Organizations can similarly redesign workflows, expertise hierarchies, and decision routines around artificial systems. The long-run economic effect therefore concerns more than the productivity of a task at one moment. It also concerns the kinds of human and organizational subjects produced by sustained participation in AI-mediated relations.

Subject transformation provides the bridge to capacity formation. A generative relation becomes especially important when participation produces abilities, resources, forms of coordination, or institutional access that were unavailable to the participants before the relation developed.

1.17.3 Relations and Capacity Formation

Capacity formation gives the generative dimension a more precise economic object. A relation is generatively significant when participation helps produce a capacity that changes what a subject or collective can subsequently do. Capacities can be productive, epistemic, organizational, relational, political, or adaptive. They may reside partly in identifiable subjects and partly in the relations and infrastructures through which those subjects act.

The capability perspective offers an important point of contact because it evaluates resources through the substantive opportunities they enable rather than through possession alone (Sen 1999). GRE extends this concern temporally. The question becomes how present relations contribute to the formation of later capabilities and how unequal access to those relations shapes future opportunity. A training grant, for example, has one immediate recipient, yet its effect depends on educational institutions, mentorship, time, social support, recognition, and pathways into later work. Resource allocation and capacity generation are therefore analytically distinct stages.

Some capacities are intrinsically relational. Trust cannot be possessed by one actor in isolation in the same manner as a physical asset. Coordination capacity emerges through repeated mutual adjustment. A professional network becomes useful through reciprocal recognition and access. Collective knowledge depends on communication, shared standards, and institutional memory. Organizational resilience can depend on redundancy, distributed expertise, and the quality of relations among units. These examples show why a purely possessive vocabulary can

underdescribe capacities whose efficacy lies in structured interdependence.

Capacity can also be generated at a higher level than the participants through whose interaction it arises. A research collaboration can create a shared dataset, protocol, instrument, or body of tacit knowledge that later participants inherit. A supply network can develop standards and logistical routines that increase the productive capacity of the network as a whole. A community can establish norms and institutions that support collective action. The resulting capacity is real in its effects even when it cannot be assigned without remainder to any single member.

Relational capacity formation is often cumulative. Early participation can create the competence required to enter more advanced relations, which then generate further capability. Education, professional apprenticeship, scientific collaboration, entrepreneurship, and institutional membership frequently exhibit this structure. The trajectory can become self-reinforcing when generated capacities increase access to subsequent opportunities. The reverse is also possible: weak initial access can reduce later participation and create cumulative disadvantage.

The distribution of capacities therefore depends partly on the distribution of generative relations. Two actors receiving identical nominal resources can experience different long-run outcomes because their surrounding relations differ. Access to mentors, infrastructure, stable institutions, trusted collaborators, legal recognition, and time can determine whether a resource becomes an enduring capability. This observation is central to the later GRE treatment of allocation. Allocation affects economic futures partly by changing the relations through which capacity can be generated.

Capacity formation also clarifies why generativity should remain separate from immediate performance. A relation may reduce short-term efficiency while increasing learning, redundancy, adaptability, or future option space. Conversely, a highly optimized arrangement may produce excellent immediate output while generating little new capability among participants. GRE later develops the evaluative consequences of this distinction. At the historical level of the present chapter, the important point is that the productive significance of a relation can appear only across time.

The temporal extension of capacity leads directly to future possibility. Generated capability matters because it changes the set of relations, actions, and trajectories available later.

1.17.4 Relations and Future Possibilities

Economic relations participate in the construction of future possibility by changing which actions, affiliations, projects, and institutional positions become available. A future opportunity is rarely created by a resource alone. It emerges from a configuration that connects capacity, recognition, infrastructure, information, legal permission, social access, and material conditions. The generative effect of a relation can therefore be described partly through the possibilities it opens, preserves, redirects, or forecloses.

This perspective adds a temporal dimension to scarcity. Section 1.12 argued that contemporary scarcity increasingly concerns attention, trust, institutional access,

and generative opportunity alongside persistent material scarcity. Generative opportunity is distinctive because its value lies in what can follow from participation. Access to a research laboratory matters partly through experiments that become possible; access to a professional community matters through collaborations and recognition that may emerge; access to a stable learning environment matters through capabilities that develop over time. The economic object is therefore a pathway rather than a single consumable unit.

Future possibility is path dependent because present participation can alter later access. A first job can generate experience that changes eligibility for later work. A credit relation can create a repayment history that affects future finance. Membership in a standards body can provide information and influence over later technical rules. Participation in a platform can accumulate reputation and audience. These relations create histories that institutions later use when allocating further opportunities. Economic systems thereby convert past relations into conditions of future participation.

Possibility can also be foreclosed. Debt burdens can constrain later choices; restrictive contracts can limit mobility; dependency on proprietary infrastructure can raise switching costs; narrow credential systems can exclude forms of competence that lack recognized representation; concentrated ownership can prevent participants from converting contribution into control. The generative analysis of economic relations therefore requires attention to both expansion and contraction of future option spaces.

The same structure operates collectively. A community that loses a school, clinic, transport link, financial institution, or research facility may lose more than the immediate service. It can lose the relations through which later capabilities and projects would have formed. Conversely, shared infrastructure can generate opportunities that were not specified in the original investment. The return on infrastructure may therefore include emergent activities that could not be enumerated in advance because they depend on subsequent relations among users.

This openness distinguishes generative possibility from prediction. A generative relation can expand the range of feasible futures without determining which future will occur. Educational access can enlarge capability without fixing occupation; scientific infrastructure can enable discoveries without specifying them; social trust can support cooperation without determining its object. GRE is therefore interested in conditions that make later generation possible while retaining contingency in the trajectories that follow.

Future possibility also introduces a distributional problem. Some actors possess wide option spaces because they can draw on wealth, institutions, networks, mobility, and recognized credentials. Others confront narrow spaces even when their current consumption appears similar. A static snapshot can therefore understate inequality when it ignores the unequal capacity to generate future alternatives. The later GRE framework will treat this issue through generative opportunity, value circulation, and justice across time.

The relation between participation and possibility now becomes explicit. Participation is economically generative when it changes the conditions under which later

participation can occur. This gives the final subsection its organizing principle.

1.17.5 Generative Structures of Economic Participation

Economic participation has a generative structure when taking part in an activity changes the participant, the relation, or the surrounding institutional conditions in ways that affect later participation. This formulation extends the conventional focus on what an activity produces immediately. Employment can produce goods and income while also generating skills, reputations, dependencies, and organizational roles. Education can deliver instruction while generating curiosity, competence, social connection, and later access. Research can produce findings while creating instruments, communities, standards, and new questions. Care can meet present needs while sustaining the capacities through which persons participate in future social and economic life.

The generative structure of participation can be analyzed through several dimensions. The first is subject formation: participation can stabilize or transform the identity and position of the participant. The second is capacity formation: participation can generate abilities and resources that persist. The third is relational reproduction: participation can strengthen, weaken, or reorganize relations among actors. The fourth is institutional transformation: repeated participation can alter rules, expectations, and recognized categories. The fifth is option-space transformation: the preceding changes can expand or contract future possibilities.

These dimensions need not move together. A relation can generate productive capacity while reducing autonomy. It can expand organizational capability while concentrating control. It can strengthen trust within a group while increasing exclusion at its boundary. It can create valuable knowledge while producing dependency on infrastructure controlled by another actor. Generativity therefore describes a structure of downstream production rather than a complete normative evaluation. Later chapters address power and justice because the distribution, direction, and control of generative effects require separate analysis.

Participation can also generate relations that were not specified by the initiating objective. Collaboration undertaken to complete a project may produce a durable research network. Shared use of infrastructure may create a community of practice. A cooperative response to crisis may establish institutions that persist after the immediate problem has passed. These outcomes matter because they alter the relational environment from which later economic action begins. The economic significance of participation can therefore exceed the objective under which the activity was initially organized.

The distinction between ordinary relationality and generativity can now be stated positively. Relational analysis asks how actors, organizations, and institutions are connected and constituted through relations. Generative analysis asks how those relations produce changes that become conditions of subsequent economic life. The object includes newly generated subjects, capacities, institutions, relations, constraints, and possibilities. This temporal extension is the reason GRE requires more than a static map of economic relations.

The distinction is especially important under conditions of artificial intelligence

and symbolic abundance. An AI-mediated relation can improve immediate productivity while changing skill formation, professional recognition, dependency, organizational memory, and access to future work. A platform can facilitate exchange while reshaping market entry, reputation, data accumulation, and bargaining power. A transfer can raise present consumption while leaving generative opportunity unchanged, or it can support relations that produce durable capability. The same immediate outcome can therefore sit inside very different generative trajectories.

Generative participation also provides an alternative route for thinking about economic inclusion after the destabilization described in Section 1.15. If productive necessity weakens as a universal basis of social membership, participation can still matter through learning, care, inquiry, creation, cooperation, institution building, and other relations that generate capacities and future possibilities. This observation does not establish a normative programme or an allocation rule. It identifies an economic object that becomes more visible when productive contribution, productive necessity, and meaningful participation no longer coincide automatically.

Section 1.18 develops the analytical consequence. Once economic subjects and capacities are understood as relationally generated, an entity-centered account becomes incomplete whenever internal relations, external relations, relations among relations, downstream effects, or transformations of future generative conditions are required to explain an intervention. The next section therefore specifies the relational and generative limits of entity-centered economics before the chapter turns to the scientific conditions that make more demanding forms of analysis increasingly possible.

1.18 Relational and Generative Limits of Entity-Centered Economics

This section specifies the analytical boundary reached by entity-centered economic description after the historical developments reconstructed in Sections 1.5–1.17. Its role in the chapter is to identify the conditions under which persons, firms, households, states, and other recognized entities remain adequate units of analysis, and the conditions under which additional relational and generative description becomes necessary. The objective is therefore one of scope rather than replacement: entity-centered analysis remains powerful where entity boundaries are stable and the economically relevant effects of an intervention can be represented at the level of the recipient. The discussion proceeds from relations internal to entities, through relations surrounding them and relations among relations, to downstream intervention effects and transformations of future generative conditions. The method is conceptual and comparative, using established work on firms, embeddedness, network organization, global value chains, and entitlement to show that economically consequential structure can reside both within and between recognized entities.

1.18.1 Internal Relations within Economic Entities

An economic entity is often represented by variables attributed to the entity as a whole: income for a household, productivity for a firm, assets for a corporation, expenditure for a public body, or output for a national economy. Such variables are indispensable for comparison and administration. Their adequacy depends, however, on whether the internal relations through which the entity operates can be treated as analytically secondary for the question at hand. When internal organization shapes the conversion of resources into action, the same entity-level quantity can correspond to substantially different economic capacities.

The firm provides the clearest historical example. Coase's classic analysis of the firm begins from the observation that productive activity can be coordinated through authority inside an organization as well as through market exchange across organizational boundaries (Coase 1937). The distinction matters because a firm is more than an owner of inputs. It is a patterned arrangement of authority, employment, information, routines, and contractual relations through which inputs are combined. Two firms holding similar assets can therefore exhibit different productive capacities when their internal coordination, knowledge distribution, worker relations, or organizational routines differ.

Organizational law reinforces this point by stabilizing the entity without exhausting its internal structure. Hansmann and Kraakman show that organizational law supports standardized legal entities partly through asset partitioning, which separates organizational assets and creditor claims from those of owners or managers (Hansmann and Kraakman 2000). This legal boundary is economically consequential because it makes the organization tractable as a bearer of assets and obligations. Yet the boundary does not describe how authority, expertise, risk, reward, and decision rights are distributed inside it. A legally unified corporation can contain highly unequal or internally fragmented relational structures while appearing as one administrative recipient.

Households display a parallel difficulty. A transfer recorded at household level can alter the resources available to the household while leaving open the internal distribution of control, care obligations, time, bargaining position, and effective access. Treating the household as a single recipient can be appropriate for some fiscal or demographic questions and inadequate for questions concerning who can actually command the transferred resources. The general issue is the conversion from entity-level possession to participant-level capability. Where this conversion depends on internal relations, the entity boundary becomes an important part of the explanation rather than a neutral container.

Internal relations also shape the persistence of capacities. Knowledge can be distributed among workers and routines rather than stored in any single individual. Trust can be localized in teams. Authority can be centralized or dispersed. Care obligations can allocate time asymmetrically. Data can be accessible to some organizational positions and unavailable to others. These structures influence what an entity can do even when conventional balance-sheet or resource measures remain unchanged. A relational description therefore becomes useful when variation inside the entity explains variation in action, learning, adaptation, or access that entity-level

quantities cannot capture.

The implication is a scope condition. Entity-centered analysis is strongest when internal heterogeneity does not materially affect the causal or evaluative question. Relational analysis becomes increasingly necessary as internal organization determines the conversion of nominal resources into effective capacities. This does not dissolve the entity. It adds a second analytical resolution at which the entity is reconstructed as a stabilized configuration of relations.

1.18.2 External Relations around Economic Entities

Economic entities also derive capacities from relations that cross their recognized boundaries. Suppliers, customers, creditors, regulators, professional communities, infrastructures, knowledge networks, platforms, and public institutions can alter what an entity is able to produce, access, learn, or survive. Entity-level resources therefore acquire economic meaning partly through the external relations that make those resources usable.

Granovetter's account of embeddedness provides a foundational statement of this problem by showing that economic action is situated in ongoing structures of social relations rather than occurring among atomized actors (Granovetter 1985). The analytical consequence is especially visible where trust, reputation, repeated interaction, or social position affect exchange. A firm with modest internal resources can occupy a highly advantageous position in a dense network of reliable partners, while a better-capitalized firm can remain constrained by weak access, low trust, or peripheral position. Entity attributes and relational position therefore provide distinct information.

Interorganizational production sharpens the distinction. Powell's analysis of network forms of organization identifies arrangements in which reciprocal communication and continuing exchange coordinate activity in ways that are poorly described as either discrete market transactions or internal hierarchy (Powell 1990). Section 1.8 used this literature to reconstruct the expansion of relational production. The present concern is analytical: once production depends on continuing interorganizational relations, a firm's productive capacity cannot be inferred from its owned assets alone. It also depends on the quality, accessibility, and durability of relations through which complementary capabilities are obtained.

Global value chains extend this structure across jurisdictions and organizational scales. Gereffi, Humphrey, and Sturgeon distinguish several governance forms whose emergence depends on transaction complexity, codifiability, supplier capability, explicit coordination, and power asymmetry (Gereffi et al. 2005). The relevant unit of analysis is therefore larger than any one firm. Lead firms, suppliers, standards, logistics systems, contractual practices, and technical interfaces together produce the conditions under which production occurs. An intervention directed toward one participant can propagate through this wider configuration.

External relations are also central to effective command over resources. Sen's entitlement analysis demonstrates that access to food cannot be inferred from aggregate availability alone because persons obtain command through production possibilities, trade opportunities, state entitlements, and other socially recognized channels

(Sen 1981). The same analytical lesson generalizes cautiously: a resource can exist in the environment and remain economically inaccessible to an entity whose relational pathways to it are absent or blocked. Access is therefore a relational condition connecting resources to subjects.

This point becomes particularly important under digital and AI-mediated production. Access to compute, datasets, model interfaces, platforms, payment systems, professional networks, standards, and trusted intermediaries can determine the usefulness of nominally owned assets. External relations can also impose dependency: an organization may appear autonomous at the entity level while relying on a small number of infrastructural or platform relations for essential functions. Relational analysis reveals these conditions without requiring the abandonment of entity-level accounting.

The external limit of entity-centered analysis is reached when economically decisive capacities and constraints arise from position in a relational environment. At that point, the question changes from the quantity of resources held by an entity to the relations through which those resources become actionable, exchangeable, recognized, and reproducible.

1.18.3 Relations among Economic Relations

Economic systems frequently contain structures in which one relation changes the operation of another. These higher-order configurations cannot be represented fully by listing pairwise ties because the economically relevant object is the relation among relations. Credit conditions can alter employment relations; legal classifications can reshape market access; platform rules can mediate buyer–seller relations; professional standards can condition relations between expertise and institutional authority; and ownership structures can change how organizational decisions are connected to labor, investment, and distribution.

The distinction is easiest to see in mediated exchange. A buyer and seller can transact through a platform, yet the terms of their relation depend on a further relation between each participant and the platform. Visibility, ranking, payment, data access, dispute resolution, and reputation can all be mediated through this additional structure. The buyer–seller relation therefore changes when the platform's rules or incentives change even if the two participants remain otherwise identical. The economically significant object is a configuration in which one relation governs, conditions, or transforms another.

Organizations contain similar higher-order structures. A manager's authority over a worker may be conditioned by labor law, collective agreements, professional norms, internal grievance procedures, or algorithmic monitoring systems. A creditor's claim may alter the relation between managers and investment decisions. A shareholder structure can influence how organizational surplus is connected to workers, suppliers, or research expenditure. These arrangements involve several relations whose interaction produces effects that no single dyad carries alone.

Network and value-chain research provides empirical settings in which such configurations become visible. Network forms coordinate relations among organizations through repeated exchange and reciprocal communication (Powell 1990), while

global value-chain governance connects lead-firm coordination, supplier capability, standards, and power asymmetry within structured production relations (Gereffi et al. 2005). A relation can therefore become consequential because of the other relations in which it is embedded. The same supplier tie can generate learning in one network, dependence in another, and exclusion in a third.

This higher-order perspective also clarifies why institutional change can have broad economic effects without transferring resources directly. A change in legal recognition, reporting rules, standards, or eligibility criteria can modify the relations through which many other interactions occur. Section 1.5 showed that legal personality, accounting boundaries, statistics, and administrative recognition stabilize economic entities. The same institutional devices can restructure relations among those entities by changing who may contract, who bears liability, what counts as compliant performance, or which transactions are visible to regulators and counterparties.

Relations among relations create a methodological demand for explicit boundary and scale choices. An analyst can always enlarge the relational map, and no practical inquiry can include every connection. The relevant question is whether omitting a higher-order relation changes the explanation of the outcome under study. GRE therefore treats higher-order analysis as problem-dependent. It becomes warranted where the behavior of a focal relation varies systematically with the configuration of surrounding relations.

The resulting picture remains compatible with entity-level economics. Entities continue to matter as legal, administrative, and organizational condensations. The additional analytical layer concerns the architectures through which their relations are coupled. This layer becomes central whenever intervention in one relation changes the operation of others.

1.18.4 Downstream Effects of Economic Intervention

Entity-centered evaluation commonly begins with a defined intervention and a defined recipient: a transfer to a household, a subsidy to a firm, a loan to an organization, a tax on an income stream, or an investment in a public body. This structure is often appropriate for immediate incidence. Its generative limit appears when the intervention changes relations whose later effects extend beyond the initial recipient and evaluation horizon.

A resource transfer can generate several distinct downstream pathways. It may alter bargaining position, enable entry into a network, support education or training, change creditworthiness, reduce dependence on a particular employer, permit migration, create time for care or inquiry, or allow an organization to invest in standards and relationships that affect later collaboration. Two transfers with the same nominal value can therefore produce different trajectories because they enter different relational configurations.

The distinction between receipt and command is again useful. Sen's entitlement framework shows that resource outcomes depend on socially organized channels through which persons gain effective command (Sen 1981). In a generative setting, the question extends further: effective command at one moment can alter the chan-

nels available later. Access to credit can create a repayment record; access to education can change occupational networks; access to infrastructure can change market participation; access to a platform can generate data and reputation that affect future visibility. An intervention can therefore modify the relations through which later interventions or opportunities are converted into capability.

Downstream effects can also propagate across entities. Support to one firm may sustain suppliers, preserve specialized knowledge, alter local employment, or strengthen a technological standard. A procurement decision can reorganize a supply network. A platform rule can change incentives for thousands of participants. A financial intervention can alter expectations and counterparties beyond its formal recipient. The immediate recipient remains administratively important, while the causal object expands to include the relational pathways through which the intervention propagates.

Evaluation horizons shape whether these effects appear. A short-horizon assessment may correctly report immediate consumption, output, employment, or solvency while omitting changes in learning, trust, dependency, network position, institutional access, or option availability that emerge later. Longer horizons create their own uncertainty and attribution problems. GRE therefore does not presume that downstream effects can always be measured precisely. It treats temporal extension as a question of analytical adequacy: when plausible downstream mechanisms are central to the intervention's significance, the evaluation should state which are included, which are excluded, and what evidential confidence attaches to them.

The same discipline applies to negative downstream effects. An intervention can create dependency, crowd out alternative relations, increase concentration, lock participants into proprietary infrastructure, or shift risk to actors outside the original evaluation boundary. Entity-centered accounting may record a local gain while relational analysis detects a redistribution of constraint elsewhere. Such cases are especially important when the initial recipient and the later bearer of cost are different entities.

Downstream analysis therefore changes the unit of evaluation from a recipient-state pair to a trajectory through a relational system. The intervention remains identifiable, and the recipient remains important, yet the relevant economic question includes what relations the intervention forms, strengthens, weakens, or redirects over time.

1.18.5 Transformation of Future Generative Conditions

The deepest limit of entity-centered analysis appears when economic activity changes the conditions under which future economic activity can be generated. At this point the object is no longer only a downstream outcome. It is the transformation of the relational, institutional, material, or epistemic conditions that structure later possibilities.

Capacity formation provides one route. A relation can generate skills, trust, organizational routines, infrastructure, or shared knowledge that later activities presuppose. Section 1.17 described these processes as generative because participation changes what subjects and institutions can subsequently do. The same logic applies to

constraints. A relation can produce dependency, exclusion, standardized interfaces, proprietary lock-in, debt obligations, or institutional classifications that narrow later options. Generativity therefore includes the production of enabling and constraining conditions.

Institutional persistence amplifies these effects. Once a relational arrangement is stabilized through law, accounting, standards, administrative categories, or organizational routines, it can shape later transactions that were absent from the original decision. A financing rule can influence which organizations survive long enough to innovate. A credentialing system can determine who enters a profession. A platform's data architecture can shape later visibility and bargaining power. A property regime can influence which forms of cooperation or exclusion become ordinary. These structures operate as inherited conditions for actors who did not choose their initial form.

The transformation of future conditions is especially important for value and allocation. A present allocation can generate capacities that increase later access to resources, or it can support relations whose benefits circulate beyond the initial recipient. Conversely, a present extraction can weaken the relations required for future generation even when current output remains high. The later Parts of this book develop these questions through relational allocation, heterogeneous value, generative return, spacetime, power, and justice. The historical argument of the present chapter is narrower: contemporary economic organization increasingly makes these future-conditioning effects difficult to treat as peripheral.

Artificial intelligence intensifies the issue because current arrangements can shape the distribution of future productive intelligence. Decisions about compute, data, model access, research infrastructure, intellectual property, standards, and institutional participation can influence which actors are able to learn from and contribute to later technological development. Immediate productivity effects are therefore only one dimension of the economic significance of AI-related investment and allocation. The configuration of relations around artificial productive capacity can alter the future distribution of capability itself.

A generative analysis also requires restraint. Future conditions are uncertain, relational pathways branch, and interventions can produce unintended effects. Strong claims about long-horizon generation therefore require stronger evidence than descriptions of present allocation. GRE's later methodology distinguishes association, enablement, contribution, co-generation, and stronger forms of attribution so that temporal extension does not become speculative license. The present section establishes only the analytical reason for asking the question.

The resulting scope condition can be stated positively. Entity-centered economics remains highly effective when the relevant outcomes are well represented by attributes of recognized entities within a specified horizon. Relational analysis becomes necessary when internal organization, external position, or higher-order relational structure materially affects those outcomes. Generative analysis becomes necessary when present relations transform the subjects, capacities, constraints, institutions, or possibilities through which later economic life unfolds. These analytical layers are complementary resolutions of economic reality rather than mutually exclusive schools.

This distinction completes the historical movement from the modern entity-centered order reconstructed in Sections 1.3–1.6 to the relational and generative problems made increasingly visible by globalization, digital mediation, artificial intelligence, symbolic abundance, and changing subjecthood. Sections 1.19 and 1.20 now turn from historical necessity to historical possibility: the scientific formalisms, computational resources, and analytical vocabularies that make more demanding relational and generative inquiry increasingly feasible.

1.19 Scientific Conditions for Relational Analysis

This section identifies the scientific conditions that have made relational economic analysis increasingly tractable. Its role in the chapter is historical and methodological: the preceding sections established why contemporary economic problems increasingly exceed an exclusively entity-centered description, while the present section asks which analytical developments make more explicit study of relations feasible. The objective is to specify a repertoire rather than to prescribe a single formalism. The discussion proceeds from dynamical systems and complex-systems approaches to network and higher-order representations, field-based descriptions, and multiscale or background-sensitive formalisms. Each subsection distinguishes the analytical possibility supplied by a scientific language from the stronger claim that economic reality literally possesses the ontology of the formal system used to describe it.

1.19.1 Dynamical Systems

Dynamical-systems theory enlarges economic analysis by making trajectory, stability, feedback, and qualitative change explicit objects of study. A static description records the state of an economic entity or relation at a selected moment. A dynamical description asks how that state changes, which states are reachable from it, which configurations persist after disturbance, and how local changes accumulate along a trajectory. The analytical language is mature across the natural and applied sciences, where nonlinear systems are studied through state spaces, flows, fixed points, periodic behavior, bifurcations, and sensitivity to initial conditions (Strogatz 2024). Its relevance to relational economics lies in the possibility of treating relations and relational configurations as time-indexed variables whose evolution matters to the economic outcome.

The gain is especially clear when a relation has memory. Employment relations accumulate experience and expectation; credit relations acquire repayment histories; supply relations generate specialized routines; platform relations accumulate reputation and data; institutional relations carry prior classifications into later access. A cross-sectional description can identify that a relation exists, while a dynamical description can ask how its present form depends on the path by which it was reached. The trajectory becomes economically relevant because two configurations that appear similar at one moment may respond differently to later disturbance when their histories have generated different capacities, expectations, or constraints.

Dynamical systems also provide a precise distinction between stability and value.

Stability concerns how a configuration responds to perturbation. It does not establish that the configuration is efficient, just, desirable, or generative. This distinction is important for GRE because persistent economic structures can include durable cooperation, durable exclusion, resilient infrastructure, or resilient dependency. A dynamical description can characterize persistence without silently converting persistence into normative endorsement.

Nonlinearity further expands the range of analyzable relational phenomena. When the effect of one relation depends on the state of other relations, aggregate behavior may fail to equal a simple sum of isolated effects. Feedback can amplify or damp disturbances; thresholds can make similar interventions consequential in one configuration and negligible in another; interaction among several processes can produce regime changes absent from any component considered separately. Such possibilities matter in economies organized through interdependent firms, financial claims, standards, infrastructures, and institutional expectations.

The methodological contribution remains bounded. A dynamical model requires a defensible specification of states, variables, boundaries, and transformation rules. Social and economic systems also include reflexive subjects whose interpretation of a model can enter the subsequent dynamics. The availability of dynamical-systems theory therefore establishes a scientific possibility: economic relations can be studied as evolving configurations rather than as static background conditions. It does not by itself establish which dynamical representation is appropriate to a particular economic problem. That question belongs to model construction, evidence, and later methodological chapters.

1.19.2 Complex Systems

Complex-systems research provides a second condition for relational analysis by directing attention to systems whose macroscopic behavior depends on interaction among heterogeneous, adaptive, and partially autonomous components. The relevant scientific shift is analytical rather than terminological. A system can display regularities at one scale that are difficult to infer from isolated components because interaction, feedback, adaptation, and boundary formation contribute to the collective pattern. Holland's work on complex adaptive systems, for example, treats signals, boundaries, and evolving organization as central to the behavior of systems ranging from biological organization to markets and governments (Holland 2012).

For economic analysis, this perspective weakens the presumption that explanation must begin and end with attributes of independently specified units. Firms can adapt to competitors and regulators; households respond to institutions and changing prices; standards alter which technologies are compatible; market participants learn from one another; organizations modify routines in response to observed outcomes. The state of one participant is therefore partly conditioned by a surrounding configuration that is itself changing in response to participants. Complexity-oriented analysis provides a vocabulary for studying this reciprocal dependence without requiring that every collective regularity be reduced immediately to a single representative agent or equilibrium condition.

The approach also makes heterogeneity analytically productive. Differences

among actors in resources, expectations, information, capabilities, and network position can affect system-level behavior because interaction transmits and transforms those differences. Heterogeneity can produce clustering, specialization, segmentation, cascades, or uneven adaptation. In a relational economy, the distribution of positions can therefore matter as much as an average attribute. A system composed of actors with the same mean income, skill, or productivity can exhibit different dynamics when the relations among them differ.

Complex-systems approaches are particularly useful for distinguishing local rule from global pattern. A participant may act according to a relatively simple decision rule while the aggregate configuration exhibits persistence, volatility, concentration, or coordination that no participant designed. This possibility resonates with the historical argument developed earlier in the chapter. Modern economic institutions often generate structures whose consequences exceed the horizon of the actors participating in them. The scientific significance of complexity research is that such distributed generation can be represented and investigated without assigning the collective pattern to a central designer.

Adaptation introduces another important dimension. Economic actors respond to outcomes, and their responses alter the environment to which later actors adapt. The resulting feedback can change the effectiveness of a rule over time. A regulatory threshold, ranking metric, trading strategy, or recommendation system can have one effect before widespread adaptation and another after participants reorganize around it. Complexity-oriented analysis therefore encourages researchers to treat observation, strategy, and institutional response as potentially endogenous components of the system.

The term *complexity* can easily become too broad to discipline analysis. GRE therefore uses complex-systems language only when the local problem exhibits the relevant structure: interaction, heterogeneity, feedback, adaptation, multilevel organization, or emergent collective regularity. Complexity is a scientific resource for relational inquiry rather than an explanation by itself. Its historical importance lies in the development of formal and computational methods capable of treating interdependence as a primary analytical object.

1.19.3 Network and Higher-Order Models

Network science provides the most direct formal language for representing economic relations among identifiable entities. Nodes represent analytically specified units and edges represent specified relations among them. Once such a representation is justified, analysis can address connectivity, centrality, clustering, community structure, path length, assortativity, diffusion, robustness, and the interaction between network topology and dynamical processes. Newman's review of complex networks documents the development of these concepts across social, technological, and biological systems and emphasizes the study of both network structure and dynamics on networks (Newman 2003).

The relevance to economics is immediate because many economic phenomena already have relational form. Credit links connect borrowers and lenders; supply chains connect buyers and suppliers; ownership links connect shareholders and

firms; labor mobility connects organizations; communication links connect teams; trade links connect jurisdictions; platform relations connect several participant groups through an intermediary. A network representation can therefore preserve relational information that disappears when each entity is summarized only by its own attributes.

Network models also make positional effects explicit. Two firms with similar observable resources can occupy very different positions in a supply network. Two researchers with similar individual capabilities can have different access to knowledge because their collaborative neighborhoods differ. Two households with similar income can face different opportunity structures because transport, care, credit, or social-support connections differ. In each case, an entity-level variable remains relevant, while network position adds information about the pathways through which resources, risks, information, and opportunities can move.

Pairwise networks have a clear limitation: many economic relations involve groups, institutions, or coordinated sets of participants whose effects cannot be represented adequately as collections of independent dyads. A project consortium, household, standards committee, cooperative, research team, or multilateral agreement can impose conditions on a group as a group. Higher-order network research has developed explicit representations for such cases through hypergraphs, simplicial complexes, and related structures. Battiston and colleagues survey this literature and show that interactions among three or more units can generate dynamical behavior that is not captured by pairwise links alone (Battiston et al. 2020).

Higher-order models are especially relevant to the GRE concern with relations among relations. A contract can depend on a regulatory institution; a supply relation can depend on a standard jointly maintained by several organizations; a worker's access to employment can depend on credentialing relations linking educational institutions, professional bodies, and employers. Such structures can be flattened into pairwise edges, but flattening can erase the condition that the relevant effect exists only when several relations are jointly present. Higher-order representations make that joint dependence visible.

These models nevertheless remain representations. Nodes must be chosen, edges must be defined, interaction order must be specified, and the temporal stability of the representation must be justified. A legal entity, household, platform account, institution, or community can function as a node for one question and as an internally structured relational system for another. Network analysis therefore does not eliminate the boundary problem; it renders the boundary decision explicit and makes its consequences inspectable. This is a scientific advance because relational structure can be formalized, compared, and tested while preserving awareness that the graph is an analytical construction.

1.19.4 Field-Based Representations

Field-based representations become useful when economically relevant conditions are distributed across a domain and cannot be localized adequately in a finite set of isolated links. In mathematics and mathematical physics, field descriptions assign quantities to locations in a continuous or discretized domain and study how

local states vary, interact, and propagate. Partial differential equations provide a developed formal language for representing such spatially or continuously distributed dynamics, including nonlinear propagation, diffusion, transport, and wave-like processes (Evans 2010). GRE draws from this scientific repertoire at the level of representation: some economic conditions may be better described as distributed environments than as attributes attached to individual entities.

Several economic objects have this character. Accessibility can vary continuously across geographic space; labor-market opportunity can depend on local density and transport; information exposure can vary across communication environments; regulatory intensity can differ across jurisdictions; trust or reputational climate can be unevenly distributed; infrastructure can create gradients of connection and cost. In such cases, the relevant condition surrounds many actors at once and changes the consequences of local relations. A field representation can encode this distributed context without assigning the whole effect to one neighboring entity.

Field language also helps distinguish a relation from the conditions under which the relation operates. The same contractual form can have different consequences in regions with different institutional capacity. The same amount of credit can generate different outcomes where market access differs. The same platform rule can affect participants differently when local alternatives, network density, or legal protections vary. Treating the surrounding condition as a field makes it possible to model systematic variation in relational effect across position.

The approach can be extended beyond geographic space when the relevant domain is abstract. A field can be defined over a state space, capability space, or other structured domain if distance and neighborhood have defensible meanings. Such constructions can represent how similar configurations experience similar pressures or how local changes propagate through a structured possibility space. Their usefulness depends on whether the chosen geometry captures an empirically meaningful relation rather than merely providing a visually attractive mathematical surface.

Field-based representation therefore carries a stronger burden of justification than ordinary metaphor. A model must specify what the field variable represents, what domain indexes it, what counts as locality, how interactions propagate, and how the representation connects to evidence. GRE's ontological suspension is important here. The success of a field model would show that a distributed representation is analytically productive for a given problem; it would not establish that an economy is literally a physical field. The scientific condition consists in the availability of mature mathematics for distributed, locally coupled systems and in the possibility of adapting that mathematics under explicit domain-specific assumptions.

1.19.5 Multiscale and Background-Sensitive Formalisms

Relational economic systems operate across several scales at once. Individuals participate in households, organizations, networks, institutions, markets, jurisdictions, and transnational systems; processes at each level can constrain or enable processes at others. Multiscale analysis supplies concepts for studying how organization, variation, and response differ across scale rather than assuming that one analytical resolution is sufficient. Bar-Yam's multiscale treatment of complex systems formalizes the

idea that effective response depends on matching the scale of variation in a system and has been applied to biological and social organization (Bar-Yam 2004).

The economic importance of scale is visible in ordinary examples. A workplace policy can affect an individual immediately while altering organizational culture slowly. A local supply disruption can propagate into sectoral production when many firms share dependencies. A financial position can be safe at the level of one institution while contributing to correlated systemic exposure. A household decision can be rational under prevailing prices while repeated decisions across many households alter the market conditions on which those choices depended. Relational analysis therefore requires the ability to move among levels without presuming that a pattern observed at one scale can be transferred unchanged to another.

Multiscale formalisms also clarify why aggregation can both reveal and conceal. Coarse-graining can expose collective regularities invisible at the level of individual events, while the same operation can erase heterogeneity and local dependence that matter to causal interpretation. Disaggregation can recover local structure while making system-level constraints harder to see. The choice of scale is therefore part of the model rather than a neutral technical detail. A relational account should report which distinctions are preserved at the selected resolution and which are suppressed.

A related scientific development concerns formalisms in which the background against which dynamics unfold is itself allowed to vary. General relativity provides a paradigmatic case: spacetime geometry is dynamical rather than a fixed stage, and background-independent approaches in gravitational physics develop descriptions in which the geometry relevant to motion is part of the system being modeled (Rovelli 2004). GRE does not infer a social ontology from this physical result. The methodological significance is narrower: modern science contains coherent formalisms in which the structure conditioning local dynamics need not be treated as permanently external and fixed.

This possibility matters for relational economics because economic backgrounds are often historically produced. Market boundaries change; infrastructures are built and abandoned; legal categories are revised; standards alter compatibility; platforms reorganize access; institutions modify the relations they regulate. A model that holds the surrounding structure fixed can be adequate over a limited interval, while a longer-horizon analysis may need the background itself to become variable. Section 1.20 develops this issue in generative terms by asking how states, relations, constraints, and transformation rules can coevolve.

Background sensitivity also disciplines comparison. A relation observed in one institutional setting may not preserve its effects when transplanted into another because the surrounding rules, infrastructures, histories, and scales differ. Formal models can represent this contextual dependence through parameters, boundary conditions, changing topology, or evolving geometry. The appropriate device depends on the problem. The common principle is that the relation cannot always be interpreted independently of the structure in which it is embedded.

The scientific opening described across this section is therefore plural. Dynamical systems make trajectories and stability analyzable; complex-systems approaches make interaction, heterogeneity, feedback, and adaptation central; networks and

higher-order models represent explicit relational structure; field approaches represent distributed conditions; multiscale and background-sensitive formalisms permit analysis across levels and under changing contextual structure. None of these formalisms establishes GRE by itself. Together they change the historical feasibility of a relational economics by providing mathematical and conceptual languages in which relations can become explicit objects of analysis. Section 1.20 turns to the stronger problem of generativity, where the analytical task includes the endogenous transformation of the structures and rules through which later economic change occurs.

1.20 Scientific Conditions for Generative Analysis

This section identifies the scientific conditions that make generative economic analysis increasingly possible. Its role in the chapter is to move beyond the explicit representation of relations developed in Section 1.19 toward a stronger analytical problem: economic relations can change the structures, constraints, and transformation rules under which later economic activity occurs. The objective is to specify the scientific languages capable of representing this endogeneity without treating every historical change as an instance of one universal mechanism. The discussion proceeds through endogenous dynamics, structure-changing processes, path dependence, coevolution, and the evolution of transformation rules. The method is comparative and conceptual. It draws on evolutionary economics, institutional economics, path-dependent dynamics, and complex-adaptive-systems research to identify analytical possibilities that later GRE chapters may formalize more precisely.

1.20.1 Endogenous Dynamics

Generative analysis begins where the conditions of change enter the dynamics being studied. A model can describe an economic system dynamically while leaving its transformation law fixed: prices, quantities, employment, or network positions may change through time according to a stable rule. Such a model is already richer than a static comparison because it represents trajectories. Generative analysis asks a further question. Economic activity can alter the conditions that shape later activity, so the variables governing subsequent change may themselves become endogenous to the history of the system.

Evolutionary economics supplies a developed precedent for this orientation. Nelson and Winter organize economic analysis around processes in which firm behavior, routines, search, innovation, and competitive selection jointly determine industrial change through time rather than around instantaneous optimization toward a predetermined equilibrium (Nelson and Winter 1982). The analytical importance of this move for GRE lies in its treatment of economic behavior and industrial structure as mutually consequential. Firms act within inherited routines and market conditions, yet search, innovation, imitation, investment, and differential survival can alter the distribution of routines and capabilities that later firms confront.

Endogeneity in this stronger sense can appear through several channels. Learning can change an actor's future response to a similar situation. Investment can create infrastructure that changes the feasible action set. Repeated exchange can build trust

or dependency. Regulation can produce new categories to which future regulation refers. Platform participation can generate data that improve the platform's later matching or ranking capability. A subsidy can expand a technology sufficiently to lower its later cost, and the lower cost can alter subsequent adoption. In each case, present activity modifies a condition relevant to the next round of activity.

Institutional economics adds another level of endogeneity. North treats institutions as humanly devised constraints that structure political, economic, and social interaction while also developing an account of institutional change in which organizations, incentives, and accumulated choices affect the evolution of those constraints (North 1990). This creates an analytical loop important for GRE: institutions condition economic action, economic action generates incentives and organizational responses, and those responses can contribute to institutional persistence or transformation. The conditioning structure therefore belongs to the history of the system rather than remaining permanently external to it.

Endogenous dynamics should still be specified locally. Some constraints can remain effectively fixed over the time horizon of a study; some institutional changes arrive through exogenous shocks; some actor responses are well represented by stable rules. GRE therefore does not require every model to endogenize every background condition. The scientific condition established here is the availability of frameworks in which a conditioning variable can become part of the dynamics when the research question requires it. This possibility is the first step from relational description toward generative analysis.

1.20.2 Structure-Changing Processes

Generative economic processes can alter more than the values attached to a fixed set of variables. They can change the structure through which variables are related. A supply relation can be created or terminated; a firm can merge with another; a market can acquire a platform intermediary; a legal category can make a new organizational form available; an infrastructure investment can connect previously separated regions; a technological standard can render previously incompatible components interoperable. The analytical object is therefore sometimes a changing architecture rather than movement inside an unchanged architecture.

This distinction matters because parameter adjustment and structural change carry different implications. A fall in a transaction cost changes the strength of an existing relation. The creation of a new intermediary changes which relations exist and how other relations are routed. A wage increase changes the terms of an employment relation. The legal recognition of a new form of worker, firm, property, or digital asset can change the categories through which economic relations are constituted. Generative analysis requires formalisms capable of representing these alterations in topology, membership, boundary, rule, or institutional status.

Evolutionary approaches again provide an important scientific precedent. Nelson and Winter's framework treats technological and organizational change as processes in which variation, search, selection, and retained routines can alter the composition and behavior of industries over time (Nelson and Winter 1982). Complex-adaptive-systems research broadens the representational possibility by treating signals, bound-

aries, and hierarchical organization as structures that can themselves develop and reorganize (Holland 2012). These traditions differ in object and formal detail, yet both make structural transformation an analytical problem rather than a residual category for changes that a fixed-state model cannot absorb.

Network and higher-order models discussed in Section 1.19 can also be made generative when the relational topology evolves. Nodes may enter or leave; edges may form, strengthen, weaken, or dissolve; higher-order groups may assemble or fragment; network position can affect the probability of subsequent tie formation. The same principle applies beyond networks. Field boundaries can shift, institutional classifications can be rewritten, and the scales at which coordination occurs can change. The scientific requirement is a representation in which the structure at one time can influence, and be influenced by, the processes unfolding within it.

Structure-changing analysis also disciplines causal interpretation. When an intervention alters the architecture through which later effects propagate, the relevant causal question extends beyond the immediate response of a fixed system. The intervention may create new channels of diffusion, new dependencies, new exclusion boundaries, or new organizational capacities. Two interventions with identical short-term outputs can therefore generate different long-term trajectories when one leaves the surrounding structure unchanged and the other rewrites it. This distinction becomes central later in GRE's treatment of relational allocation and generative value.

1.20.3 Path Dependence and Historical Trajectories

Generative analysis requires historical trajectories because the effect of a present relation can depend on the sequence through which the current configuration was produced. Path dependence provides a scientific language for this dependence on prior development. Arthur's analysis of competing technologies shows how increasing returns can make early events consequential for later adoption and can produce lock-in under specified conditions (Arthur 1989). The contribution is methodological as much as substantive: a historically contingent event can matter because it changes the returns, expectations, compatibility relations, or learning environment confronting later choices.

A path-dependent account differs from a simple statement that history matters. The relevant claim identifies a mechanism through which earlier events alter later transition possibilities. Increasing returns, sunk investments, institutional complementarity, network effects, learning, or accumulated expectations can make the consequences of an action depend on when it occurs and on what has occurred before. A trajectory therefore contains information that a comparison of endpoints can lose.

Institutional development displays the same structure in a different register. North's account of institutional change emphasizes that existing institutions shape the incentives and organizations through which later change proceeds, giving institutional development a cumulative and historically conditioned character (North 1990). The implication for GRE is that economic relations can inherit constraints generated by earlier relations even after the original circumstances have disappeared. Ownership forms, labor classifications, accounting conventions, technical standards, transport networks, and financial infrastructures can continue structuring action

because later investments and expectations have formed around them.

Historical trajectories also permit branching. A configuration can support several feasible continuations, and relatively small differences in timing, sequencing, or local interaction can direct development toward different regions of the possibility space. This does not require the claim that every historical outcome is radically contingent. Some paths are strongly constrained; others are open across a wider range. Generative analysis therefore benefits from distinguishing structural persistence, path dependence, branching possibility, and exogenous disturbance rather than placing all historical change under a single label.

For GRE, the importance of path dependence extends to value and subject formation. Skills acquired under one technological regime can shape access to the next. A reputation accumulated in one institutional setting can affect later credit or employment. A community's prior exclusion can constrain current participation even after formal barriers are removed. A platform's early relational centrality can attract further participants and data. The generative consequence of a relation is therefore partly temporal: it can modify the conditions under which later relations become possible, valuable, or difficult to escape.

Path dependence also has a methodological limit. Lock-in claims can be too easily inferred retrospectively from persistence alone. Arthur's mechanism depends on specific increasing-return processes rather than on the mere fact that one outcome endured. GRE should therefore identify the mechanism through which prior states affect later transition probabilities, costs, or available options. Historical narrative and formal path dependence can complement one another only when the connection between sequence and later constraint is made explicit.

1.20.4 Coevolution of States, Relations, and Constraints

A generative economic system can contain several mutually changing layers. Actor states change, relations among actors change, and the constraints governing those relations change. Treating these layers separately can be useful for local analysis, while longer-horizon explanation often requires their coevolution. The scientific challenge is to represent feedback across layers without assuming that one layer permanently determines the others.

Consider an employment system. Workers acquire skills and experience; firms reorganize tasks and technologies; labor-market relations alter bargaining positions and mobility; legal institutions revise classifications and protections; training systems respond to changing demand. Each layer conditions the others. A change in technology can alter the value of a skill, which changes hiring patterns, which changes incentives for training, which changes the future distribution of skills, which can alter the technologies firms find profitable to adopt. A single state variable can describe one slice of this process, while a coevolutionary account follows the reciprocal modification of several kinds of structure.

The same logic applies to finance, platforms, and knowledge systems. Credit histories influence lending relations, lending relations shape investment, investment changes productive capability, and new capabilities alter future creditworthiness. Platform rules shape interaction, participant behavior generates data, data influence

algorithmic ranking, and revised ranking changes participant behavior. Research institutions allocate attention and resources, resulting inquiry changes the stock of knowledge, and new knowledge changes which questions appear feasible or valuable. In each case, generative relations operate through recursive coupling among state, relation, and constraint.

Complex-adaptive-systems research supplies conceptual resources for such recursive organization. Holland's treatment of evolving signals and boundaries emphasizes that adaptation can occur through changing interactions and organizational structures rather than through movement of an isolated variable alone (Holland 2012). Evolutionary economics similarly treats behavior, search, capability, and competitive structure as historically linked processes (Nelson and Winter 1982). GRE draws from these approaches a methodological possibility: the object of explanation can be a coupled trajectory in which the units, relations, and constraints relevant to later behavior are partly generated by earlier behavior.

Coevolution also limits simple attribution. When several layers change together, a downstream outcome can be jointly generated by processes that are difficult to isolate as independent causes. A regulatory change may alter firm behavior only because technological capabilities have changed; a technological opportunity may matter only because institutions recognize a new organizational form; a new organizational form may diffuse only because financing relations support it. Generative analysis therefore requires language for contribution, enablement, mediation, and co-generation in addition to strong single-cause attribution. Later methodological chapters develop those distinctions explicitly.

The coevolutionary perspective remains compatible with analytical decomposition. Researchers can hold some layers fixed to study a local mechanism, compare periods in which one layer changes faster than another, or construct reduced models for particular questions. The crucial scientific advance is the ability to relax those simplifications when they become explanatorily consequential. States, relations, and constraints can be modeled as jointly historical objects rather than as permanently separated levels.

1.20.5 Evolution of Transformation Rules

The strongest form of generative analysis treats the rule governing change as historically variable. A conventional dynamical representation specifies how a current state is transformed into a later state under a given transition rule. Many economic applications can legitimately hold that rule fixed over the period of interest. A generative system can require another level of description when learning, institutional change, technological innovation, or reflexive adaptation modifies the rule through which subsequent states are produced.

Economic routines provide a concrete illustration. Nelson and Winter treat organizational routines as persistent elements of firm behavior while also giving search and innovation a role in changing the routines and capabilities that shape later behavior (Nelson and Winter 1982). The analytical implication is subtle. A firm's current action may be generated by an inherited routine, while the outcome of that action can contribute to search, learning, imitation, or selection that changes the routine governing

future action. The transformation process therefore has a history of its own.

Institutional rules exhibit a similar recursion. Property definitions, accounting standards, eligibility criteria, contractual forms, and regulatory classifications can shape economic action. Repeated use of those rules can generate disputes, workarounds, constituencies, complementary investments, or new information that later motivates rule revision. Once revised, the institution changes the mapping from economic circumstance to permitted or rewarded action. Institutional change is therefore generative in a stronger sense when it alters the rule through which later economic relations are constituted or evaluated.

Adaptive digital systems make this issue especially visible. A ranking or recommendation rule can be updated from observed behavior; participants then adapt to the updated rule; their adaptation generates new observations that affect subsequent updates. The operative transformation rule is consequently embedded in a feedback process. Economic analysis that treats the algorithm as a fixed parameter can be adequate for a short interval, while analysis of longer-run behavior may need to represent the update procedure, participant adaptation, and institutional oversight as part of the system.

The evolution of transformation rules marks the boundary between a merely dynamic account and the more demanding conception of generativity developed in this book. Generativity does not require that every transformation rule change continuously. It requires analytical openness to the possibility that present relations can modify the mechanisms, constraints, classifications, or rules through which future relations are produced. This is the scientific condition that later permits GRE to study economic spacetime as historically generative rather than as a fixed arena containing changing entities.

The section's five conditions can now be stated together. Endogenous dynamics make conditioning variables part of the process; structure-changing models allow relational architectures to evolve; path dependence gives prior trajectories causal relevance; coevolution links changing states, relations, and constraints; evolving transformation rules make the mechanisms of change themselves historical objects. These scientific resources do not yield a complete generative economics, and none supplies a universal formalism. They establish a historical possibility: contemporary economic analysis possesses increasingly developed languages for asking how economic activity changes the conditions of its own continuation. Section 1.21 turns from scientific form to computational capacity and asks what makes these richer representations practically analyzable at scale.

1.21 Computational Conditions of Contemporary Analysis

This section identifies the computational conditions that make the richer scientific representations introduced in Sections 1.19 and 1.20 practically analyzable. Its role is distinct from the previous two sections. Scientific formalisms establish that relational and generative structures can be represented; computational infrastructures determine whether those representations can be explored at useful scale, temporal resolution, and heterogeneity. The objective is to reconstruct a historical shift in fea-

sible economic inquiry rather than to equate computational power with explanatory adequacy. The discussion proceeds from the expansion of computational capacity to large-scale simulation, dynamic network computation, agent-based and multiscale modeling, and emerging paradigms that make increasingly complex models differentiable, composable, and computationally tractable. Throughout, computational feasibility is treated as an enabling condition for inquiry rather than as evidence that a model is empirically correct.

1.21.1 Expansion of Computational Capacity

The first computational condition is the sustained expansion of the scale at which numerical procedures can be executed. Gordon Moore's 1965 observation concerning rapidly increasing component density in integrated circuits became a historical marker for a broader technological trajectory in which increasingly capable processors, memory systems, storage, networking, and software infrastructures reduced the cost of many forms of computation (Moore 1965). The significance for economic analysis lies less in any single hardware metric than in the resulting expansion of the model classes that can be investigated routinely.

Earlier analytical methods often benefited from strong reductions because computational constraints made large heterogeneous systems difficult to represent directly. Representative agents, aggregate state variables, stationary environments, sparse interaction structures, and short simulation horizons can all be theoretically justified in appropriate domains. They also reduce computational burden. As computational capacity expands, however, some reductions become choices rather than unavoidable technical necessities. Researchers can preserve more heterogeneity, maintain explicit interaction structures, examine longer trajectories, repeat analyses across parameter configurations, and compare several model specifications rather than committing immediately to a single reduced representation.

The increase in feasible computation changes the relation between model complexity and empirical discipline. A richer model can carry more of the structure that the research question considers consequential: multiple actor types, institutional rules, evolving networks, spatial structure, delayed effects, and several temporal scales. The same computational expansion also makes it easier to construct models whose internal complexity exceeds their evidential support. The historical opening is therefore double. More relational structure can be represented, while the space of underdetermined models also becomes larger.

Computation further changes the practice of uncertainty analysis. A model need not be examined at one parameter vector or under one deterministic scenario. Ensembles can explore sensitivity to initial conditions, stochastic shocks, behavioral rules, boundary assumptions, and alternative institutional specifications. This makes uncertainty more explicit when the ensemble is designed around substantively meaningful alternatives. It can also create an appearance of comprehensiveness when the sampled alternatives omit the main source of uncertainty. Computational abundance expands the set of questions that can be asked; it does not decide which uncertainties deserve representation.

For GRE, the main historical consequence is that relational detail has become less

dependent on analytical compression than in earlier computational environments. A model can increasingly retain the identity of several classes of relations, preserve temporal ordering, and follow feedback across scales. This capacity does not remove the need for abstraction. It changes the reason for abstraction: simplification should be defended by the analytical role it serves rather than by computational necessity alone.

1.21.2 Large-Scale Simulation

Simulation provides a second computational condition because it allows researchers to investigate systems whose aggregate consequences are difficult to derive analytically from local rules. Epstein and Axtell's *Growing Artificial Societies* provided an influential demonstration in the social sciences by constructing artificial populations in which macro-level patterns emerge from repeated interaction among heterogeneous agents (Epstein and Axtell 1996). The methodological importance of this approach lies in the ability to make an explicit set of micro-level rules generate a trajectory that can then be inspected, perturbed, and compared with alternatives.

Large-scale simulation is especially useful when a research question concerns interaction effects. A rule governing one actor may have little meaning in isolation because its consequences depend on the simultaneous behavior of many others. Credit defaults can propagate through balance-sheet relations; supply interruptions can move through production networks; migration decisions can alter local opportunity structures; institutional rules can induce adaptation that changes the effect of the rule itself. Simulation permits these interactions to be represented as processes rather than collapsed immediately into an equilibrium condition or comparative-static result.

The growth of computational capacity also makes repeated simulation more important than a single illustrative run. A stochastic model can be executed across many seeds; a parameterized model can be explored across ranges; several institutional designs can be compared under the same disturbance; rare but consequential trajectories can be searched for rather than assumed absent. Such ensembles are particularly relevant to generative analysis because the object of interest may be a distribution of possible trajectories, the frequency of transition between regimes, or the conditions under which a local perturbation produces a system-level effect.

Simulation also supports counterfactual reasoning under explicit assumptions. A model can compare a historical baseline with altered network structure, different access rules, alternative timing, or modified institutional constraints. The comparison is valuable because it forces the counterfactual mechanism to be stated operationally. Its evidential standing remains conditional. A simulated counterfactual shows what follows within the model from the altered assumptions; it does not establish that the real economy would have followed the same path. Calibration, validation, historical plausibility, and comparison with observed trajectories remain separate tasks.

This distinction is essential for GRE. Simulation can make generative hypotheses visible by showing how a proposed relational mechanism could produce a downstream configuration. It can also reveal that an intuitively plausible mechanism fails to generate the expected effect once interactions and feedback are made explicit.

Both outcomes are useful. Neither converts synthetic output into empirical confirmation. Computational simulation is therefore best understood as a controlled environment for mechanism exploration, sensitivity analysis, and the comparison of possible trajectories.

1.21.3 Dynamic Network Computation

Network analysis becomes more powerful when computation can follow relations that change through time. A static network records a topology for a selected interval. Many economic relations, however, form, dissolve, recur, switch direction, or change weight. Temporal-network research formalizes this problem by representing contacts or ties with explicit timing and duration, making the order of interactions part of the analytical object (Holme and Saramäki 2012). The computational condition is important because temporal ordering substantially enlarges the information required to describe a network and the number of possible paths through it.

Dynamic network computation changes several familiar economic questions. In finance, the relevant exposure structure can evolve as positions are opened and closed. In production, suppliers can be replaced, duplicated, or vertically integrated. In labor markets, workers move among organizations and carry skills and information across firm boundaries. On digital platforms, recommendation, ranking, and participant behavior can change the effective network on a much shorter timescale. The economic consequence of a relation can therefore depend on when it exists, what preceded it, and which other relations are simultaneously active.

Temporal computation also makes path-sensitive diffusion analyzable. A sequence of edges can transmit information, liquidity, disruption, reputation, or opportunity only when their timing permits the sequence to occur. Two networks with the same aggregate number of edges can support different propagation because the edges appear in different orders. This matters for GRE because the generative effect of a relation may depend on whether it arrives before or after a complementary capability, institutional recognition, or competing pathway has formed.

The same computational logic extends to networks whose topology coevolves with behavior. Participants can create or sever relations in response to outcomes, and those relational changes alter later incentives. A supplier may diversify after disruption; a lender may reduce exposure after loss; a platform participant may migrate after changes in ranking; a research group may form new collaborations after acquiring a technique. Computation permits the network itself to become an endogenous state variable rather than a fixed background for action.

Dynamic network models nevertheless inherit the representational limits described earlier. The existence of a time-stamped edge still depends on a definition of the relation, a boundary around the system, and data that capture the relation with sufficient resolution. Computational tractability cannot recover relations that were never observed, distinguish causal influence from coincident timing by itself, or decide whether a higher-order configuration should be represented as several edges or as a distinct collective relation. The historical advance is the capacity to compute with changing topology; the epistemic burden of defining and validating the topology remains.

1.21.4 Agent-Based and Multiscale Modeling

Agent-based computation provides a fourth condition by permitting heterogeneous actors, local rules, institutional constraints, and interaction structures to coexist within one executable model. Agent-based computational economics explicitly developed this possibility as an alternative way to study decentralized economic systems whose aggregate behavior is generated through interaction, learning, strategic adaptation, conventions, organizations, and institutional arrangements (Tesfatsion 2006). The approach complements the complex-systems perspective of Section 1.19 by giving the interacting components an operational computational representation.

The value of agent-based modeling for GRE lies in the ability to preserve heterogeneity that may be generatively consequential. Workers can differ in skills and network position; firms can differ in routines and financing; households can differ in obligations and access; institutions can impose different rules across categories; artificial agents can possess capabilities unavailable to human participants. These differences can be represented together with local interaction rules, allowing the analyst to ask whether macro-level concentration, segregation, coordination, instability, or capacity formation emerges from the specified configuration.

Agent-based representation does not require an ontological commitment to isolated atomic individuals. An "agent" can be an analytical object whose behavior is partly constituted by relational position, organizational membership, inherited resources, institutional classification, or internal state. Organizations, households, collective bodies, and algorithmic systems can also be represented as agents at appropriate scales. The computational framework is therefore compatible with a relational account so long as the model does not treat the agent's attributes as independent of the relations the theory claims are constitutive.

Multiscale modeling extends the same logic when economically relevant processes operate at different resolutions. Local transactions can occur rapidly, organizational routines can change more slowly, institutions can evolve over longer intervals, and infrastructure can impose constraints across several scales. A computational model can couple these layers explicitly, allowing fast processes to generate inputs into slower processes and slower structures to condition the space within which faster interactions occur. Such coupling is particularly important for the fast–slow historical perspective developed elsewhere in GR, while GRE need not assume that every economic system admits a clean separation of timescales.

The difficulty lies in validation. A model that includes heterogeneous agents, networks, institutions, and several scales can fit many qualitative patterns for many different reasons. More computational detail can increase realism in one dimension while reducing identifiability overall. Agent-based and multiscale models therefore require careful documentation of which mechanisms are load-bearing, which parameters are calibrated, which structures are empirical, and which are exploratory. Their historical significance is that such questions can now be investigated computationally with far fewer reductions than before; their scientific standing still depends on evidence and comparative model evaluation.

1.21.5 Emerging Computational Paradigms

Contemporary computation is also changing the form of modeling itself. One important development is automatic differentiation, which evaluates derivatives of computer programs efficiently and has become a central component of modern machine-learning systems and differentiable programming (Baydin et al. 2018). The broader significance is that increasingly complex computational pipelines can be treated as composable objects whose parameters may be estimated, optimized, or linked to inference procedures without requiring every derivative or intermediate transformation to be derived manually.

For relational and generative analysis, this opens several possibilities. A simulation can be connected to parameter estimation; a network process can be embedded within a larger model; a surrogate model can approximate a computationally expensive component; and an end-to-end pipeline can propagate information across several stages. These possibilities reduce the technical distance between formal specification, simulation, estimation, and sensitivity analysis. They also make it easier to construct hybrid models that combine institutional rules, network dynamics, statistical components, and learned functions.

Parallel and distributed execution further alters the feasible scale of inquiry. Rather than treating a simulation as a single sequence of calculations, researchers can divide parameter sweeps, Monte Carlo replications, network partitions, or independent scenarios across many processors or machines. Accelerator-based computation makes some matrix- and tensor-intensive models practical at scales that would previously have been prohibitive. Cloud infrastructures can make such resources available without local ownership of equivalent hardware. These developments broaden access to some forms of computation while also introducing new dependencies on software ecosystems, specialized hardware, infrastructure providers, and technical expertise.

Machine-learning methods introduce another change by allowing components of a model to be estimated from data when an explicit functional form is unavailable or deliberately left flexible. This can support prediction, emulation, dimensionality reduction, or the approximation of expensive simulations. It can also weaken interpretability when learned components become more complex than the mechanism the model was intended to clarify. GRE therefore treats learned components as one computational resource among others. Their use should follow the epistemic role of the model: prediction, mechanism reconstruction, counterfactual exploration, or decision support impose different requirements on transparency and validation.

The emergence of these paradigms does not imply convergence toward a single computational methodology. Some economic questions remain best served by transparent low-dimensional models; others benefit from simulation, networks, agent-based systems, or learned approximations. The historical change lies in the expansion of feasible combinations. Formal components can increasingly be composed, differentiated, simulated, and compared within one computational environment. This makes generative relational questions more tractable while also making model governance, reproducibility, provenance, and infrastructure dependence more important.

The five conditions developed in this section define a computational opening

rather than a computational solution. Expanding capacity permits richer representations; large-scale simulation explores interaction and counterfactual trajectories; dynamic network computation follows changing relations; agent-based and multi-scale models preserve heterogeneity across levels; and emerging paradigms make complex computational systems increasingly composable. None resolves the evidential problem of whether the modeled relations correspond to the world. Section 1.22 therefore turns from computational feasibility to evidential conditions: the data infrastructures, longitudinal records, continuous observation, and distributed evidence systems through which relational and generative claims may be confronted with empirical traces.

1.22 Evidential Conditions of Contemporary Governance

This section identifies the evidential conditions that make more adaptive forms of economic governance and institutional decision-making increasingly feasible. Its role in the chapter is narrower than a general theory of governance. The objective is to reconstruct how changes in data production, longitudinal linkage, distributed observation, evidence updating, and feedback-oriented decision processes alter the practical possibility of following relational and generative economic processes through time. The discussion proceeds from continuous data collection to longitudinal infrastructures, distributed sources of observation, iterative evidence revision, and adaptive decision processes. The method is historical and institutional: the section treats contemporary evidence infrastructures as enabling conditions for GRE while preserving the distinction between evidence, interpretation, judgment, and legitimate action.

1.22.1 Continuous Data Collection

A first evidential condition is the movement from episodic measurement toward more continuous forms of observation. Traditional censuses, surveys, audits, and periodic administrative reports remain indispensable because they are designed around explicit statistical purposes and can provide carefully structured observations. Contemporary public sectors, however, increasingly operate alongside administrative databases, digital service records, transaction logs, sensor streams, platform traces, and machine-generated records that are produced as part of ongoing activity. The World Bank's 2021 account of public-intent data explicitly includes administrative, census, survey, citizen-generated, and machine-generated sources and emphasizes their roles in policy design, execution, monitoring, and evaluation (World Bank 2021). The OECD similarly describes a data-driven public sector as one in which data become an integral resource for policy making, service delivery, organizational management, and innovation (Ooijen et al. 2019).

The methodological change is temporal as much as quantitative. A periodic observation compares a small number of states separated by an interval. A more continuous evidential infrastructure can preserve intermediate changes, timing, sequence, and recurrence. This matters for relational analysis because a relation can form, weaken, reverse, or disappear between conventional observation points. It matters even more for generative analysis because the sequence through which capacities,

constraints, and institutional responses develop may be part of the explanation. A record of endpoints can show that a transition occurred; a denser temporal record can sometimes reveal the pathway through which it occurred.

Continuous observation also changes the practical relation between evidence and intervention. When evidence arrives only after a long reporting cycle, institutions often evaluate effects retrospectively. When administrative or operational indicators are updated more frequently, deviations can become visible during implementation. Such visibility does not by itself determine whether a deviation matters, whether the underlying measure is valid, or whether action should follow. It changes the feasible timing of inquiry. Institutions can potentially distinguish a transient fluctuation from a persistent change sooner, compare the development of several trajectories, and identify where additional investigation is needed before the end of an intervention cycle.

The increase in observational frequency introduces corresponding risks. Data generated continuously are often generated for operational rather than analytical purposes. Definitions can change as software, eligibility rules, administrative procedures, or institutional priorities change. Missingness may become systematic because participation in digital systems is unequally distributed. High-frequency measurement can also encourage attention to what changes rapidly while slower structures remain difficult to observe. A rich stream of immediate indicators may therefore produce an evidential bias toward fast variables precisely when the economic process of interest depends on institutional, demographic, ecological, or cultural variables that move more slowly.

Continuous data collection should therefore be treated as an expansion of temporal access rather than as complete observation. It increases the density of traces available to analysis while leaving unresolved questions of validity, provenance, representativeness, privacy, and interpretation. For GRE, its historical significance lies in making trajectories easier to reconstruct. The evidential object can increasingly become a process unfolding through time rather than a pair of states compared before and after an event.

1.22.2 Longitudinal Evidence Infrastructures

The second condition is the development of infrastructures capable of relating observations across time. Longitudinal evidence differs from repeated measurement when records can be connected to persons, organizations, places, programs, institutions, or relational configurations in ways that preserve temporal continuity. The analytical gain is substantial. Repeated cross-sections reveal population-level change; longitudinal systems can additionally show trajectories, persistence, transitions, and heterogeneous sequences within the changing population.

Contemporary data-governance initiatives increasingly recognize integration and linkage as institutional questions rather than purely technical tasks. The World Bank's *World Development Report 2021* develops the idea of an integrated national data system in which data production, exchange, and use are connected across public institutions and, under appropriate arrangements, with academic, private-sector, civil-society, and individual participants (World Bank 2021). The OECD's account of

a data-driven public sector likewise emphasizes data governance across the public sector rather than isolated use within single agencies (Ooijen et al. 2019). These developments create the possibility of observing economic processes whose relevant evidence is distributed across organizational boundaries.

Longitudinal linkage is especially important for generative questions because effects can appear after substantial delay. An educational intervention may affect labor-market position years later; infrastructure can alter patterns of firm formation only after complementary investments accumulate; institutional recognition can affect credit access, organizational survival, or intergenerational opportunity over long horizons. A short evaluation window may correctly measure immediate outputs while missing later relational or capacity effects. Longitudinal evidence creates the possibility of following these effects without assuming that the value of an intervention is exhausted by its first measurable consequence.

The same infrastructure also supports the analysis of path dependence. If later outcomes depend on the sequence through which earlier states were reached, an evidential system must preserve more than current status. It must retain enough historical structure to distinguish trajectories that end at similar observed states but arrive there through different institutional histories. This requirement links evidence design to the historical arguments developed in Section 1.20: path dependence is analytically meaningful only when the history required to identify the path has been preserved.

Longitudinal evidence is therefore inseparable from institutional memory. Data definitions, identifiers, classifications, and access rules must persist long enough for records to remain comparable, or their changes must themselves be documented. A category that changes meaning over time can create false continuity when the same label is treated as stable. Conversely, a change in classification may be evidence of institutional transformation rather than a nuisance to be harmonized away. The evidential infrastructure must preserve both observations and the history of the categories through which those observations were produced.

This point is central to GRE's emphasis on future re-epistemization. Evidence retained for one analytical purpose may later be revisited under different concepts or methods. Longitudinal infrastructure therefore has a generative epistemic function of its own: it preserves the possibility that future inquiry will reconstruct present processes differently. The value of preservation is not limited to improving current prediction. It also maintains future access to historical relational structure.

1.22.3 Distributed Observation

A third evidential condition is the distribution of observation across many institutions and forms of participation. Economic reality is rarely observed from a single point. Tax administrations, statistical offices, regulatory agencies, firms, financial institutions, researchers, civil-society organizations, households, digital platforms, sensors, and citizens can all produce traces relevant to the same economic process. The World Bank describes the contemporary data-governance ecosystem as extending beyond government to the private sector, civil society, academia, and other actors, and it emphasizes the institutional problem of enabling data to be combined and exchanged

while safeguarding rights, security, and integrity (World Bank 2021).

Distributed observation matters because different observers have access to different manifestations of the same relational system. Administrative records may reveal recognized membership and formal transfers. Surveys may reveal experiences and expectations that administrative systems do not record. Transaction data may reveal realized exchanges with high temporal resolution. Qualitative fieldwork may reveal meanings and informal relations that standardized records cannot represent. Citizen-generated evidence can make visible local conditions that centralized institutions observe poorly. None of these sources provides a neutral view from nowhere; their combination can nevertheless reveal discrepancies that would remain invisible within a single evidential regime.

The analytical opportunity is therefore triangulation across positions. When several sources converge despite different production processes, confidence in some claims may increase. When they diverge, the divergence can become substantive evidence. A statistical indicator may report stable service delivery while interview evidence documents changing barriers to access. Administrative records may show formal program participation while transaction data reveal that effective use is concentrated among a subset of recognized participants. The discrepancy may indicate measurement error, category mismatch, selective observation, or a genuine difference between formal recognition and realized relation.

Distributed observation also introduces a relational problem among evidence producers themselves. Data are generated under different mandates, incentives, legal constraints, business models, technical standards, and temporal rhythms. Combining them requires interfaces: shared identifiers, interoperable formats, provenance records, agreements over access, and institutions capable of resolving conflict among sources. Evidence infrastructure is therefore itself a relational system. Its architecture influences which observations can be connected, which remain isolated, which actors gain interpretive authority, and which absences become structurally persistent.

This makes evidential plurality both a strength and a governance challenge. A system with many observers can reduce dependence on one institutional viewpoint, yet concentration in key infrastructures can create new forms of asymmetry. Platforms with privileged access to behavioral data may see relations unavailable to public institutions or researchers. Public agencies may possess administrative authority that makes their classifications consequential even when alternative descriptions exist. Communities may hold contextual knowledge that has little institutional standing. The distribution of evidence production is consequently linked to the distribution of epistemic power, a theme developed more fully in later parts of the book.

For GRE, distributed observation expands the possibility of reconstructing relational reality from multiple manifestations. It also reinforces ontological and epistemic restraint. Agreement among sources can strengthen an inference; disagreement can reveal the dependence of representation on institutional position. The existence of many observations does not eliminate the inverse problem of moving from manifestations to the relational structures that generated them.

1.22.4 Evidence Updating

The fourth condition is the institutional capacity to revise evidential judgments as new information becomes available. Evidence-informed policy making is defined by the OECD broadly enough to include statistics, data, research evidence, and evaluation in decisions to plan, implement, and, where relevant, alter public policies and programs (OECD 2020a). This formulation is important because it treats evidence as part of an iterative process rather than as a single justificatory input delivered before action begins.

Updating has several analytically distinct forms. New observations can change estimates within an existing model. They can reveal that a previously measured relation has weakened or reversed. They can expose a missing variable, a classification error, or a boundary condition that the original analysis omitted. In stronger cases, evidence can undermine the representation itself and require a change of model, category, or theory. GRE's generative perspective makes the last possibility especially important because the system under study may change the relations that made an earlier model adequate.

An updating infrastructure must therefore preserve revision rather than merely replace earlier states of knowledge. Versioned datasets, documented methodological changes, model histories, evaluation reports, and explicit records of revised assumptions allow later researchers to reconstruct why a decision or interpretation changed. Without such provenance, an institution can update its current estimate while losing the history of its own learning. The result is a paradoxical form of informational abundance in which current dashboards improve while the trajectory of interpretation becomes harder to recover.

Evidence updating also requires a distinction between evidential revision and automatic policy response. An estimate can change without changing the relevant decision because the difference is too small, the intervention is costly to reverse, normative commitments constrain the available actions, or several evidential sources point in different directions. Conversely, a modest evidential change can become decision-relevant when a system is close to an institutional threshold or when delay carries large costs. Evidence informs judgment; it does not mechanically substitute for judgment.

This distinction becomes more important when evidence arrives at different frequencies. Operational indicators may update daily, survey estimates quarterly, fiscal data annually, and structural outcomes only over several years. Treating every update as equally decision-relevant would allow high-frequency indicators to dominate simply because they arrive more often. A generative-relational approach instead asks which timescale corresponds to the process being governed and whether the evidence updates the fast state, the slower relational architecture, or the assumptions linking the two.

The scientific significance of evidence updating is therefore deeper than responsiveness. It institutionalizes revisability. A governance system capable of learning from new evidence can revise representations, evaluations, and interventions without assuming that the original model was final. This does not guarantee learning; institutional incentives can suppress inconvenient findings, methods can remain

locked into outdated categories, and rapid updating can amplify noisy indicators. It creates a historical possibility for governance to remain epistemically open while acting under incomplete knowledge.

1.22.5 Adaptive Decision Processes

The fifth condition is the incorporation of feedback into decision processes. The OECD's policy framework on public governance describes monitoring information as a resource that can feed decision-making, track implementation, and support adjustment, and it emphasizes feedback loops and evaluation across the policy cycle (OECD 2020c). Its cross-country work on policy evaluation likewise treats evaluation as a source of accountability, learning, and improved decision-making rather than as a purely retrospective exercise (OECD 2020b). These institutional practices make it increasingly feasible to treat some interventions as revisable processes rather than fixed decisions followed by a single final assessment.

Adaptive decision processes are especially relevant where causal structure is uncertain and the consequences of intervention unfold over time. An institution can begin with a provisional model, monitor selected consequences, compare observed and expected trajectories, revise the model, and alter the intervention when predefined or deliberatively assessed conditions are met. The practical logic resembles the research-practice relation developed later in this book: action generates evidence, evidence revises understanding, and revised understanding changes subsequent action.

Adaptation requires more than frequent data. The evidence must arrive in a form that can be interpreted relative to the decision. Institutions need authority to revise implementation, procedures for recording why revisions occur, and safeguards against the continuous redefinition of objectives in response to short-term indicators. An adaptive process also needs temporal discipline. Some interventions require enough time for effects to emerge; premature adjustment can prevent the very relation being evaluated from stabilizing. Other interventions create rapidly compounding harms for which delayed response is costly. The appropriate update interval is therefore a property of the intervention and the relevant dynamics rather than a universal preference for faster feedback.

Reversibility further conditions adaptation. When an action can be adjusted at low cost, institutions can learn through incremental changes more readily. When interventions alter legal status, infrastructure, ecological conditions, or long-horizon expectations, later correction may be partial or impossible. In such cases, evidence updating still matters, but adaptive governance must operate through staged commitments, safeguards, contingency planning, or more demanding ex ante justification. The availability of real-time evidence does not make irreversible action experimental in the same sense as a reversible pilot.

Adaptive decision processes also remain normatively and politically situated. Evidence can indicate consequences and uncertainty; it does not decide which consequences deserve priority, whose losses require protection, or which distributions are acceptable. These questions lead directly to Section 1.23, which examines the political and normative conditions under which relational governance becomes institution-

ally meaningful. The evidential architecture developed here supplies information for decision; it does not supply the legitimacy or normative ordering of the decision itself.

The historical opening is therefore specific. Contemporary institutions can increasingly observe economic processes at higher frequency, connect evidence across time and organizations, revise interpretations as evidence accumulates, and alter some decisions during implementation. These capacities make relational and generative governance more technically conceivable because trajectories and feedback can enter institutional practice. They also expose new problems of surveillance, data concentration, representational power, model dependence, and temporal mismatch. GRE treats this evidential expansion as a condition of possibility for adaptive economic analysis and action, while retaining the distinction between observing a generative system and possessing the knowledge or authority required to control it.

1.23 Political and Normative Conditions of Relational Governance

This section identifies the political and normative conditions that have made relational questions increasingly admissible within economic governance. Its role in the chapter is historical and disciplinary: Sections 1.19–1.22 reconstructed scientific, computational, and evidential capacities, whereas the present section concerns the standards by which institutions decide whose relations, capabilities, interests, and temporal claims enter the field of evaluation. The objective is to show how political participation, human-rights recognition, capability-oriented development, commons governance, and environmental or intergenerational normativity widened the range of economically relevant objects beyond administratively isolated recipients and contemporaneous outputs. The discussion proceeds through those five developments in sequence. Its method is reconstructive rather than prescriptive. The section treats these traditions as historical conditions that make relational governance thinkable and institutionally legible; systematic governance theory remains outside the scope of this chapter and is reserved for later GRE interfaces with Generative Relational Governance.

1.23.1 Political Participation

Political participation changes the position from which governance problems are formulated. An administrative model can treat persons primarily as recipients, taxpayers, employees, consumers, regulated entities, or statistical units. Participatory arrangements introduce an additional status: persons and organized groups can enter the process through which public problems, priorities, and institutional responses are interpreted. This change matters for relational analysis because affected parties often possess information about dependencies, informal practices, exclusion mechanisms, and downstream effects that remain weakly represented in administrative categories.

The institutionalization of participation as a governance concern is visible in

twentieth-century rights instruments. Article 25 of the International Covenant on Civil and Political Rights recognizes for citizens the right and opportunity to take part in the conduct of public affairs, directly or through freely chosen representatives, alongside electoral and public-service rights (United Nations General Assembly 1966). The significance for the present argument lies in the formal recognition of participation as part of the structure of public affairs. Governance is thereby evaluated partly in terms of relations between institutions and those subject to, represented within, or participating in public decisions.

Participation also alters the evidential architecture described in Section 1.22. Distributed observation acquires a political dimension when experiences and local knowledge enter institutional deliberation through hearings, consultation, representative bodies, associations, unions, community organizations, or other channels. Administrative evidence can reveal formally recorded transfers and statuses; participants can identify how those arrangements operate in practice. A benefit formally available to all eligible persons may be difficult to obtain because of language, time, location, documentation, digital access, stigma, or dependence on intermediaries. These conditions are relational because the effective outcome depends on the configuration linking claimant, institution, infrastructure, and other actors.

The analytical value of participation therefore extends beyond preference aggregation. Participants can contest the definition of the object itself. A housing problem may be framed as insufficient units, insecure tenure, spatial exclusion, financing constraints, discriminatory access, or inadequate transport relations. Each formulation identifies a different relational structure and therefore a different possible intervention. Participatory processes can expose these competing formulations before an administrative category becomes fixed as the sole representation of the problem.

Participation also has clear limits. Access is uneven, organized interests possess different resources, participation can be costly, and institutional forums can reproduce existing asymmetries. A meeting or consultation does not establish that every affected relation has become visible. Nor does participation remove the need for expertise, legal authority, or accountable decision. For GRE, the historical importance of participatory norms is more specific: they weaken the assumption that the economic object of governance can be fully specified from the administrative center before those situated within its relational field are heard.

This condition matters especially for generative questions. The long-run effects of an intervention may include changes in trust, capability, dependency, organizational learning, and future access. Such effects often appear first in the experiences of participants rather than in the primary output metric. Political participation creates institutional channels through which some of these effects can become objects of public interpretation and later evidence.

1.23.2 Human Rights and Institutional Recognition

Human-rights frameworks provide a second condition by institutionalizing forms of recognition that are not exhausted by economic role. The Universal Declaration of Human Rights states that everyone has a right to recognition everywhere as a person before the law and articulates equality before the law among its foundational guar-

antees (United Nations General Assembly 1948). The present chapter does not derive a complete normative theory from these provisions. Their historical significance for GRE lies in the expansion of institutional standing: a person enters governance as a bearer of recognized claims whose relevance cannot be reduced to ownership, productivity, income, contractual position, or contribution to measured output.

This development complicates purely recipient-centered economic description. A transfer system can be efficient in reaching a target population while still affecting privacy, family relations, freedom of association, legal recognition, or access to remedy. A labor arrangement can increase output while altering dependence, voice, or exposure to arbitrary exclusion. A data infrastructure can improve administrative coordination while creating new asymmetries in visibility and classification. Once recognized rights become part of the institutional environment, these dimensions become relevant constraints on the design and evaluation of economic governance.

Institutional recognition is itself relational. A right requires more than the internal possession of an attribute by an isolated individual. Its practical effect depends on relations among the person, legal rules, administrative bodies, courts or review mechanisms, documentation systems, and other actors capable of honoring or violating the recognized claim. Formal recognition can therefore be represented as a stabilized institutional relation whose effectiveness varies with access, enforcement, and the organization of remedies. This does not reduce rights to economic relations; it clarifies why rights matter to economic institutions even when their normative foundation is external to economics.

The distinction is especially important for heterogeneous subjects. Section 1.16 separated economic subjecthood from final metaphysical or moral personhood. Human-rights traditions reinforce the need to preserve that separation. Economic systems may assign roles to persons, organizations, or artificial agents for purposes of contract, production, or allocation, while normative and legal standing follows different criteria. GRE therefore requires care whenever economic functionality is used as a proxy for broader status. Productive capacity does not settle legal recognition, and administrative recognition does not settle moral standing.

Human-rights frameworks also expand the temporal stability of claims. Economic positions can change rapidly: employment can end, assets can be lost, and market participation can fluctuate. Rights-based recognition is designed to persist across many such changes. This creates an institutional layer whose continuity can constrain short-horizon optimization. From a generative perspective, such continuity can affect future options by preserving access to institutions, remedies, participation, and protections during periods of economic transition.

The resulting contribution to relational governance is a boundary condition rather than a policy formula. Rights language identifies some relations and statuses as institutionally salient even when they are poorly captured by current output measures. GRE can analyze the economic consequences of those relations while leaving their ultimate normative justification to political philosophy, law, and human-rights theory.

1.23.3 Capability and Human Development

The capability and human-development traditions provide a third condition by shifting evaluation from resources alone toward substantive opportunities. Sen's capability-oriented account treats development in terms of the expansion of substantive freedoms and the effective opportunities persons possess to pursue valued ways of living (Sen 1999). This change is directly relevant to relational economics because identical resource bundles can generate different practical possibilities when persons occupy different social, institutional, bodily, geographic, or infrastructural positions.

Capability analysis changes the evaluative unit without dissolving the importance of resources. Income, assets, services, and public provision remain means through which capabilities can be supported. Their significance depends on conversion conditions. A transport subsidy has little mobility effect where transport infrastructure is absent. Digital access has different consequences when literacy, language, hardware, electricity, or institutional recognition differ. Formal educational access has different value when care obligations, discrimination, health, or local labor-market structures alter the feasible use of education. These examples make visible the relational environment through which resources become effective opportunities.

This shift also creates a bridge between entity-centered and relational evaluation. The person remains a central normative referent, while the explanation of effective freedom requires attention to the relations surrounding that person. The analytical question becomes wider than resource possession. It includes the social and institutional conditions through which possession is converted into the ability to act. GRE can therefore inherit an important discipline from capability analysis: resources, outcomes, and opportunities should remain distinct analytical objects.

The capability perspective also introduces plurality into economic evaluation. If development concerns several kinds of functioning and freedom, a single aggregate output measure provides only a partial view. Health, education, mobility, participation, security, and other dimensions can interact without being reducible to one immediate metric. For GRE, the importance of this plurality is methodological as well as normative. Heterogeneous values may require different evidential forms and may circulate through different relational pathways. Later chapters extend this problem into value conversion and partial commensurability; the present section identifies the historical tradition that made plural opportunity structures a legitimate economic concern.

A generative extension follows when present capabilities affect the production of future capabilities. Education can generate learning capacity; political participation can generate organizational experience; secure institutional recognition can expand future access; health can affect later employment and care relations. Capability at one moment can therefore become an enabling condition for capability at another. This temporal extension should be handled cautiously because long-horizon attribution is difficult. It nevertheless reveals why capability-oriented evaluation is congenial to a generative framework: the object of interest can include the changing possibility set through which later economic action becomes feasible.

The relationship between GRE and the capability tradition remains one of dialogue

rather than identity. Capability analysis supplies a normative and evaluative vocabulary centered on substantive opportunity. GRE adds questions about relational generation, circulation, conversion, and historical transformation. The two can overlap substantially while preserving different theoretical commitments.

1.23.4 Commons and Collective Governance

Commons scholarship supplies a fourth condition by demonstrating that shared-resource problems can be organized through institutional forms more diverse than a binary opposition between centralized control and individualized private ownership. Ostrom's comparative work on common-pool resources analyzes self-organized and self-governed arrangements, including both long-enduring institutions and cases of fragility or failure (Ostrom 1990). The historical importance of this research lies in making collective rule formation, monitoring, boundary definition, conflict resolution, and institutional adaptation legitimate objects of economic analysis.

The commons perspective is relational at several levels. Resource use depends on relations among appropriators, relations between users and the resource system, and relations between local arrangements and wider authorities. The relevant economic object is therefore difficult to represent as a resource plus a set of independent claimants. Rules concerning access, monitoring, sanctions, contribution, and conflict resolution alter how the group interacts and how the resource is reproduced over time. Institutional performance depends on the configuration of these relations.

This perspective also widens the concept of governance capacity. Coordination can emerge from participants who construct and revise rules rather than receiving a fully specified institutional design from an external authority. Such self-organization does not imply spontaneity without structure. Ostrom's analysis emphasizes institutions, information, credible commitments, monitoring, and the conditions under which participants can organize collective action (Ostrom 1990). The result is an empirical challenge to analytical frameworks that treat collective governance as conceptually secondary to state administration or market exchange.

For GRE, commons research is especially relevant to the distinction between allocation and generativity. A shared resource can be allocated among current users while the institutional relations required for future reproduction are simultaneously strengthened or weakened. Rules that maximize present extraction may reduce future resource availability or institutional trust. Rules that preserve the resource can impose present costs while maintaining later options. Evaluation therefore requires attention to the relation between current distribution and the reproduction of the relational system through which future use remains possible.

The commons tradition also provides a useful warning against idealizing relational organization. Collective governance can fail, exclude outsiders, reproduce internal hierarchy, or become fragile under changing conditions. Ostrom's own comparative programme includes failures as well as successes (Ostrom 1990). Relational density therefore has no automatic normative priority. GRE treats the structure, distribution, revisability, and generative effects of relations as empirical and normative questions rather than assuming that more relation is inherently better.

This restraint clarifies the contribution of commons scholarship to the present

chapter. Its historical significance is the expansion of the institutional imagination available to economics. Shared resources can be governed through architectures in which users, rules, monitoring, and collective learning form an evolving system. That possibility supplies an important precedent for GRE's later examination of relational allocation, collective capacity, and institutional generativity.

1.23.5 Environmental and Intergenerational Normativity

Environmental and intergenerational norms provide a fifth condition by extending economic evaluation across temporal and ecological boundaries. The World Commission on Environment and Development's 1987 report, *Our Common Future*, articulated sustainable development through the relation between present needs and the ability of future generations to meet their own needs, while explicitly linking environmental limits to technology and social organization (World Commission on Environment and Development 1987). This formulation helped stabilize a normative vocabulary in which future consequences and ecological conditions became integral to development rather than external aftereffects.

The temporal extension changes the structure of the economic subject. Future persons cannot participate in current markets, vote in current institutions, or contract with present actors, yet current investment, extraction, infrastructure, emissions, debt, and technological choices can alter their opportunity sets. Intergenerational evaluation therefore requires institutions to represent interests that are temporally absent from ordinary exchange. This is a relational problem because current actions create relations of inheritance, dependence, exposure, and constraint across time even when the later participants are not presently available as counterparties.

Environmental problems introduce a related spatial and systemic extension. Ecological processes cross property boundaries, jurisdictions, and accounting periods. Resource depletion, pollution, biodiversity loss, and climate effects can connect actors who never transact directly. The relevant causal structure can therefore extend beyond the legal boundaries of the entity generating an immediate economic output. Environmental normativity makes these externalized relations harder to exclude from evaluation simply because they fall outside the original contract or reporting unit.

The combination of environmental and intergenerational concerns also changes the meaning of economic efficiency across horizons. An arrangement can produce high current output while degrading ecological or institutional conditions required for later production. Conversely, present investment can maintain capacities whose returns become visible only over long periods. GRE's generative vocabulary is well suited to this temporal structure because it distinguishes present outcomes from the conditions under which future outcomes can be generated. The normative judgment about how present and future claims should be weighted remains a separate problem.

This separation is important. Generativity does not itself determine goodness. A system can generate durable forms of domination as readily as durable capabilities; an environmentally persistent arrangement can remain unjust; preservation can conflict with present claims of people facing urgent deprivation. Environmental and

intergenerational evaluation therefore requires explicit normative reasoning about distribution, rights, risk, recognition, and acceptable tradeoffs. GRE can contribute an account of how current relations transform future possibility while leaving the ranking of competing claims open to normative theory.

The five developments reconstructed in this section collectively widen the space within which relational governance can be conceived. Participation makes affected relations relevant to problem formation; human-rights recognition gives institutional standing to persons beyond their market roles; capability analysis directs attention toward effective opportunities and conversion conditions; commons research establishes collective institutional arrangements as substantive economic objects; and environmental or intergenerational normativity extends evaluation across ecological systems and historical time. None of these traditions yields GRE by itself. Together they create a political and normative environment in which economic governance can increasingly be asked to account for relations, heterogeneous forms of standing, future possibilities, and the conditions through which economic life is reproduced. Section 1.24 turns next to the development of nomos and institutional form: the legal and organizational structures through which such expanded objects of recognition can acquire durable institutional expression.

1.24 Development of Nomos and Institutional Form

This section identifies the institutional developments through which relational and collective economic claims acquire durable forms of recognition. Its role in the chapter is to connect the political and normative opening reconstructed in Section 1.23 with the legal and organizational forms that make such claims actionable over time. The objective is to show how *nomos*, used here in a deliberately broad sense for the operative normative and institutional order that assigns statuses, claims, duties, boundaries, and procedures, changes the range of economic relations that can be represented and governed. The discussion proceeds from legal recognition of economic subjects to collective and relational interests, then examines fiduciary, cooperative, and commons-based institutions before turning to adaptive and revisable governance. The method is institutional and comparative. It treats legal and organizational forms as historically developed devices for stabilizing relations, allocating authority, preserving claims, and structuring revision, while leaving the systematic theory of governance to later GRG work.

1.24.1 Legal Recognition of Economic Subjects

Legal recognition supplies one of the principal mechanisms through which an economic subject becomes durable across transactions. Section 1.5 showed that modern economic entities become administratively legible through legal personality, property, contract, accounting, and statistical classification. The present subsection develops the institutional implication of that argument. Recognition gives continuity to a position that can own assets, incur liabilities, enter contracts, appear in accounts, receive transfers, and bear responsibilities across time. Economic analysis can then treat that position as sufficiently stable for allocation and coordination even when

the persons, assets, or internal relations composing it change.

Organizational law illustrates the structure clearly. Hansmann and Kraakman emphasize the role of organizational law in separating organizational assets and creditor claims from the personal asset positions of owners and managers (Hansmann and Kraakman 2000). This legal partitioning stabilizes a boundary through which an organization can persist as an economic unit across changes in membership and management. The System of National Accounts similarly treats institutional units as basic economic and statistical units capable of owning assets, incurring liabilities, making economic decisions, and entering transactions in their own right (European Commission et al. 2009). The legal and statistical vocabularies differ, yet both rely on institutional criteria that transform a changing configuration of persons and resources into a recognizable economic position.

Recognition therefore participates in the production of the economic object it later regulates. Once an entity is recognized as a corporation, public body, household, nonprofit institution, or other institutional unit, contracts, accounts, taxes, liabilities, transfers, and statistics can attach to that recognized position. The resulting stability supports coordination across actors who need not reconstruct the entity's entire internal relational history before every transaction. Recognition reduces uncertainty by supplying a durable institutional address for claims and obligations.

The same mechanism also creates selective visibility. Legal and administrative forms foreground the relations that are necessary to maintain the recognized position: ownership, authority, liability, membership, contractual capacity, reporting boundaries, and related incidents. Other relations can remain external to the formal identity of the unit even when they matter economically. Care relations within households, dependencies in supply chains, informal obligations, platform-mediated access, or ecological dependencies can shape the capabilities of an entity while receiving weaker recognition in the formal representation.

The development of nomos therefore changes economic ontology at the practical level. The point concerns institutional reality rather than ultimate metaphysics. A legal form can make a configuration sufficiently stable and causally efficacious for economic coordination, while the broader social and relational constitution of that configuration remains open to analysis. This institutional stabilization is one historical condition for entity-centered economics, and it also creates the starting point from which relational analysis can ask which constitutive relations remain outside the recognized boundary.

1.24.2 Recognition of Collective Interests

Collective interests extend institutional recognition beyond a simple aggregation of individually held claims. Their significance for GRE lies in the possibility that an institution can assign standing, assets, decision rights, or continuity to a group whose economic activity depends on coordinated relations among members. The relevant development concerns the creation of forms through which a collective can persist and act even as individual participants enter, leave, or change their contributions.

The corporation is one familiar example, though collective recognition extends beyond shareholder-owned firms. Associations, cooperatives, mutuals, unions, pension

arrangements, foundations, public bodies, and commons institutions organize interests whose practical content depends on continued relations among multiple participants. Organizational forms can provide a durable account of membership, authority, assets, obligations, and procedures for collective decision. The recognized collective thereby acquires a temporal continuity that individual contracts alone may reproduce only at substantial cost.

Cooperative institutions provide a particularly explicit example of collective economic recognition. The International Cooperative Alliance defines a cooperative as an autonomous association of persons who voluntarily unite to meet common economic, social, and cultural needs through a jointly owned and democratically controlled enterprise (International Cooperative Alliance 1995). The institutional form links economic participation to membership and democratic control rather than treating invested capital as the sole basis of authority. The form therefore stabilizes a collective interest while preserving identifiable relations between members, enterprise, capital, and decision procedures.

Collective recognition also changes the possible recipient of economic allocation. Resources can be directed toward a jointly owned reserve, a common infrastructure, a pension fund, a mutual insurance pool, or an institution whose purpose concerns a class of members rather than an isolated owner. The economic consequence is important: the same nominal transfer can have different effects depending on whether it becomes private property, common capital, an indivisible reserve, or an institutional asset governed under membership rules. Collective forms therefore make visible the organization of the recipient, not merely its legal name.

The analytical implication for GRE concerns persistence and aggregation. A collective interest gains economic relevance when the institutional form can preserve some relation or capability across turnover in individual participants. The collective then becomes a legitimate object of analysis because decisions taken at the collective level can affect access, bargaining position, risk sharing, investment, and future participation. Collective recognition does not establish that every group claim is normatively valid. It establishes that economic institutions have developed devices through which certain shared claims can be stabilized, governed, and carried through time.

This development widens the space of economic subjecthood introduced in Section 1.16. Subject positions can be individual, organizational, or collective, and their stability can depend on different institutional mechanisms. GRE can therefore examine how a form of collective recognition alters the relations through which resources, risks, authority, and returns circulate.

1.24.3 Recognition of Relational Interests

Relational interests concern claims whose practical meaning depends on a structured relation among parties rather than on possession by a single isolated holder. Their institutional significance becomes visible when economic law or organizational design protects a beneficiary relation, membership relation, stewardship relation, access relation, dependency, or continuing obligation whose value cannot be described fully as an immediately transferable asset. The objective of this subsection is to identify the institutional possibility of recognizing such interests while preserving the distinction

between a relation and an entity created to administer it.

Trust law offers a useful illustration. Hansmann and Mattei analyze the trust as an organizational form that structures relations among parties to the trust and between those parties and third parties, with asset partitioning playing a central role in the form's economic function (Hansmann and Mattei 1998). The legal arrangement separates dimensions of control, benefit, and creditor access that coincide more closely under simple ownership. A beneficiary's economic interest therefore depends on an institutionalized relation to assets managed through another position. The interest is intelligible through the relation among trustee, beneficiary, trust assets, and third parties.

Membership provides a second illustration. Cooperative rights derive their practical meaning from a person's relation to the cooperative and to the procedures through which the cooperative is controlled. The ICA principles connect membership to participation in policy and decision making, member economic participation, autonomy, and cooperation among cooperatives (International Cooperative Alliance 1995). These rights have an economic content that differs from a detached claim to an asset because their exercise depends on continuing membership and institutional procedures.

Commons institutions provide a third form. Ostrom's comparative work documents arrangements in which groups establish rules concerning access, use, monitoring, sanctioning, and collective choice around common-pool resources (Ostrom 1990). The relevant interest is structured through relations among users, resource conditions, monitoring practices, and institutional rules. Access to the resource can therefore depend on membership and rule-governed relations rather than on exclusive ownership by a single actor.

These examples suggest a cautious extension of economic representation. Some interests can be represented more adequately by specifying the relation through which the claim is sustained. A transfer to a beneficiary, a member, or a resource user changes more than the recipient's balance sheet when it also alters membership, control, dependence, monitoring obligations, or future access. Relational analysis becomes useful where these continuing relations materially shape the effect of the transfer.

Institutional recognition can nevertheless reify what it stabilizes. A fluid relation may be converted into a fixed legal category, a standardized entitlement, or an administratively bounded membership class. Such stabilization can be necessary for enforceability and coordination, while also narrowing the variation that the institution can perceive. GRE therefore treats recognition as a generative intervention into the relation itself. The act of making an interest legible can alter the boundaries, participants, duties, and future trajectories of that interest.

The resulting problem is central to later relational allocation theory. Economic institutions require stable addresses for claims, yet generative relations can change through time. A relationally sensitive nomos therefore needs forms that can recognize continuing interests while leaving room for revision when the relations supporting those interests change.

1.24.4 Fiduciary, Cooperative, and Commons-Based Institutions

Fiduciary, cooperative, and commons-based institutions demonstrate several ways in which economic organization can distribute ownership, control, benefit, and responsibility across differentiated positions. Their importance for the present chapter lies in institutional variety. Modern economic ordering already contains forms that depart from the simple image of one owner controlling one asset for one private purpose. These forms provide concrete precedents for GRE's later inquiry into allocation toward relations, shared infrastructures, collective capacities, and future beneficiaries.

Fiduciary structures separate authority from beneficial interest under a rule-governed relation. Trust law can partition assets and structure claims among trustees, beneficiaries, and third parties in ways that ordinary bilateral contracting may reproduce only imperfectly (Hansmann and Mattei 1998). The institutional form permits resources to be administered under purposes and duties that persist beyond a particular transaction. Pension funds, charitable trusts, and other fiduciary arrangements differ substantially in law and function, yet they share the broader feature that control over assets and entitlement to benefits can occupy distinct institutional positions.

Cooperatives organize a different separation. Their institutional identity places membership, joint ownership, and democratic control at the center of the enterprise. The ICA principles include voluntary and open membership, democratic member control, member economic participation, autonomy, cooperation among cooperatives, and concern for community (International Cooperative Alliance 1995). These principles provide an explicit example of an economic organization whose architecture links capital to a wider structure of membership and collective decision. The form does not guarantee equal outcomes or successful governance. It demonstrates that economic control and return can be institutionally organized through relations other than proportional investor ownership.

Commons-based institutions add another configuration. Ostrom's cases show that users of common-pool resources can, under some conditions, develop durable rules for access, monitoring, conflict resolution, sanctioning, and collective choice (Ostrom 1990). Their significance lies in the institutionalization of reciprocal and continuing relations around a shared resource. The resource remains economically consequential through a pattern of use and governance that cannot be reduced to a sequence of isolated transfers.

Taken together, these forms show that institutional architecture can distribute economic functions across multiple roles. Asset control, beneficial claim, membership, monitoring, participation, stewardship, and residual return can be attached to different positions and linked through rules. GRE can therefore treat institutional form as part of the causal structure of allocation. A resource entering a trust, cooperative, or commons arrangement enters a different generative configuration from the same resource entering an individually controlled account.

The comparison also supplies a methodological caution. Fiduciary, cooperative, and commons institutions arise from distinct legal histories and solve different problems. Their inclusion in one subsection identifies a family resemblance in the distri-

bution of economic roles, rather than an equivalence among the forms. Later GRE chapters can ask which structural features matter for generativity, participation, return, or justice without treating any existing institution as a ready-made model for a generative relational economy.

The historical lesson is therefore modest and important. Institutional pluralism already exists within modern economic orders. The development of GRE does not require inventing relational organization from an empty institutional field. It requires learning how existing forms distribute relations, which capacities they preserve, which asymmetries they create, and how their rules affect the circulation and return of value.

1.24.5 Adaptive and Revisable Governance

Adaptive and revisable governance provides the final institutional condition considered in this section. Relational and generative systems change while institutions act upon them, so a governance form that can monitor consequences, evaluate implementation, revise rules, and reopen decisions possesses a different temporal structure from a one-time allocation. The objective here is to identify institutional revisability as a historically developed governance capacity, while maintaining the distinction between revisability and a complete theory of adaptive governance.

Institutional revision begins with explicit procedures for observation and feedback. The OECD's framework on sound public governance treats monitoring as a source of information during implementation and connects monitoring and evaluation to adjustment of policy and resource allocation (OECD 2020c). Its comparative work on policy evaluation similarly presents evaluation as a mechanism for accountability, learning, and improved decision making (OECD 2020b). These practices create formal channels through which observed consequences can re-enter the decision process.

Revisability matters because the object of governance can change during implementation. A program can alter incentives, participation, organizational routines, information flows, or the composition of the population it serves. A rule designed for one relational configuration can therefore become mismatched to the configuration partly generated by the rule itself. Monitoring then has a generative significance: the institution observes a system in which its own intervention has become one of the causal relations.

Adaptive capacity also depends on the architecture of amendment. Institutions vary in who can initiate revision, what evidence can count, whose testimony has standing, which decisions are reviewable, how quickly rules can change, and which commitments remain protected from short-horizon adjustment. These procedural differences shape the relation between stability and learning. Rapid revision can make an institution responsive while reducing predictability; rigid rules can preserve expectations while allowing mismatch to accumulate. The relevant design problem concerns the organization of temporal responsiveness across different kinds of rule and different timescales of change.

Existing institutions already embody partial solutions. Cooperative principles can be interpreted and updated through living guidance while preserving a continuing

institutional identity (International Cooperative Alliance 2017). Commons arrangements can contain collective-choice and monitoring procedures through which rules respond to local conditions (Ostrom 1990). Public-governance frameworks increasingly formalize monitoring, evaluation, and revision across policy cycles (OECD 2020c; OECD 2020b). These examples differ in authority and domain, yet each illustrates an institutional attempt to combine continuity with revisability.

For GRE, revisability has a further implication. If institutions participate in generating the relations they govern, evaluation cannot be confined to whether an intervention reached its initial target. It must also ask what relations, capacities, dependencies, and future options emerged through implementation. The answer can justify revision even when the initial output metric was achieved. This creates an institutional bridge between the evidential conditions of Section 1.22 and the generative analysis developed in Sections 1.17–1.20.

The development of nomos therefore expands the practical possibility of relational economics in two directions. Institutional forms can recognize subjects, collectives, and continuing relational interests; revision procedures can preserve the capacity to learn when those recognized forms change through time. The same developments also create new risks of reification, unequal recognition, procedural capture, and excessive administrative complexity. Sections 1.25 and 1.26 turn to these limits directly by examining the remaining epistemic and governance constraints on relational analysis.

1.25 Contemporary Limits of Relational Knowledge

This section specifies the epistemic limits that remain after the scientific, computational, evidential, political, and institutional openings developed in Sections 1.19–1.24. Its role in the chapter is to prevent the historical possibility of richer relational analysis from being mistaken for complete access to relational reality. The objective is to distinguish five persistent limits: partial observation, dependence on representation and model choice, causal underdetermination, boundary and scale dependence, and the temporal incompleteness of generative evaluation. The discussion is epistemological and methodological. It treats these limits as conditions under which relational knowledge must be produced, qualified, compared, and revised, while reserving the fuller epistemology of GRE for Chapter 5.

1.25.1 Partial Observation

Relational economic analysis begins from evidence that is necessarily selective. Some relations are formally recorded because institutions require contracts, accounts, registrations, transactions, tax records, administrative classifications, or platform logs. Other relations remain informal, tacit, private, strategic, episodic, or distributed across several organizations. Even where a relation leaves traces, the traces may register only a subset of its dimensions: a payment can record transfer without recording dependence; an employment contract can record legal status without recording informal authority; a platform interaction can record clicks without recovering the meaning assigned to them by participants. The expansion of data

infrastructures therefore increases observational capacity while leaving observation partial.

The limitation is partly institutional. Observation follows the categories and purposes of the apparatus that produces the record. Administrative systems collect information relevant to eligibility, compliance, taxation, service delivery, or organizational management; firms collect information relevant to production, customers, risk, or control; platforms record events that can be captured through their technical architecture. These records can be highly informative, yet their coverage follows the operational needs of the institution. Relations that matter economically can remain weakly observed when no reporting system has reason, authority, or technical capacity to record them.

The limitation is also distributed. Hayek's account of dispersed knowledge emphasized that economically relevant knowledge exists in incomplete and frequently contradictory fragments across many participants rather than as a single integrated dataset available to one observer (Hayek 1945). Contemporary digital infrastructures can aggregate quantities that were previously unavailable, but aggregation does not eliminate dispersed local knowledge. Tacit routines, contextual expectations, unrecorded obligations, local meanings, and strategic interpretations can remain distributed even in data-rich environments.

Observation can also be asymmetric. Powerful organizations may observe workers, consumers, suppliers, or users more extensively than those participants can observe the organizations that classify and act upon them. Regulators may receive disclosures unavailable to ordinary market participants; platforms may infer behavior from traces that users cannot inspect; organizations can combine datasets across domains while individuals encounter only the immediate interface. Relational knowledge therefore has a distribution as well as a quantity. The question concerns who can observe which relations, at what resolution, and under what rights of access.

Partial observation does not imply that relational claims are arbitrary. It requires explicit evidential scope. A study can state which relations are directly observed, which are inferred, which are represented through proxies, which are inaccessible, and which may be missing systematically. Section 1.22 showed that contemporary evidence infrastructures make such distinctions increasingly tractable. The epistemic discipline is to treat improved observation as an expansion of access rather than as completion of the object.

1.25.2 Representation and Model Dependence

Observed traces become relational knowledge only after they are represented. A representation identifies the entities or positions to be distinguished, the relations to be recorded, the attributes attached to them, the temporal resolution of observation, and the boundary within which the description is constructed. This dependence is present in statistical tables, legal categories, network graphs, field models, agent-based simulations, and qualitative relational maps alike. Relational analysis therefore inherits the epistemic problem already identified for economic categories in Section 1.1: analytical objects become visible through historically and methodologically specific forms of description.

Statistical and administrative classifications provide an obvious case. Desrosières showed historically how statistical reasoning depends on conventions of classification, coding, equivalence, and aggregation that make heterogeneous cases comparable (Desrosières 1998). Hacking likewise emphasized that categories and styles of reasoning have histories and can participate in the formation of the objects they classify (Hacking 2002). For GRE, the implication is that a relational dataset never contains relations in an entirely pre-analytical form. It contains observations organized through decisions about what counts as an actor, event, tie, transaction, household, firm, sector, location, or period.

Formal relational models make these decisions especially explicit. A network representation requires nodes and edges; a higher-order representation requires specification of group interactions; a field representation requires a domain, variables, locality, and boundary conditions. Newman and Battiston and colleagues show how different relational formalisms preserve different structures and support different dynamical questions (Newman 2003; Battiston et al. 2020). A pairwise graph can be appropriate for one problem and lose essential information for another in which an interaction exists only through a group or institutional configuration.

Model dependence therefore concerns the conditional character of inference. A conclusion can be robust within one representation and change when the same empirical material is organized differently. The appropriate response is comparison rather than the search for a representation free of assumptions. Where several defensible models exist, GRE can ask which distinctions each preserves, which it suppresses, and which conclusions survive translation across representations. Later methodology chapters develop this principle through triangulation, sensitivity analysis, and model plurality.

Representation also feeds back into practice. Once a model becomes an administrative category, performance indicator, credit classification, eligibility rule, or platform score, it can change behavior and institutional treatment. Model dependence then becomes generative as well as epistemic: the representation partly enters the relational system it was designed to describe. This possibility strengthens the requirement that GRE state the standing of its models precisely. A model can be descriptively useful without being ontologically exhaustive, and its institutional use can create consequences not contained in its original evidential purpose.

1.25.3 Causal Underdetermination

Relational association does not by itself identify the mechanism that generated it. Two organizations may display similar network positions for different historical reasons; a strong association between membership and outcome may reflect selection, common institutional exposure, reciprocal influence, or an unobserved relation; a policy intervention may coincide with change while several other processes evolve simultaneously. The problem becomes more demanding in generative systems because relations, subjects, institutions, and constraints can coevolve, allowing causes and conditions to change while the observed process unfolds.

The econometric identification literature provides a disciplined language for this limitation. Manski argues that empirical analysis should distinguish what the avail-

able data identify from what follows only after additional assumptions are introduced, and develops methods for learning under incomplete data and partially identified treatment responses (Manski 2008). The relevance to GRE is methodological rather than doctrinal. Rich relational data can narrow the space of plausible explanations while leaving several mechanisms compatible with the observations. Stronger causal claims require stronger design, temporal evidence, institutional knowledge, or assumptions whose credibility must be stated rather than hidden inside the model.

Generative analysis adds historical underdetermination. Path-dependent systems can reach similar visible states through different sequences, and similar interventions can produce different consequences when they enter different institutional trajectories. North's account of institutional change and Arthur's treatment of increasing returns both make historical sequence analytically consequential (North 1990; Arthur 1989). The present state therefore need not uniquely reveal the path that generated it, while a path reconstructed from records may still admit competing mechanism accounts.

Causal underdetermination is especially important for relational intervention. An observed improvement after strengthening one relation can coexist with changes in resources, expectations, network position, institutional recognition, or external conditions. A claim that the relation generated the improvement should therefore identify the mechanism, timing, relevant alternatives, and evidence that discriminates among them. Where the evidence supports only contribution, enablement, or association, the language of the claim should remain correspondingly limited.

This limitation does not reduce GRE to causal skepticism. It specifies an evidential gradient. Some cases support strong identification; others support partial identification, mechanism plausibility, process evidence, or bounded counterfactual claims. The research task is to align claim strength with evidential strength. A generative framework is most useful when it makes additional mechanism questions visible, while remaining willing to leave several explanations open when the evidence does not discriminate among them.

1.25.4 Boundary and Scale Dependence

Relational descriptions depend on where the system boundary is drawn and at what scale the system is observed. An organization's internal network can appear dense when suppliers, regulators, households, and infrastructures are excluded, while the same organization can occupy a peripheral or dependent position in a wider production network. A household can appear as one allocation unit in national accounts and as a differentiated set of care, income, authority, and dependency relations at a finer resolution. Neither description is automatically defective. Each answers a different question by preserving a different set of distinctions.

The statistical literature provides a classic warning against transferring relationships across levels of aggregation. Robinson demonstrated that correlations calculated for grouped populations can differ materially from corresponding relationships among individuals and that aggregate associations therefore do not license direct inference about individual behavior (Robinson 1950). The lesson extends beyond ecological correlation. Relations observed at one scale can be generated by compositions,

constraints, or interactions that disappear when the analysis moves to another scale.

Complex-systems research supplies a complementary perspective. Bar-Yam's multiscale framework treats structure as scale-dependent and emphasizes that the organization visible at one resolution can differ from that visible at another (Bar-Yam 2004). Network analysis likewise depends on the population of nodes and ties admitted to the graph (Newman 2003). Centrality, clustering, brokerage, modularity, and dependency can all change when the boundary expands, when a layer is added, or when a higher-order interaction is represented explicitly.

Boundary selection also has normative and political consequences. A firm-level productivity analysis can exclude unpaid household labor on which workers depend; a project-level cost calculation can exclude environmental effects outside the administrative jurisdiction; a platform-level analysis can omit alternative infrastructures that determine user exit; a national analysis can externalize transnational labor or ecological relations. The boundary therefore determines which effects become internal to evaluation and which remain external to it.

GRE should consequently treat boundary and scale as reportable analytical choices. Robust relational claims should indicate whether their conclusions persist across plausible alternative boundaries and resolutions. Where conclusions change, the variation is itself informative: it identifies the scale or relational neighborhood at which the mechanism appears. This discipline makes multiscale disagreement a source of knowledge rather than a defect to be concealed by choosing one preferred level.

1.25.5 Temporal Limits of Generative Evaluation

Generative evaluation faces a temporal limit because the object of evaluation includes consequences that have not yet fully emerged. A transfer can alter capacity only after training, trust, infrastructure, or institutional learning accumulates. A new dependency can remain invisible while short-run output rises. A legal or organizational reform can change incentives immediately while its effects on membership, bargaining position, or future options unfold over years. The evaluation window therefore participates in the result.

Historical economics already contains several mechanisms that make timing consequential. North emphasizes that institutions shape subsequent incentives and paths of change, while Arthur shows how early events can be amplified through increasing returns and produce later lock-in (North 1990; Arthur 1989). These mechanisms imply that a present intervention may acquire significance through a trajectory whose later stages are unavailable at the moment of decision. The evaluator observes a prefix of the process rather than the completed process.

The problem is sharper for generative value because later effects can include changes in the capacity to generate further relations and options. An educational opportunity may alter later learning relations; infrastructure can generate complementary investment; institutional access can create future membership and information; extraction can weaken capacities whose loss becomes visible only after repeated use. Short observation windows can therefore favor effects that manifest quickly and discount effects whose causal pathway is delayed or distributed across

scales.

Long-horizon evaluation also encounters changing contexts. The institutional environment, technology, value structure, and subject positions relevant to an intervention can change while the intervention's effects unfold. A model calibrated to the initial context can therefore lose adequacy before the trajectory ends. This is one reason why adaptive evaluation and institutional learning, discussed in Sections 1.22 and 1.24, are historically important: they permit judgments to be revised as later evidence arrives rather than treating the first evaluation as final.

Temporal incompleteness places a limit on certainty rather than on evaluation itself. GRE can distinguish immediate outcomes from delayed effects, preserve the assumptions under which projections are made, identify indicators of intermediate mechanism, and reopen judgments when new stages of the trajectory become observable. Intergenerational and environmental evaluation makes this requirement especially visible because the subjects affected by present action can include persons who cannot participate in present evidence production or decision procedures (World Commission on Environment and Development 1987).

The five limits developed in this section define an epistemic boundary around the contemporary opening reconstructed in the chapter. More data leave observation partial; richer formalisms remain representation-dependent; relational patterns can support several causal accounts; boundaries and scales shape what becomes visible; and generative evaluation remains temporally incomplete while the future is still being produced. These limits do not cancel the case for GRE. They determine the form that a responsible relational economics must take: explicit about observation, conditional about models, disciplined about causal language, transparent about scale and boundary, and revisable across time. Section 1.26 extends the argument from knowledge to governance by examining the practical constraints that arise when institutions attempt to act within systems they can only partially know.

1.26 Contemporary Limits of Relational Governance

This section identifies the practical limits that remain when relational knowledge is translated into governance. Its role in the chapter is to complement the epistemic limits developed in Section 1.25: even when relevant relations can be observed with reasonable confidence, governing them requires administrative categories, legally actionable statuses, computationally tractable representations, normative judgments, and institutional authority over observation and classification. The objective is to specify five recurrent constraints on relational governance: administrative reification, legal dependence on stable categories, computational complexity, normative plurality, and asymmetries in the power to observe and classify. The discussion is institutional and diagnostic. It does not develop a general governance theory, which belongs to the later GRG programme; it clarifies why richer relational knowledge does not automatically yield frictionless or normatively determinate intervention.

1.26.1 Administrative Reification

Relational governance requires administrative action, and administrative action requires objects that can be named, compared, recorded, assigned responsibility, and linked to procedures. This requirement creates a recurring tension. Relations are often continuous, overlapping, historically variable, and distributed across more than one institution, while administrative systems operate through discrete records, statuses, eligibility categories, reporting units, and decision rules. Governance therefore converts a relational field into administratively actionable objects. The conversion is necessary for implementation, but it can also stabilize the representation more strongly than the underlying relation warrants.

Modern statistical and administrative systems provide a clear illustration. Statistical practice depends on conventions that establish equivalence, coding, classification, and aggregation among heterogeneous cases (Desrosières 1998). Standardized quantitative procedures also became institutionally attractive because they support impersonal and transportable judgment (Porter 1995). These achievements make large-scale administration possible. They also establish a practical grammar in which only some aspects of relational life become legible enough to govern.

The problem can be described as administrative reification: a representation introduced to make a relation governable can acquire the practical standing of the relation itself. A household category may become the unit through which eligibility is determined; an employment status may determine access to benefits; a reporting entity may define which transactions are consolidated; a statistical sector may determine how economic activity is aggregated. The administrative object then influences the distribution of resources and responsibilities, so its boundary has causal consequences even when the underlying relational configuration remains more complex.

Hacking's historical ontology is useful for specifying the feedback involved. Classifications can become part of the conditions under which people and institutions understand, organize, and respond to the classified object (Hacking 2002). The point for GRE is not that every category mechanically creates what it names. It is that classificatory schemes can enter the relations they describe through eligibility rules, compliance procedures, accounting boundaries, organizational incentives, and social recognition. Administrative representation can therefore become one component of the generative environment.

Relational governance cannot remove this problem simply by adding more categories. Finer classification increases descriptive resolution, but it also increases administrative complexity and may create additional boundaries whose practical effects require justification. Nor does replacing discrete categories with continuous scores eliminate reification. A score can become an equally powerful administrative object when access, risk, priority, or surveillance is tied to it. The central governance question concerns how a representation is used, how contestable its boundary remains, and how easily the institution can revise it when the relations it governs change.

The practical implication is a discipline of representational modesty. Administrative categories should be treated as instruments with stated scope, provenance, and revision procedures. Where a category carries high-stakes consequences, gov-

ernance should preserve some capacity to inspect cases that fit the administrative representation poorly. This principle does not dissolve the need for categories. It recognizes that governance acts through abstractions whose convenience can otherwise conceal their generative effects.

1.26.2 Legal Dependence on Stable Categories

Law intensifies the demand for stability because rights, duties, liabilities, ownership claims, contracts, jurisdiction, and procedures require sufficiently determinate subjects and objects. Economic relations may change rapidly, yet legal institutions must decide who bears an obligation, who controls an asset, which entity enters a contract, which claimant has standing, and which boundary determines responsibility. Relational governance therefore encounters a second limit: the more fluid the underlying relations become, the more difficult it is to preserve both relational sensitivity and legal determinacy.

Organizational law illustrates the productive side of stable legal categories. Hansmann and Kraakman show how organizational forms create standardized legal entities and partition assets and creditor claims, making complex collective activity governable through relatively stable legal boundaries (Hansmann and Kraakman 2000). Trust law can likewise separate control, benefit, and claims against assets in ways that organize relations among trustees, beneficiaries, settlors, and third parties (Hansmann and Mattei 1998). These forms do more than describe economic relations. They constitute durable positions through which those relations can be coordinated over time.

The same stability can become constraining when relational reality changes more quickly than legal form. A firm may reorganize production across contractors, platforms, subsidiaries, and algorithmic systems while liability remains attached to formally recognized entities. A worker may occupy economically dependent positions that fall imperfectly within inherited employment categories. A digital platform may mediate transactions across jurisdictions whose legal classifications do not align. The governance problem is therefore temporal as well as conceptual: legal categories need enough persistence to support expectation and accountability, while economic relations continue to evolve.

Accounting and statistical systems reveal analogous tensions. The IFRS Conceptual Framework treats the reporting entity as a boundary constructed for financial reporting and allows that boundary to include a single entity, part of an entity, or multiple entities (IFRS Foundation 2018). The System of National Accounts similarly relies on institutional units capable of owning assets, incurring liabilities, entering contracts, and making economic decisions (European Commission et al. 2009). Such frameworks show that institutional practice already works with analytically constructed boundaries. Relational governance can therefore revise boundaries, but it must do so through procedures that preserve comparability, responsibility, and legal intelligibility.

The limit is consequently structural rather than merely conservative. Governance cannot continuously redefine every subject and relation at the speed of the underlying economy without destabilizing the expectations that institutions themselves sus-

tain. Legal and administrative forms have characteristic revision times. Their relative slowness can support coordination by making obligations predictable. The same slowness can generate mismatch when new relations become economically consequential before the corresponding legal categories evolve.

GRE should therefore treat legal stability and relational sensitivity as jointly necessary institutional properties whose balance varies by domain. Some contexts require durable categories because responsibility must remain traceable across time. Others require flexible recognition because fixed categories systematically omit economically dependent or newly mediated relations. The analytical task is to identify which features require continuity, which can be revised, and what institutional process governs the transition. Systematic theories of legal change belong outside GRE, but the economic consequences of such temporal and classificatory mismatch remain central to relational analysis.

1.26.3 Computational Complexity

Relational governance also faces a computational limit. As the number of relevant actors, ties, higher-order interactions, temporal states, institutional constraints, and possible interventions increases, the space of relationships that could matter expands rapidly. Contemporary computation makes much richer analysis possible, as Section 1.21 established, yet increased computational capacity does not remove the need to simplify. Governance decisions must operate with finite models, finite observation windows, and finite time for deliberation.

Network analysis already demonstrates how relational structure creates analytical burdens absent from isolated-unit models. Newman surveys methods for representing large systems through networks, while higher-order network research shows that pairwise edges can fail to preserve interactions that exist only at the level of groups or simplicial structures (Newman 2003; Battiston et al. 2020). Adding temporal variation increases the problem further because the relevant structure is then a sequence of changing relational configurations rather than a single graph. The computational object can become very large before uncertainty in measurement or causality is even considered.

Complex-systems analysis adds another difficulty: local interventions can propagate through feedback, adaptation, and reorganization. Bar-Yam's multiscale treatment emphasizes that different structures become visible at different scales and that organization at one scale cannot be inferred straightforwardly from another (Bar-Yam 2004). A governance model that represents only one scale may therefore miss interactions that dominate elsewhere. A model that attempts to include every scale can become too complex to interpret, calibrate, or use within a decision process.

Computational complexity is consequently also a problem of model selection. Governance must choose which relations to resolve, which to aggregate, which time horizon to simulate, which behavioral responses to include, and which uncertainty to represent. Agent-based models can explore heterogeneous interaction, while dynamical and network models can reveal trajectories, feedback, and topological dependence. Each representation reduces the system differently. Richer models may expose mechanisms hidden by simpler ones, yet they can also become harder to validate and easier

to overfit to assumptions rather than evidence.

The practical limit becomes especially visible when a model is used for intervention. Decision makers often need an answer before exhaustive computation, data collection, or model comparison is possible. In such settings the relevant standard is not maximal descriptive detail but sufficient robustness for the decision at hand. A relational governance process should therefore identify which conclusions survive plausible changes in boundary, scale, representation, and parameter assumptions. Later chapters develop this through sensitivity analysis, model plurality, and adaptive revision.

Computational capacity thus changes the frontier of feasible governance without eliminating incompleteness. The historical significance of contemporary computation lies in making previously inaccessible relational structures analyzable. The corresponding discipline lies in refusing to treat computational resolution as equivalent to causal certainty or institutional wisdom. The more complex the model, the greater the need to state what it omits, which assumptions drive its results, and which decisions would change if another representation were adopted.

1.26.4 Normative Plurality

Relational governance is further limited by normative plurality. A relational description can show that an intervention changes access, dependence, capability, trust, participation, risk, ecological conditions, or future possibilities. The description does not by itself determine how these consequences should be ranked. Relations can support several legitimate values simultaneously, and changes that improve one dimension can burden another. Governance therefore requires normative judgment in addition to relational knowledge.

The capability approach provides one important illustration. Sen shifts attention from resources alone toward the substantive opportunities people possess to achieve valued ways of living (Sen 1999). This move makes conversion conditions and heterogeneous circumstances analytically visible, but it does not reduce all valued functionings to a single universally fixed metric. Human-rights traditions introduce another vocabulary centered on recognition, equality, participation, and protected claims (United Nations General Assembly 1948; United Nations General Assembly 1966). Environmental and intergenerational frameworks extend evaluation to conditions affecting future persons and ecological systems (World Commission on Environment and Development 1987). Commons scholarship adds concerns with collective rule making, participation, and durable institutional arrangements (Ostrom 1990). These frameworks overlap, yet they are not interchangeable.

Normative plurality becomes particularly demanding when consequences are distributed across time and scale. An intervention can improve immediate output while reducing long-horizon ecological resilience. A classification can improve administrative consistency while excluding a minority whose circumstances fit poorly. A platform policy can increase average efficiency while concentrating dependence on an intermediary. A commons institution can protect collective resources while imposing participation burdens unevenly. Relational analysis reveals these connections more clearly, but greater descriptive richness can increase the number of values that enter

evaluation.

This is a limit on optimization rather than a rejection of it. Optimization is appropriate where the objective, constraints, and metric are sufficiently specified and normatively legitimate for the local problem. The difficulty arises when governance projects heterogeneous values into a single scale without examining what the conversion suppresses. GRE therefore needs to distinguish between locally commensurable objectives and domains in which value translation remains partial, contested, or institutionally imposed. The later chapters on heterogeneous value and justice develop this problem directly.

Normative plurality also limits claims about generativity. A system capable of generating more relations, options, or future capacities is not therefore morally superior. Generativity describes a capacity of a system; goodness requires additional normative premises. A relation can be highly generative while reproducing domination, environmental harm, or exclusion. Conversely, some constraints can be ethically justified precisely because they limit what may be generated. Relational governance must therefore keep generative evaluation and normative evaluation analytically connected without collapsing one into the other.

The governance implication is procedural as well as philosophical. Where values cannot be reduced credibly to one metric, institutions need ways to expose the relevant dimensions, represent affected positions, preserve disagreement, and revise decisions as consequences become clearer. Participation, rights, public reasoning, and institutional contestability become important partly because normative plurality cannot be resolved by data alone. GRE can analyze the economic effects of these arrangements while leaving the choice among comprehensive moral theories open.

1.26.5 Power over Observation and Classification

The final limit concerns power over the production of governable reality. Relational governance depends on observation, categorization, measurement, and model construction. The actors controlling these processes can influence which relations become visible, which subjects are recognized, which outcomes are measured, and which interventions appear administratively available. Observation and classification therefore have a political economy of their own.

The history of statistical reasoning makes this visible. Desrosières shows that statistical categories depend on conventions that make heterogeneous cases comparable, while Porter demonstrates how quantitative standards acquire authority through institutional practices of objectivity (Desrosières 1998; Porter 1995). Hacking adds that classifications can participate in shaping the objects and persons to which they are applied (Hacking 2002). Together, these traditions imply that the infrastructure of observation is not a neutral window placed outside economic relations. It is itself composed of institutions, technologies, standards, professional roles, and access rights.

Contemporary data infrastructures intensify this issue because observational capacity is unevenly distributed. Section 1.25 noted that platforms, firms, regulators, public agencies, researchers, and individuals can possess very different access to the same relational system. The World Bank's treatment of data-governance ecosystems explicitly emphasizes that data use depends on institutional arrangements, interop-

erability, safeguards, and relations among multiple actors (World Bank 2021). OECD work on data-driven public sectors similarly treats data governance as a system-wide institutional problem rather than a purely technical matter (Ooijen et al. 2019). The ability to combine, interpret, and operationalize data is therefore itself an economic capability.

Power can enter at several points. An institution may determine which categories are officially recognized; a platform may define the events its interface records; a rating system may choose the variables that enter a score; an employer may observe worker performance at greater resolution than workers can observe organizational decision rules; a public authority may possess administrative records unavailable to the persons classified by them. These asymmetries affect both knowledge and action because the observing institution can convert its representation into eligibility, pricing, ranking, surveillance, resource allocation, or enforcement.

Classification power should nevertheless be distinguished from arbitrary control. Institutions often require standardized categories to coordinate at scale, preserve legal equality, maintain comparability, and administer scarce resources. The relevant GRE question concerns the relational conditions under which classificatory authority becomes accountable. Important dimensions include transparency about category construction, rights to correction or appeal, separation between measurement and automatic sanction where appropriate, access to provenance, and the possibility of revising categories whose consequences diverge from their intended scope.

The same point applies to models. A relational model used only for research has one kind of influence; the same model embedded in a decision system can acquire allocative power. The transition from description to intervention changes the normative and institutional burden carried by the model. Governance therefore needs to track who constructs the representation, who can inspect it, who bears its errors, and who possesses authority to revise it. These questions connect epistemology directly to economic power without implying that every act of measurement is domination.

Taken together, the five limits of this section qualify the practical promise of relational governance. Administrative systems require simplification; law requires stability; computation requires tractable models; normative plurality requires judgment; and observational infrastructures distribute classificatory power unevenly. None of these limits makes relational governance impossible. They determine the conditions under which it can remain accountable, revisable, and proportionate to what is actually known. The historical opening identified in the preceding sections is therefore accompanied by a corresponding discipline: greater relational visibility expands the space of possible intervention while also making the institutional consequences of representation harder to ignore.

1.27 The Double Character of Contemporary Technical Capacity

This section synthesizes the technical and institutional developments examined in Sections 1.19–1.26 by identifying their double character. Contemporary infrastructures expand the capacity to observe relations, predict outcomes, simulate alterna-

tives, and assist decision-making. The same infrastructures can also intensify surveillance, behavioral steering, infrastructural dependence, and concentration of analytical power. The objective is to state this duality without assigning technology an intrinsic political direction. The discussion proceeds through five coupled developments: observation and surveillance, prediction and behavioral intervention, computational assistance and concentration, artificial intelligence as both analytical capacity and economic power, and the relation between technical capability and epistemic humility. The method is historical and institutional: technical affordances are treated as capacities whose economic consequences depend on ownership, access, authority, institutional embedding, and the relations through which technical outputs become actionable.

1.27.1 Observation and Surveillance

Contemporary data infrastructures make a wider range of economic relations observable at finer temporal and organizational resolution. Administrative records can be linked longitudinally; platforms record interaction histories; firms collect transaction and workflow data; sensors and digital systems produce machine-generated traces; and public institutions increasingly organize data across previously separated administrative domains. These developments provide important conditions for relational analysis because relations that once appeared only through episodic surveys or retrospective reconstruction can increasingly be observed as evolving patterns (Einav and Levin 2014; World Bank 2021; Ooijen et al. 2019).

Observation acquires a different institutional character when visibility is asymmetric and linked to consequential action. A platform may observe participants' transactions and interactions at a level of detail unavailable to the participants themselves. An employer may observe task timing, communication patterns, or performance indicators while workers possess limited visibility into the models used to evaluate them. A public authority may combine administrative sources that no individual subject can assemble. In these cases, expanded observation becomes part of a relation between observer and observed rather than a purely epistemic improvement.

The distinction between observation and surveillance therefore turns on relational conditions as much as on the technical act of data collection. Relevant conditions include who observes whom, whether visibility is reciprocal, which purposes authorize collection, who controls the resulting records, whether subjects can inspect or correct representations, and which decisions can be made from the collected data. The same technical infrastructure can support accountability in one configuration and disciplinary control in another. OECD and World Bank work on data-driven public systems accordingly places institutional safeguards, governance arrangements, and relations among data holders and users alongside the expansion of analytical capacity (Ooijen et al. 2019; World Bank 2021).

Algorithmic management provides a concrete economic illustration. Kellogg, Valentine, and Christin document how computational systems can participate in directing, evaluating, and disciplining work, showing that the relevant technology is embedded in organizational relations of authority rather than operating as a detached measurement device (Kellogg et al. 2020). The observational capacity is eco-

nomically consequential because it can be converted into scheduling, performance evaluation, task assignment, or sanction.

For GRE, the important historical change is therefore an increase in the resolution at which economic relations can be rendered observable together with an increase in the asymmetry with which such observation may be distributed. Relational visibility creates new possibilities for research and governance while also making control over observation itself an economic resource. The analytical task is to trace the institutional relation that converts visibility into action.

1.27.2 Prediction and Behavioral Intervention

The second development concerns the coupling of prediction with intervention. Improvements in data availability and computational modeling allow institutions to estimate future outcomes at a scale and frequency that would previously have been impractical. Prediction can support screening, forecasting, risk assessment, resource prioritization, and other decisions in which action depends on expectations about future states. Manski's treatment of prediction and decision emphasizes the importance of distinguishing what data identify from what follows only after additional assumptions, a distinction that remains central when predictive systems enter practical decision processes (Manski 2008).

Prediction becomes economically generative when the predicted classification changes the conditions under which the subject subsequently acts. A risk score may alter access to credit or insurance. A ranking may alter visibility in a marketplace. A forecast may change inventory, investment, or staffing. A recommendation system may reorganize attention. A workplace model may alter assignments, targets, or evaluation. The technical output therefore participates in the relational system that produces the next round of data.

This feedback means that predictive performance and causal understanding occupy different analytical positions. A model may rank future outcomes accurately while leaving the mechanism producing those outcomes only partially specified. Once a prediction is used to intervene, the intervention can alter incentives, opportunities, expectations, and observed behavior. The subsequent data then reflect both the underlying process and the institution's prior decisions. Relational governance therefore requires attention to the pathway through which prediction becomes action rather than treating predictive accuracy as a complete account of policy or organizational adequacy.

Algorithmic control in organizations illustrates this coupling. Systems that predict performance or classify workers can also structure the tasks, metrics, and incentives through which later performance is produced (Kellogg et al. 2020). The distinction is especially important in settings where subjects adapt strategically to measures or where institutional decisions affect the opportunities that later appear in the data. Prediction can then become one component of a recursively generated environment.

The double character of predictive capacity lies in this recursion. Better prediction can reduce local uncertainty and improve the timing or targeting of decisions. The same capacity can intensify behavioral intervention when predictions are embedded in institutions with authority over access, ranking, work, prices, or eligibility. GRE

therefore treats prediction as an epistemic capacity whose economic consequences depend on the relation between model, decision-maker, affected subject, and subsequent feedback.

1.27.3 Computational Assistance and Computational Concentration

Contemporary computation also combines diffusion of analytical assistance with concentration of upstream productive capacity. At the level of use, software, cloud services, machine-learning tools, and generative systems can reduce the time and expertise required for search, coding, drafting, simulation, and data analysis. Experimental and workplace evidence on generative AI already shows that assistance can raise productivity in bounded tasks and that gains can be heterogeneous across users (Noy and Zhang 2023; Brynjolfsson et al. 2025). These developments can broaden access to forms of analytical work that once required larger teams or more specialized training.

The upstream conditions of frontier computation display a different structure. Advanced model development depends on large-scale compute, specialized hardware, data infrastructure, engineering expertise, and substantial capital expenditure. The 2026 AI Index reports that industry produced more than ninety percent of notable AI models in 2025 and documents rapid growth together with substantial concentration in global AI compute infrastructure (Stanford Institute for Human-Centered Artificial Intelligence 2026). The diffusion of interfaces to many users can therefore coexist with concentration of the infrastructural capacity on which those interfaces depend.

These two movements should be analyzed together. A small organization may gain access to powerful analytical assistance through an external service while becoming more dependent on a small number of infrastructure providers. A researcher may gain computational capacities that would once have required institutional-scale resources while losing visibility into training data, model updates, or service continuity. A firm may reduce internal analytical costs while increasing switching costs or exposure to upstream pricing and access decisions. Local capability expansion can therefore occur together with systemic dependency.

Computational concentration is not an automatic consequence of computational progress. Open models, shared infrastructure, public research institutions, interoperability, and falling hardware costs can diffuse capability. The present historical configuration nonetheless makes the relation between downstream accessibility and upstream concentration analytically important. GRE needs to distinguish the availability of a tool to users from ownership or control of the productive infrastructure that makes the tool possible.

The distinction also matters for value capture. Assistance can generate productivity gains across a broad set of users while infrastructure owners capture rents through access fees, complementary services, proprietary interfaces, data advantages, or control over standards. The distribution of gains therefore depends on the institutional pathways through which computational capacity is accessed and monetized. Technical diffusion and economic concentration can proceed simultaneously because they operate at different layers of the production structure.

1.27.4 Artificial Intelligence as Analytical Capacity and Economic Power

Artificial intelligence sharpens the double character of contemporary technical capacity because it can function simultaneously as an analytical instrument and as an economically controlled productive asset. As an analytical instrument, AI can expand the capacity to search, summarize, classify, generate hypotheses, write code, compare scenarios, and interact with complex information environments. The productivity evidence reviewed in Section 1.11 shows that these systems can complement workers and redistribute access to task-relevant expertise in specific settings (Brynjolfsson et al. 2025; Noy and Zhang 2023).

Analytical capability becomes economic power through institutional conversion. A model that can classify customers, workers, suppliers, applicants, or content has limited allocative consequence until an organization can connect its classifications to prices, access, visibility, employment, credit, procurement, or enforcement. A system capable of generating high-quality recommendations has limited bargaining power unless an actor controls the infrastructure, interface, or organizational position through which those recommendations shape decisions. The distinction between capability and power therefore remains essential.

Several conversion interfaces are especially important. Ownership links technical capacity to claims over revenue and assets. Platform position links analytical capacity to control over access and intermediation. Organizational authority links prediction to task assignment and evaluation. Infrastructure ownership links computational capacity to dependency and pricing. Data access can reinforce model quality and observational asymmetry. These relations can combine, allowing a technically capable system to become part of a durable structure of economic influence.

The concentration documented in the AI Index is therefore relevant to economic power without establishing a deterministic relation between frontier capability and social dominance (Stanford Institute for Human-Centered Artificial Intelligence 2026). Concentrated model development and compute create one possible basis for asymmetry; law, market structure, interoperability, public infrastructure, competition, organizational design, and user exit determine how that asymmetry is converted into power. The same technical system can occupy different economic positions under different institutional arrangements.

AI also complicates the location of agency inside economic systems. A firm may delegate analysis to a model while retaining formal decision authority. Workers may rely on AI assistance while remaining responsible for output. Platforms may embed model judgments in ranking systems that influence participants without presenting the model as an independent economic subject. These arrangements distribute analytical agency across humans, organizations, and artificial systems. GRE therefore benefits from treating AI first as a relationally embedded capacity and then asking which subject positions, claims, dependencies, and responsibilities are generated around it.

This approach also preserves the distinction developed in Section 1.16 between economic subjecthood and final metaphysical personhood. An artificial system can become economically consequential through its position in productive and decision

relations even where legal or moral personhood remains absent. The economic problem concerns how capability is institutionalized, who controls its deployment, who bears its errors, who captures its returns, and which forms of dependency follow.

1.27.5 Technical Capability and Epistemic Humility

The expansion of technical capacity increases the need for epistemic discipline. Richer data, larger models, faster simulation, and more capable artificial systems permit analysis of economic structures that were previously inaccessible. They also increase the number of representations, model choices, generated hypotheses, and intervention pathways that researchers and institutions must evaluate. Technical capability can reduce some forms of uncertainty while creating new dependencies on complex systems whose limitations are difficult to observe directly.

The distinction between symbolic performance and epistemic adequacy remains central. Bender and colleagues caution that fluent language generation should not be treated as equivalent to understanding, and the argument applies more broadly to the interpretation of machine-generated analytical output (Bender et al. 2021). A system can produce coherent classifications, explanations, forecasts, or policy drafts whose evidential basis, causal adequacy, or domain validity still requires independent examination. The lower marginal cost of producing analysis can therefore increase the scarcity of verification and judgment.

Contemporary AI evaluation provides a second illustration. The 2026 AI Index documents rapid capability gains together with declining transparency for some frontier systems and growing difficulty in maintaining benchmarks that remain informative as model performance changes (Stanford Institute for Human-Centered Artificial Intelligence 2026). Improved technical performance does not remove the need to ask what a benchmark measures, how training and evaluation data relate, which failure modes remain hidden by aggregate scores, and how results transfer into institutional settings.

Relational and generative systems add another source of uncertainty because observation and intervention can change the system being analyzed. A model embedded in allocation, ranking, or governance can alter the behavior that later supplies its evidence. A classification can reshape the subject position it describes. A successful intervention can transform the relation that made the original model valid. The practical value of a model therefore depends partly on whether institutions can detect when the conditions supporting it have changed.

Epistemic humility in GRE is consequently a positive methodological discipline. It includes calibrated claim strength, explicit model assumptions, provenance, validation against alternative representations, preservation of uncertainty, rights of contestation where models affect subjects, and willingness to revise conclusions as relations evolve. Computational and AI assistance can strengthen each of these practices when used to compare models, search evidence, test sensitivity, and document provenance. Their contribution is greatest when technical capacity expands the range of questions that can be examined while institutional arrangements preserve the capacity to recognize error.

The double character of contemporary technical capacity can now be stated in the

terms required by this chapter. The same historical developments that make relational and generative economics increasingly possible also increase the capacity to observe, classify, predict, intervene, and concentrate control over the infrastructures through which economic reality is represented. Technical progress therefore widens both the epistemic reach of economic inquiry and the institutional stakes of economic representation. This combination supplies an important part of the historical opening for GRE developed in the next section: the contemporary economy is simultaneously more relationally observable and more dependent on the governance of the very instruments that make such observation possible.

1.28 Historical Opening for Generative Relational Economics

This section draws together the historical argument developed across Sections 1.1–1.27. Its role is to explain why Generative Relational Economics becomes intelligible as a distinct research programme under the present historical configuration. The objective is narrower than a claim of historical inevitability. GRE is treated as one possible theoretical response to a conjunction of transformations in productive forces, inherited relations of production, scarcity, allocation, subjecthood, scientific representation, computation, evidence, and institutional form. The discussion therefore proceeds through six linked developments: transformation of productive forces, tension within inherited relations of production, transformation of scarcity and allocation, reorganization of productive dependence, destabilization of entity-centered subjecthood, and the emergence of economic problems whose object is increasingly relational and generative. The method is historical-material and reconstructive. It asks which material and institutional changes make certain economic questions more difficult to contain within inherited abstractions, while preserving the possibility that other theoretical responses to the same historical condition remain available.

1.28.1 Transformation of Productive Forces

The contemporary opening for GRE begins with a transformation in productive forces. Marx's historical-material formulation linked changes in productive forces to tensions within existing relations of production, while leaving open the concrete form through which such tensions are resolved (Marx 1859). Chapter 1 has used this formulation as a historical orientation rather than as a deterministic law. The relevant contemporary change is the expansion of productive capacity through digital networks, data infrastructures, automated cognition, machine learning, large-scale computation, and globally distributed organizational systems.

Digitalization lowers important costs of search, copying, communication, tracking, and verification, thereby changing which transactions and forms of coordination are economically feasible (Goldfarb and Tucker 2019). Artificial intelligence extends this transformation into cognitive and symbolic tasks. Task-based analyses of automation emphasize that technologies can displace some forms of labor while creating complementary or reinstated tasks elsewhere, so technological change should be studied through changing task structures rather than through a simple substitution narrative

(Acemoglu and Restrepo 2019). Experimental and workplace evidence on generative AI similarly indicates substantial productivity effects in bounded cognitive tasks, with gains distributed unevenly across workers and contexts (Noy and Zhang 2023; Brynjolfsson et al. 2025).

The historical significance of these developments lies in the kind of productive capacity they make increasingly available. Earlier mechanization primarily expanded the scale and speed of physical production. Contemporary systems also expand the production, recombination, classification, translation, and circulation of symbols. They therefore intervene in domains previously associated with expertise, communication, research, administration, and professional judgment. The result is a productive system in which material, informational, symbolic, organizational, and computational capacities are more tightly coupled than in earlier industrial configurations.

The transformation is also uneven. Access to advanced analytical interfaces can diffuse rapidly while upstream infrastructures remain highly concentrated. Frontier model development depends on capital-intensive compute, specialized hardware, data infrastructure, and organizational capability, and recent AI-industry evidence documents continuing concentration in frontier model production and compute capacity (Stanford Institute for Human-Centered Artificial Intelligence 2026). Productive expansion therefore coexists with new dependencies on infrastructure providers, model developers, platforms, and institutions able to finance and govern high-cost computational systems.

This combination matters for GRE because it changes the analytical object of production. Productive capacity is increasingly difficult to locate within a single worker, firm, machine, or asset. It emerges from relations among human expertise, software, models, data, platforms, organizational routines, legal permissions, energy and compute infrastructures, and transnational supply networks. The transformation of productive forces therefore creates a historical setting in which relational configuration becomes more directly productive and in which the capacity of relations to generate later capabilities becomes economically salient.

1.28.2 Tension within Inherited Relations of Production

The transformation of productive forces becomes theoretically consequential when it is placed beside inherited relations of production. Modern economic institutions developed around property, contract, firms, employment, administratively recognizable recipients, and relatively stable categories of productive contribution. These forms remain indispensable. They organize responsibility, allocate rights, structure investment, and make complex economies legally and administratively actionable. Their historical effectiveness is one reason entity-centered economic analysis became so powerful.

Contemporary productive organization places increasing pressure on the assumption that productive contribution can be attributed cleanly to bounded entities. Firms remain important, yet production may depend on platform ecosystems, contractual networks, external research communities, data contributors, open-source infrastructures, cloud providers, supply chains, and distributed knowledge relations. Coase's

analysis of firms already treated organizational boundaries as an institutional response to the comparative costs of using markets and internal direction rather than as a natural partition of economic reality (Coase 1937). Granovetter's account of embeddedness later emphasized that economic action is situated within ongoing social relations rather than exhausted by atomized actors or anonymous markets (Granovetter 1985). Contemporary digital production intensifies the practical relevance of both observations.

A second tension concerns employment. Wage labor historically connected productive contribution, income, organizational membership, and social recognition. Automation and AI can loosen these connections by altering which tasks require human labor and by changing the relative productive advantage of workers across tasks (Acemoglu and Restrepo 2019; Korinek and Stiglitz 2019). The resulting problem is not reducible to the quantity of employment. It concerns the institutional architecture through which access to income, insurance, training, status, and participation has been attached to employment. A productive transformation can therefore become an allocative and recognitional transformation even when total output rises.

A third tension concerns ownership and control. Productivity gains generated by collective infrastructures can be appropriated through legally concentrated claims. Evidence on the rise of highly productive "superstar" firms provides an important structural precedent: technological and organizational changes can increase aggregate productivity while simultaneously increasing concentration and altering labor shares (Autor et al. 2020). The specific mechanisms of AI-era concentration remain empirical questions, but the broader analytical point is already established. Productive abundance does not determine the distribution of control over productive assets or the claims on the surplus they generate.

These tensions do not imply that inherited relations of production have become obsolete. They indicate that the mapping from productive contribution to recognized ownership, income, authority, and participation becomes increasingly mediated by institutional relations. GRE enters this space by asking how economic relations convert productive capacities into claims, dependencies, exclusions, and future possibilities. The historical opening therefore lies in the growing explanatory importance of the conversion architecture connecting productive forces to institutional positions.

1.28.3 Transformation of Scarcity and Allocation

The same historical transformation alters the structure of scarcity. Classical and neoclassical economics developed powerful languages for problems in which scarce resources must be allocated among competing uses. That problem remains fundamental. Material resources, energy, land, housing, time, specialized labor, compute, and institutional capacity remain scarce. Contemporary technical change therefore does not abolish scarcity. It changes its distribution across domains and, in some domains, the relation between abundance at one layer and scarcity at another.

Symbolic production provides the clearest example. The marginal cost of producing text, images, code, summaries, and other representations can fall dramatically when generative systems are available. Yet the abundance of symbols increases the burden placed on attention, verification, interpretation, provenance, and trust. Si-

mon's formulation that an abundance of information consumes attention becomes more important as the production of candidate messages, claims, and artifacts becomes cheaper (Simon 1971). Arrow's analysis of trust as an economically consequential institution likewise indicates why systems of exchange cannot be understood through information volume alone (Arrow 1972). Where provenance and authenticity become uncertain, the capacity to verify and trust may become more valuable precisely because symbolic supply has expanded.

Allocation problems therefore move beyond the transfer of a nominally scarce resource to a recognized recipient. Access to attention, institutional gateways, trusted channels, computational infrastructure, and relations capable of generating later opportunities may become decisive. Sen's capability approach is relevant here because it distinguishes possession of resources from the substantive opportunities a person can actually realize under specific conversion conditions (Sen 1999). GRE extends this concern temporally: present allocations can change the relations and capacities through which later opportunities are generated.

This temporal extension changes the meaning of scarcity. A resource can be abundant at the point of production while the relations required to convert it into learning, recognition, authority, or participation remain scarce. Knowledge artifacts can be plentiful while trustworthy epistemic communities remain difficult to build. Computational tools can be widely accessible while frontier compute remains concentrated. Information can be abundant while institutional attention remains rationed. A system can therefore experience simultaneous abundance and scarcity at different relational layers.

The historical opening for GRE lies partly in this layered structure. Allocation remains central, but the analytically relevant object increasingly includes the relation through which a resource becomes effective and the downstream conditions the allocation helps reproduce. The question shifts from the amount transferred to the generative pathway through which a transfer becomes capacity, dependence, participation, exclusion, or future option. This shift provides the historical bridge from an allocation-centered economics toward a generative relational one.

1.28.4 Reorganization of Productive Dependence

The development of artificial generativity introduces a further historical possibility. Political economy has long examined societies in which persons depend on goods and services generated through the activity of others and in which division of labor, property, employment, exchange, and monetary claims organize access to those outputs. This description is not offered as an exhaustive origin theory of markets or money. It identifies a persistent structural problem: subjects are not materially self-sufficient, and access to socially generated capacities and products must therefore be organized through institutions. Marx's later political writings are relevant here because they connect distributive arrangements to the organization of the conditions of production rather than treating consumption shares as an isolated problem (Marx 1994).

Artificial intelligence, especially when considered together with robotics and automated infrastructures, makes it possible to ask how this structure changes when an expanding range of useful outputs can be generated without another person's direct

labor. The present evidence concerns bounded tasks rather than a fully autonomous productive system, and task-based analyses caution against treating automation as a single process of total substitution (Acemoglu and Restrepo 2019; Korinek and Stiglitz 2019). The historical significance lies instead in the possibility opened by the trajectory: some forms of instrumental dependence on another human's productive activity may weaken as artificial systems become capable of producing, coordinating, or mediating a wider range of goods and services.

Such a development would not by itself dissolve political-economic dependence. Dependence can migrate. A subject who no longer requires another person's labor may still require access to models, compute, energy, data, robotic systems, land, networks, standards, legal permissions, or organizational infrastructures controlled by others. Productive abundance at the level of output can therefore coexist with scarcity at the level of access. The replacement of a human generator by an artificial generator does not constitute a transformation of the underlying relation when the capacity to use, modify, maintain, or redirect the generative system remains strongly conditioned by asymmetric claims or permissions.

This distinction reveals three analytically different layers. One concerns access to what has already been generated. A second concerns access to the capacity through which new outputs can be generated. A third concerns participation in shaping the conditions under which generation becomes possible and develops over time. Those conditions include material infrastructures, legal rules, knowledge, education, technical standards, organizational forms, relational networks, trust, institutional recognition, and increasingly the computational systems through which productive possibilities are opened or closed. The layers interact, but distribution at one layer does not determine distribution at the others.

The historical implication is that a reduction in necessary human labor need not produce a post-political-economic society. It can instead move the political-economic problem toward the organization of access to generative capacity and toward the formation, opening, closure, and reproduction of generative conditions. A society could become less dependent on human labor while remaining highly dependent on infrastructures whose use and evolution are unequally controlled. Conversely, broad access to productive outputs would remain incomplete if subjects had little capacity to participate in shaping the systems on which that access depends.

GRE treats this reorganization as an opening rather than as a technological destiny. It does not infer a particular institutional order from advances in artificial intelligence, nor does it assume that labor, exchange, money, or property disappear when artificial productive capability increases. The narrower historical claim is that AI makes a deeper political-economic question increasingly visible: who can enter, mobilize, influence, maintain, and alter the processes through which future economic possibilities are generated? Later parts of the book develop the implications for capital, power, exploitation, access, and governance. At this point, the question matters because it helps explain why the economic object of inquiry can no longer be exhausted by the distribution of already generated outputs.

1.28.5 Destabilization of Entity-Centered Subjecthood

The transformation of productive forces and scarcity also destabilizes inherited forms of economic subjecthood. Modern economic institutions became organized around subjects that could be recognized as workers, owners, consumers, households, firms, creditors, debtors, and public authorities. These roles were never exhaustive descriptions of the persons or organizations occupying them. They were nevertheless sufficiently stable for contract, taxation, accounting, employment, welfare provision, and statistical administration.

AI complicates this architecture because systems without settled legal or moral personhood can perform economically significant tasks, generate outputs, mediate decisions, and participate in organizational workflows. Bender and colleagues' critique of large language models remains important precisely because fluent symbolic performance does not settle questions of understanding, agency, or personhood (Bender et al. 2021). GRE therefore has reason to distinguish economic participation from final ontological status. A system may have economic effects without thereby receiving the standing of a human person, legal subject, or moral patient.

Human subjecthood is destabilized from the opposite direction. If productive tasks once central to employment can be performed more efficiently by artificial systems, the relation among work, contribution, income, recognition, and membership becomes less secure. Becker's human-capital framework captured an industrial and post-industrial world in which investments in education and skill were strongly connected to productive capacity and earnings (Becker 1964). Contemporary AI can alter the return structure of particular skills, and the social consequences depend on how institutions reorganize work, ownership, training, access, and participation.

The relevant distinction is between productive contribution, productive necessity, and subject worth. A person can contribute without being comparatively necessary for a task; a person can lose comparative productive advantage without losing the capacity for experience, relation, learning, care, judgment, or participation. Sen's emphasis on substantive freedom helps expose the insufficiency of reducing social standing to productive superiority (Sen 1999). The economic problem is therefore institutional as much as technological: inherited systems may continue to allocate income and recognition through roles whose historical relation to productive necessity is changing.

A relational account of subjecthood becomes useful under these conditions because it asks how economic positions are generated and stabilized through relations of recognition, responsibility, membership, dependence, and access. Such an account does not deny persons, firms, or organizations as entities. It asks which relations make those entities economically actionable and how changes in those relations alter the subject positions available in the economy. The destabilization of entity-centered subjecthood thus becomes one route by which contemporary conditions open space for a relational economic framework.

1.28.6 Emergence of Generative Relational Economic Problems

The preceding transformations converge in a class of problems whose object is neither a static entity nor a fixed relation. The central question becomes how economic relations generate later subjects, capacities, institutions, constraints, dependencies, and possibilities. This is the specifically generative dimension of the historical opening.

Several developments make such questions increasingly visible. Networked production means that the productivity of an actor can depend on the configuration of relations in which it is embedded. Institutional change means that rules can alter incentives while also changing the categories and relations through which later action occurs (North 1990). Evolutionary economics provides a language for routines, search, innovation, and changing populations of organizational practices (Nelson and Winter 1982). Path-dependent models show how early contingencies and increasing returns can shape later feasible trajectories (Arthur 1989). Contemporary network and multiscale methods provide additional tools for representing changing relational structures across levels (Newman 2003; Bar-Yam 2004).

The economic significance of generativity appears when present arrangements change the conditions of later generation. Education can alter future capabilities. Employment can generate professional networks and institutional access. Ownership can generate collateral, bargaining power, and future investment capacity. Platform participation can generate reputation and dependence simultaneously. Research infrastructures can generate new knowledge while concentrating access to data or compute. Allocation can therefore be evaluated partly through the futures it makes easier, harder, or impossible.

These problems exceed a static relational description because the relation itself may change through use. A cooperative relation can build trust or exhaust it. A labor relation can generate skill, dependence, identity, or exit capacity. A credit relation can expand productive capacity while changing future claims and bargaining positions. An institutional category can stabilize participation while reifying the boundary it recognizes. Generative analysis therefore asks how relations reproduce, transform, or dissolve the conditions under which later relations become possible.

GRE emerges historically at the intersection of necessity and possibility. It becomes more necessary because productive forces, scarcity, subjecthood, and power are increasingly organized through complex relations whose downstream effects matter economically. It becomes more possible because scientific, computational, evidential, and institutional capacities make such relations more observable and analyzable than before. Neither movement is complete. Relations remain partially observed, causal structures remain underdetermined, formal models remain selective, and governance remains constrained by law, normativity, computation, and power.

The historical opening should therefore be read as an invitation rather than as a conclusion. Contemporary conditions make a generative relational economics increasingly thinkable and potentially useful. They do not establish its superiority in advance. GRE must still demonstrate that relational and generative descriptions improve explanation, comparison, evaluation, or practical understanding in concrete economic problems. Section 1.29 therefore closes the chapter by stating the possibili-

ties and limits under which this historically situated research programme proceeds.

1.29 Historical Possibilities and Limits of Generative Relational Economics

This section closes Chapter 1 by stating the historical possibility conditions, analytical scope, and persistent limits under which Generative Relational Economics proceeds. Its role is to convert the chapter's historical reconstruction into a disciplined statement of theoretical standing. The objective is to specify what contemporary conditions make GRE increasingly feasible, which forms of analysis those conditions enable, which institutional developments permit relational and generative questions to become actionable, and which epistemic and normative limits remain constitutive. The discussion proceeds through relational observability, generative analytic capacity, institutional possibility, epistemic and normative limits, and the historical situatedness of GRE itself. The method is synthetic and reflexive. It draws on the chapter's historical, institutional, methodological, and normative analyses while treating GRE as one historically generated response among possible responses to the contemporary economic condition.

1.29.1 Relational Observability

A relational economics becomes practically possible only to the extent that economically relevant relations can be observed, reconstructed, or responsibly inferred. Contemporary economies generate a density of traces that earlier periods could rarely sustain at comparable scale. Administrative records, transaction logs, platform interactions, longitudinal surveys, organizational databases, supply-chain records, machine-generated telemetry, and public statistical infrastructures can preserve sequences of interaction rather than only isolated outcomes. Data infrastructures therefore enlarge the empirical space in which economic relations can be studied over time.

This expansion of observability matters because relations are rarely exhausted by the attributes of the entities they connect. A firm may possess a given stock of capital while occupying a highly dependent position in a supply network. A worker may have a given qualification while lacking access to the institutions through which that qualification becomes economically effective. A platform may mediate exchange while simultaneously structuring search, ranking, reputation, and access. Network analysis, longitudinal linkage, and higher-order relational models make some of these structures increasingly representable (Newman 2003; Battiston et al. 2020). Public-data frameworks likewise increasingly recognize administrative, survey, citizen-generated, and machine-generated data as complementary sources within wider evidence ecosystems (World Bank 2021; Ooijen et al. 2019).

Relational observability remains mediated. Data are produced through classifications, measurement conventions, legal permissions, technical architectures, and institutional incentives. Desrosières and Porter show in different ways that statistical objects depend on conventions of classification and comparability rather than emerg-

ing as transparent copies of the world (Desrosières 1998; Porter 1995). A database may therefore make a relation visible by first deciding what counts as an actor, event, category, transaction, or boundary. The resulting representation can be highly useful while remaining historically and institutionally constructed.

The distinction between a relational trace and the relation itself is therefore essential. Repeated communication may indicate collaboration, dependence, supervision, conflict, or routine administration depending on context. A contractual tie may formalize only part of the effective relation. Absence of recorded interaction may reflect genuine absence, informal coordination, inaccessible records, strategic concealment, or a measurement system designed around different categories. Section 1.25 therefore treated partial observation and representation dependence as persistent epistemic conditions rather than temporary technical inconveniences.

GRE consequently treats contemporary observability as a historical opening rather than as epistemic completion. More relations can be followed across time, organizations, and scales than was previously feasible, and this makes relational economic questions empirically more tractable. The same evidential expansion also increases the need to document provenance, classification, missingness, boundary choice, and the institutional production of data. Relational observability becomes scientifically valuable when the conditions of observation remain part of the analysis.

1.29.2 Generative Analytic Capacity

Relational observation supplies a map of connections and configurations; generative analysis requires an additional capacity to investigate how those relations produce later states, structures, constraints, and possibilities. Contemporary scientific and computational developments make this second task more feasible by allowing trajectories, endogenous change, feedback, heterogeneous interaction, and historical dependence to become explicit analytical objects.

Several methodological developments contribute to this capacity. Dynamical systems provide languages for trajectories and stability; complex-systems approaches examine emergence under heterogeneous local interaction; network and higher-order models represent changing relational topology; agent-based models permit heterogeneous actors and institutions to coevolve; and multiscale approaches make it possible to distinguish structures visible at different levels of aggregation (Strogatz 2024; Holland 2012; Newman 2003; Battiston et al. 2020; Tesfatsion 2006; Bar-Yam 2004). Evolutionary economics adds a specifically economic vocabulary for routines, search, innovation, and changing organizational populations, while path-dependent models clarify how early contingencies and increasing returns can alter later feasible trajectories (Nelson and Winter 1982; Arthur 1989).

These developments allow GRE to ask a stronger class of questions. A labor relation can be studied through the skills, networks, bargaining positions, and exit capacities it generates over time. An allocation can be studied through the institutional access or dependence it creates downstream. A platform relation can be studied through reputation, lock-in, and future option structure. A legal category can be studied through the subject positions and claims it makes actionable. Generative analysis therefore concerns the transformation of conditions under which later economic action occurs,

rather than only the immediate output associated with a present state.

Contemporary computation expands the feasible scale of this inquiry. Large simulations, temporal-network computation, differentiable pipelines, and hybrid empirical-modeling systems allow analysts to explore model families that would once have been prohibitively costly (Holme and Saramäki 2012; Baydin et al. 2018). Yet computational capacity changes the size of the model space more quickly than it resolves the problem of model adequacy. A simulation can represent a mechanism precisely while representing the wrong mechanism. A dynamic network can reproduce observed patterns while omitting the institutional meaning of the links. A path-dependent model can generate lock-in without establishing that the empirical case follows the proposed feedback process.

Generative analytic capacity must therefore remain tied to evidential discipline. The relevant gain is the ability to formulate, compare, and interrogate richer mechanisms, not the ability to eliminate historical contingency or uncertainty. Manski's distinction between what data identify and what additional assumptions contribute remains especially important when models become more elaborate (Manski 2008). GRE uses expanded analytic capacity to sharpen questions about generation, propagation, and transformation while preserving explicit uncertainty about mechanism, boundary, scale, and historical transfer.

1.29.3 Institutional Possibility

A theoretical framework becomes economically consequential only when institutions can recognize at least some of the objects it describes. Contemporary institutional development provides partial precedents for treating collective relations, shared assets, fiduciary responsibilities, capabilities, common resources, environmental constraints, and adaptive revision as legitimate objects of economic organization. These precedents do not constitute a ready-made GRE institutional order. They show that modern nomos already contains forms through which economic action can be organized around structures more complex than isolated ownership by a single bounded recipient.

Trust law, for example, can partition assets and organize claims among trustees, beneficiaries, and third parties through a durable legal structure (Hansmann and Mattei 1998). Cooperative institutions can connect economic participation to jointly owned and democratically controlled organizations (International Cooperative Alliance 1995). Commons scholarship demonstrates that groups can construct rule systems for governing shared resources under conditions that vary across successful and unsuccessful cases (Ostrom 1990). Human-development approaches shift evaluative attention from resource possession alone toward substantive capability and opportunity (Sen 1999). Environmental and intergenerational frameworks extend the relevant horizon beyond present output toward the conditions inherited by future participants (World Commission on Environment and Development 1987).

These institutional forms matter for GRE because they demonstrate several kinds of possibility. Economic claims can be attached to collective arrangements. Decision rights can be distributed. Stewardship can be distinguished from unrestricted alienation. Beneficial interests can differ from formal control. Rules can be revised when

ecological or social conditions change. Resources can be evaluated partly through the capabilities they enable. None of these arrangements is intrinsically generative or just; each can succeed, fail, exclude, or produce unintended dependencies. Their significance lies in demonstrating that the institutional grammar of economic life is historically variable.

Adaptive and evidence-informed governance provides a further possibility. Contemporary public-governance frameworks increasingly emphasize monitoring, evaluation, evidence updating, and institutional learning across policy cycles (OECD 2020a; OECD 2020b; OECD 2020c). Such arrangements create institutional space for decisions to be revised as downstream effects become visible. For GRE, this is particularly relevant because generative evaluation is temporally incomplete. If an intervention changes capabilities, relations, constraints, or option spaces over time, institutional arrangements require procedures for observing those effects and reopening prior judgments.

Institutional possibility therefore concerns the capacity to make relational and generative objects actionable without assuming that every relation should be formalized. Legal recognition can stabilize a relation while also reifying it; measurement can make a collective visible while narrowing its meaning; adaptive governance can increase responsiveness while also expanding surveillance or administrative reach. GRE consequently treats institutional development as an enabling condition whose design remains normatively and politically contestable.

1.29.4 Epistemic and Normative Limits

The historical possibility of GRE is inseparable from limits that cannot be removed by greater technical sophistication alone. Relations remain partially observable, causal mechanisms remain underdetermined, boundaries and scales remain analytically consequential, and generative trajectories remain temporally incomplete. Section 1.25 established these limits at the level of knowledge, while Section 1.26 showed how they reappear in governance through administrative abstraction, legal categories, computational tractability, normative plurality, and unequal power over observation and classification.

The first limit concerns inference. Rich relational data do not automatically distinguish causation from selection, common causes, strategic adaptation, or unobserved structure. Longitudinal evidence can improve temporal reconstruction without guaranteeing identification. Larger models can represent more mechanisms while creating additional degrees of freedom. The appropriate response is calibrated claim strength: association, mechanism evidence, historical reconstruction, counterfactual support, and formal plausibility should be distinguished rather than compressed into a single language of proof. Manski's analysis of identification provides a useful discipline for this restraint (Manski 2008).

The second limit concerns scale and boundary. An observed relation can change meaning when the analytical boundary expands. A cooperative relation within one organization may depend on extraction elsewhere in a supply chain. A beneficial local intervention may transfer risk across jurisdictions or generations. Robinson's demonstration that aggregate and individual correlations may differ remains a clas-

sic warning against treating patterns at one scale as direct evidence at another (Robinson 1950). GRE therefore treats multiscale analysis as a source of additional questions rather than a guarantee of a privileged final scale.

The third limit is normative. Generativity does not establish goodness. A relation can generate capability while also generating dependence; an institution can stabilize trust while excluding outsiders; an innovation can expand aggregate option space while closing options for particular groups. Sen's capability framework is useful precisely because evaluative questions depend on the substantive freedoms available to differently situated persons rather than on resource totals alone (Sen 1999). Rights, participation, recognition, historical responsibility, and intergenerational consequences introduce normative dimensions that cannot be inferred mechanically from system dynamics.

The fourth limit concerns power. Observation, classification, prediction, and intervention are themselves relational capacities. Actors able to define categories, control data infrastructures, set model assumptions, allocate compute, or determine which evidence enters institutional processes can shape the reality that governance subsequently treats as given. Contemporary technical capacity therefore has the double character developed in Section 1.27: it can widen analytical access while concentrating the infrastructures through which economic reality is represented and acted upon.

These limits define GRE's practical discipline. The framework requires sufficiently strong claims to be useful and sufficiently explicit limits to remain revisable. Relational and generative analysis should be introduced where it changes explanation or evaluation, and its additional complexity should be justified by the economic problem under study. Epistemic humility is therefore an operational condition of the framework rather than a concluding disclaimer.

1.29.5 Generative Relational Economics as a Historically Situated Theory

GRE is itself part of the historical process it seeks to analyze. Its concepts arise within a period marked by global production networks, digital intermediation, artificial intelligence, symbolic abundance, transformed scarcity, intensified data infrastructures, expanding computational capacity, new forms of concentration, and growing concern with capabilities, commons, environment, and intergenerational effects. The framework therefore has no privileged position outside history from which to describe an economy that remains historically dynamic.

This situatedness clarifies the status of the chapter's central claim. Relations have always mattered in economic life. Earlier economic theories were not simply deficient because they often foregrounded entities, prices, resources, or allocation. Those abstractions were historically powerful because property, firms, households, employment, contracts, accounts, and administrative categories made many economic processes tractable through relatively stable units. Chapter 1 has therefore reconstructed entity-centered economics as historically intelligible before identifying the contemporary conditions that expose some of its limits.

GRE emerges when several developments converge. Productive capacity becomes

increasingly distributed across relations among humans, organizations, software, data, platforms, and infrastructures. Scarcity becomes layered across material, informational, attentional, institutional, and generative domains. Economic subjecthood becomes less securely tied to inherited productive roles. Scientific and computational languages make dynamic relational structures more representable. Evidence infrastructures make some trajectories more observable. Legal and institutional forms provide partial precedents for collective, capability-based, fiduciary, cooperative, and adaptive arrangements. At the same time, uncertainty, normative plurality, surveillance, concentration, and classification power remain unresolved.

A historically situated theory must therefore remain open to historical revision. Concepts developed for the present configuration may lose explanatory value as productive forces, institutions, and social relations change. New evidence may show that a proposed generative mechanism is weak, domain-specific, or incorrectly specified. Other economic traditions may explain a problem more parsimoniously or reveal dimensions GRE has obscured. The framework's commitment to revisability follows from the same historical reasoning used to study economic categories themselves: a theory that treats economic forms as historically generated cannot coherently exempt its own categories from historical development.

This position also limits GRE's disciplinary ambition. The framework is proposed as a language and research programme for economic problems in which relational constitution, generative transformation, heterogeneous value, multiscale dynamics, and downstream possibility are analytically consequential. It does not require every economic problem to be reformulated relationally, and it does not claim to replace theories that perform well within their domains of adequacy. Its contribution must be demonstrated through comparative explanation, empirical research, formal development, historical interpretation, and practical analysis.

Chapter 1 has established the historical condition under which such a programme becomes thinkable. The next task is intellectual rather than chronological. The following chapter reconstructs the philosophical, social-theoretical, economic, and scientific lineages from which the conceptual resources of GRE can be assembled. The movement from historical conditions to intellectual genealogy preserves the chapter's central discipline: GRE is approached as a historically situated theoretical formation whose concepts require both ancestry and justification, and whose future development remains open to criticism, counterevidence, and revision.

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Chapter 3

Constitution and Research Programme of Generative Relational Economics

Chapter 3 completes the foundational movement of Part I by turning historical emergence and intellectual possibility into disciplinary constitution. Chapter 1 examined the historical conditions under which an economic framework centered on relations, generation, changing capacities, and future conditions of possibility becomes increasingly relevant. Chapter 2 reconstructed the philosophical, economic, social-theoretical, normative, scientific, and formal lineages from which such a framework can draw without treating their differences as reducible to a single doctrine. The present chapter asks a different question: what kind of research programme follows when those historical problems and theoretical resources are organized specifically around economic inquiry? Its task is therefore constitutive. It specifies the provisional identity, objects, scales, questions, epistemic commitments, modes of inquiry, normative interfaces, and boundaries of Generative Relational Economics (GRE).

The term *constitution* is used here in a methodological and disciplinary sense. GRE is still an emerging research programme, and its conceptual vocabulary remains open to revision through empirical inquiry, formal development, comparison with established economics, and criticism from neighboring disciplines. A preliminary constitution therefore does not fix an immutable doctrine. It makes explicit the commitments that currently organize the programme, the questions that distinguish it, the conditions under which a contribution can reasonably be described as GRE, and the domains in which theoretical disagreement remains legitimate. Such specification is necessary for cumulative research. An open programme becomes difficult to evaluate when its objects, boundaries, and standards remain entirely implicit; a rigid programme loses the capacity to learn when provisional commitments are transformed prematurely into protected axioms. Chapter 3 develops an intermediate institutional form: sufficiently explicit to support research coordination and sufficiently revisable to permit theoretical evolution.

The chapter begins from a domain distinction already established at the end of Chapter 2. Generative Relational Theory (GR) supplies a broader orientation toward relations, recursive generation, historical transformation, changing conditions of pos-

sibility, and the possible transformation of effective rules of change. GRE develops that orientation within economics. Its primary concern is therefore economic life: production, allocation, circulation, reproduction, labor, care, ownership, credit, valuation, institutions, technological infrastructures, ecological dependencies, economic power, and the distribution of future capacities. The broader GR framework can interact with law, political theory, education, ecology, history, aesthetics, artificial intelligence, and other domains, while GRE remains responsible for showing why a particular problem is economically significant and how its claims relate to economic evidence and existing economic knowledge.

This disciplinary positioning gives the chapter two complementary functions. The first is selective. GRE requires boundaries because relation and generation are extremely broad concepts. A study does not become GRE merely because it describes a network, identifies an interaction, invokes emergence, or discusses long-run consequences. The programme is organized around more specific analytical questions: how economic relations constitute subjects and objects; how allocations are mediated through relational configurations; how present arrangements generate later capacities, constraints, values, dependencies, institutions, and possibilities; who can access, mobilize, and shape generative capacities and the conditions that sustain them; how those effects propagate across scales; how heterogeneous forms of value are converted, circulated, captured, dissipated, or returned; how economic power alters generative conditions; and how the conditions that govern future change can themselves be transformed. The second function is pluralistic. These questions can be investigated historically, interpretively, qualitatively, quantitatively, causally, formally, computationally, normatively, and through intervention-oriented inquiry. GRE does not require a single privileged method or mathematical representation.

The chapter consequently moves from disciplinary identity to problem structure and then from problem structure to research architecture. It first specifies the scope of the emerging programme and the economic problems that motivate it. It then develops a minimal primitive vocabulary for ontological emergence and identifies the heterogeneous objects and scales that GRE may investigate. Subsequent sections formulate characteristic GRE questions and clarify the distinctive analytical movement from allocation through relational mediation, generation, propagation, conversion, recirculation, extraction, and structural transformation. The chapter then addresses economic subjecthood, the orientation of generation, modes of inquiry, epistemic commitments, praxis, normative evaluation, power, heterogeneity, disciplinary boundaries, and criteria for research contribution. Its final movement treats GRE as a cumulative and internally plural programme, states major open problems, maps the architecture of the wider research agenda, and offers a preliminary constitution that can guide later chapters without foreclosing revision.

Several restraints govern this constitutional exercise. Ontological suspension remains the default: useful relational, dynamical, network, field, geometric, or computational representations do not by themselves establish the ultimate ontology of economic reality. Descriptive generativity remains distinct from normative desirability: a relation can generate durable capacities or self-reinforcing structures while also generating domination, ecological damage, exclusion, or vulnerability. Representation remains distinct from represented reality: measures, categories, graphs, models,

and simulations are epistemic constructions whose adequacy depends on the local question and evidence. Finally, disciplinary openness remains reciprocal. GRE can borrow from neighboring traditions, and those traditions can expose GRE's errors, omissions, and domain limits.

The result is intentionally preliminary. Chapter 3 provides enough constitution for the rest of the book to proceed with a stable research language, while leaving empirical, methodological, formal, and normative disagreements available for later development. The subsequent chapters can therefore deepen GRE's ontology, epistemology, methodology, praxis, substantive economics, theories of power and justice, epistemic economy, artificial intelligence, and domain applications without repeatedly renegotiating the programme's most basic disciplinary identity.

3.1 Disciplinary Identity of Generative Relational Economics

The role of this section is to establish the preliminary disciplinary identity of Generative Relational Economics (GRE) before the chapter specifies its problem-space, objects, methods, and standards of contribution. Its objective is to explain what kind of intellectual formation GRE currently is, the scope within which it makes economic claims, and the commitments that give coherence to otherwise heterogeneous research practices. The argument proceeds from the transition between theoretical proposal and research programme to the scope of the field, the priority of economics as its primary domain, the organizing commitments of relation and generativity, and the conditions under which the programme should remain open and revisable. The method is constitutive rather than taxonomic: the section proposes a working disciplinary identity capable of coordinating research without presenting that identity as historically settled.

GRE is best understood at this stage as an *emerging economic research programme*. The phrase marks both ambition and restraint. It indicates an effort to organize a cumulative body of questions, concepts, methods, models, empirical inquiries, and normative debates around a distinctive analytical orientation. It also recognizes that GRE has not acquired the institutional history, stabilized professional community, canonical methods, or settled boundaries associated with an established discipline or mature subfield. Its identity therefore rests primarily on a coherent problem-space and a set of research commitments rather than on institutional recognition.

This distinction matters because the vocabulary of GRE ranges across several domains. Relations are studied throughout sociology, economics, anthropology, network science, political theory, ecology, and philosophy. Generation appears in theories of production, reproduction, development, evolution, emergence, innovation, complexity, and social formation. Value is central to economics and also to ethics, aesthetics, ecology, and political theory. Fields, trajectories, networks, capabilities, institutions, subject positions, and historical transformations already possess rich literatures of their own. GRE gains disciplinary identity neither by collecting these vocabularies under a new label nor by claiming ownership over their objects. Its identity arises from the specific economic questions produced when relational constitution

and downstream generation are treated together as sustained objects of inquiry.

A characteristic GRE inquiry therefore asks how an economic arrangement changes more than the variables administratively attached to its immediate recipient or transaction. An allocation of money, land, information, compute, credit, legal recognition, care, education, infrastructure, or technological capability enters an existing relational configuration. The allocation can alter capacities, dependencies, bargaining positions, recognition, expectations, institutional practices, ecological conditions, or access to later opportunities. These changes can propagate through further relations, be converted into other forms of value or constraint, become self-reinforcing, dissipate, or transform the conditions under which subsequent economic action occurs. GRE treats these downstream and relationally mediated effects as part of the economic object rather than as automatically external to it.

The programme remains compatible with narrower analyses when they are adequate to the question. A price model, accounting identity, causal estimate, institutional comparison, historical interpretation, network representation, ethnography, or simulation can each provide the most appropriate access to a local problem. GRE does not require every study to represent the full relational and generative field. Its disciplinary claim is instead that certain economically consequential phenomena become visible only when analysis can move between immediate allocation and the relations through which future capacities and constraints are produced. This claim defines a research orientation rather than a mandatory universal model.

3.1.1 From Theoretical Proposal to Research Programme

A theoretical proposal can be organized around a small number of concepts. A research programme requires a wider architecture. It must identify recurring problems, specify objects of inquiry, permit methods appropriate to different forms of evidence, distinguish stronger from weaker claims, accumulate comparative findings, expose itself to revision, and provide criteria through which researchers can disagree productively. GRE enters this second task in Chapter 3.

The transition is significant because relation and generativity can otherwise remain suggestive but underspecified. A relational statement may simply observe that economic actors are connected. A generative statement may merely report that one event has consequences for another. A research programme needs sharper questions. Which relations are constitutive of the economic situation? What entities and subject positions are stabilized through them? Which changes can reasonably be attributed to a relation or configuration rather than to coincident conditions? Through what mechanisms do effects propagate? Which forms of value are generated, converted, captured, returned, or destroyed? How do effects vary across scale and historical time? Under what conditions does a generative process reproduce itself? When does it alter its own conditions of continuation? What evidence would count against a proposed account?

These questions turn GRE from a vocabulary into a programme of inquiry. They also make possible disagreement internal to GRE. Researchers can disagree about whether a particular relation is constitutive or incidental, whether a claimed downstream effect is causal or interpretive, whether a state-space model preserves the

relevant distinctions, whether a value conversion is commensurable, whether an intervention strengthens capability or dependence, or whether a historical transformation changes only outcomes or changes the effective rules through which outcomes are produced. Such disagreements are productive when the disputed objects, assumptions, scales, and evidential standards are made explicit.

A research programme also requires cumulative structure. One study may identify a recurring relational mechanism; another may test whether it travels across institutional contexts; a third may formalize the mechanism; a fourth may show where the formalization fails; a fifth may examine its normative consequences; and an intervention study may alter the relation and observe how the surrounding system responds. The contribution of GRE lies partly in making these inquiries legible to one another. Historical interpretation, qualitative evidence, quantitative estimation, formal modeling, and normative analysis can then address different aspects of a shared problem without being forced into a single epistemic hierarchy.

The programme should therefore distinguish several levels of theoretical commitment. Some propositions will function as organizing hypotheses: for example, that present economic relations can generate future capacities and constraints that are not well represented by immediate allocation alone. Others will be domain-specific empirical claims: a particular credit architecture may generate dependence under specified institutional conditions. Still others will be methodological proposals, formal representations, normative arguments, or exploratory analogies. Treating these levels as equivalent would weaken the programme. GRE becomes more rigorous when the standing of each claim is stated locally and can change through evidence or criticism.

The term *research programme* also protects GRE from premature closure. The field can contain competing accounts of generativity, alternative formal representations, and disagreements about value while retaining a recognizable common problem-space. A programme is strengthened when rival formulations expose assumptions that one formulation had made invisible. Internal plurality therefore becomes part of disciplinary development rather than evidence that the field lacks identity.

GRE's transition from proposal to programme can consequently be summarized through four requirements. It needs a stable enough vocabulary to support communication, a sufficiently explicit problem-space to distinguish relevant contributions, methodological openness appropriate to heterogeneous evidence, and institutionalized revisability through which its own categories can change. Later sections of this chapter elaborate each requirement. The disciplinary identity established here supplies their common orientation.

3.1.2 Scope of the Emerging Field

The scope of GRE is defined by an intersection rather than by a single class of objects. The first component is economic: the inquiry concerns production, allocation, exchange, circulation, reproduction, labor, care, ownership, credit, institutions, technology, ecological dependence, valuation, power, or other processes that materially organize economic life. The second component is relational: the analytical object includes relations or configurations through which subjects, capacities, constraints,

values, and opportunities are constituted or mediated. The third component is generative: the inquiry examines how those relations contribute to later states, possibilities, structures, or rules of change.

This intersection permits a broad empirical range while limiting conceptual inflation. A study of a labor platform can belong to GRE when it investigates how contractual, algorithmic, reputational, and infrastructural relations shape workers' future bargaining capacity, subject positions, dependence, or access to opportunity. A study of agricultural credit can enter GRE through the way financing relations reorganize production choices, ecological risk, household vulnerability, and later credit dependence. A study of education can become economically relevant to GRE when it examines the generation and distribution of capabilities, knowledge, credentials, networks, and future participation in production or exchange. A study of artificial intelligence can enter through changing productive capability, ownership of computational infrastructure, knowledge concentration, labor transformation, or new asymmetries in the capacity to generate economically consequential outputs.

The same objects can also be studied outside GRE, and that coexistence is expected. A legal analysis may focus on doctrinal validity, a sociological analysis on status relations, a psychological analysis on cognition, and a GRE analysis on the economic generation and distribution of capacities through the same institution. Domain boundaries therefore concern the primary research problem rather than exclusive ownership of empirical objects. Interdisciplinary work becomes especially important when the economic mechanism cannot be understood without juridical, cultural, ecological, technological, or political relations.

Scope also varies by temporal depth. GRE can examine immediate relational mediation, medium-term capability formation, long-run institutional reproduction, intergenerational effects, or transformations in the conditions that govern later change. The appropriate horizon depends on the generative claim. A microcredit intervention may require months or years to evaluate changes in debt dependence and productive capacity. An infrastructure investment may reorganize settlement, land value, ecological conditions, and institutional expectations over decades. Knowledge and educational processes can generate effects whose later manifestations are difficult to attribute to a single intervention. GRE therefore treats temporal horizon as part of research design rather than assuming that the period convenient for measurement is identical to the period relevant to generation.

The programme is similarly multiscalar. Generative effects can occur within persons, households, organizations, communities, markets, institutions, states, ecosystems, or transnational systems, and they can propagate across these levels. A policy that expands aggregate productivity can simultaneously weaken a local community's bargaining capacity; a household intervention can change community norms; an institutional classification can alter individual access to credit; a technological standard can reorganize international production networks. GRE does not presume that effects observed at one scale aggregate straightforwardly into effects at another.

A useful boundary follows from this scope. Relational complexity alone is insufficient to define a GRE contribution. Many systems contain numerous relations. GRE becomes relevant when the inquiry identifies an economically meaningful process through which relations contribute to generation, reproduction, transformation, dis-

tribution, or foreclosure. The analytical burden is therefore positive: the researcher should specify the relation, the generated object or capacity, the mechanism or interpretive pathway connecting them, the relevant scale and horizon, and the evidence appropriate to the claim.

This scope allows GRE to remain broad without becoming synonymous with social science. It welcomes interdisciplinary objects while retaining an economic center of gravity. It also leaves neighboring GR domains available for questions whose primary object lies elsewhere. The breadth of the programme is therefore an architecture of interfaces rather than a claim of disciplinary absorption.

3.1.3 Economics as the Primary Domain

GRE is constituted within economics because its motivating questions concern the organization of material and symbolic conditions through which economic life is produced and reproduced. Production, distribution, allocation, exchange, labor, care, investment, credit, ownership, technological capability, ecological dependence, institutions, and value formation remain central. The relational and generative vocabulary changes the analytical emphasis placed on these objects; it does not dissolve the obligation to engage economic mechanisms, evidence, and established economic explanations.

This primary-domain commitment has several consequences. First, GRE should be able to state what is economically at stake in an inquiry. A sophisticated relational description does not automatically become economic analysis. The researcher must connect the relational configuration to economically consequential capacities, constraints, valuations, flows, institutions, or distributions. Second, GRE remains answerable to existing economics. When a conventional model explains the relevant outcome more parsimoniously and with adequate empirical support, GRE has no disciplinary privilege that exempts it from that result. The programme earns analytical space by identifying dimensions that established representations omit or by connecting findings that remain separated across existing literatures.

Third, economics as the primary domain does not imply a narrow definition of economic value. Market prices, income, productivity, and output are indispensable in many inquiries, but economic life also depends on capabilities, care, ecological conditions, knowledge, institutional trust, infrastructure, social reproduction, and forms of relational value whose significance may be incompletely priced. GRE therefore studies how multiple forms of value enter economic processes, while preserving the distinction between economic relevance and universal commensurability.

Fourth, the economic domain contains both descriptive and normative questions. GRE can describe how a platform generates dependency or how an institution concentrates productive capacity without thereby deciding whether the arrangement is just. Normative inquiry enters when evaluative criteria are made explicit: distribution, capability, recognition, participation, ecological sustainability, generative justice, or other justified standards. Economics supplies part of the descriptive object; ethical and political reasoning remain necessary where evaluation exceeds positive explanation.

Fifth, the primary-domain commitment helps distinguish GRE from the wider GR

framework. GR can investigate generative relations in history, law, education, epistemology, aesthetics, governance, or other domains without reducing those domains to economics. GRE concerns those interfaces when they materially affect economic processes or when economic arrangements shape the neighboring domain. A legal rule governing property, for example, is relevant to GRE because it constitutes ownership relations, allocative authority, collateral possibilities, and future investment conditions. The same rule can simultaneously require independent jurisprudential analysis concerning legal validity, interpretation, or rights. The interface is real while disciplinary identity remains differentiated.

This differentiation is important for the future development of the research programme. Without it, GRE could expand until every relational phenomenon becomes an economic phenomenon and the term loses discriminative value. With an explicit economic center, interdisciplinary expansion becomes more rigorous: each borrowing must show what economic problem it helps explain and what aspects remain better handled by another domain.

Economics also offers GRE a demanding test environment because economic systems combine formal institutions, strategic behavior, material constraints, symbolic valuations, historical change, quantitative data, and normative controversy. A viable GRE research programme must therefore interact with several established modes of economic reasoning rather than relying on a single philosophical language. The field's disciplinary identity is strengthened when relational and generative claims produce better questions, better explanations, better empirical distinctions, or more adequate evaluations within this demanding domain.

3.1.4 Relation and Generativity as Organizing Commitments

Relation and generativity provide GRE with its two principal organizing commitments. Neither concept functions as a universal explanation. Relation directs attention to the possibility that economic entities, capacities, positions, and values are partly constituted through connections, dependencies, institutions, recognitions, and repeated interactions. Generativity directs attention to the possibility that present relations alter what becomes possible later. Their conjunction gives GRE its characteristic analytical movement.

The relational commitment begins from specification. A relation should be identified with enough precision to distinguish it from mere co-presence or statistical association. Depending on the inquiry, the relevant relation may involve ownership, exchange, debt, employment, care, authority, information, recognition, technological dependence, ecological dependence, legal standing, platform access, infrastructural connection, or another structured linkage. Relations can be direct or mediated, durable or episodic, formal or informal, symmetric or asymmetric, cooperative or exploitative, visible or weakly represented in available data. GRE does not require these differences to be collapsed into a common relational metric.

Relations can also be constitutive at different levels. A contractual relation may connect already recognized legal persons while simultaneously contributing to their later capacities. Other relations help constitute the relevant economic subject or object itself. Employment relations can stabilize occupational identities and access to

social insurance; credit relations can create debtor positions and classifications; platform rules can constitute categories of worker or seller; property institutions can define the objects over which exchange rights are recognized. Relational analysis therefore includes both interaction among entities and the relational production of entityhood.

The generative commitment adds temporal and counterfactual depth. A relation matters not only through its current state but through the capacities, constraints, structures, values, and subsequent relations it helps produce. Generation can involve accumulation, learning, reproduction, institutionalization, path formation, trust, dependence, lock-in, ecological change, innovation, subject formation, or the creation of new option spaces. Some generative effects amplify later agency; others narrow the range of feasible action. Many do both for different actors or at different scales.

GRE consequently treats generativity as descriptive before it becomes evaluative. A relation can be highly generative because it reliably produces further structures or capacities while remaining normatively objectionable. Monopoly power can generate entry barriers; surveillance infrastructures can generate behavioral control; debt can generate productive investment and also dependency; extractive institutions can reproduce themselves. The strength of a generative mechanism does not determine its justice. Normative orientation must be supplied through explicit evaluative argument.

The two commitments become especially distinctive when the generated effects alter the conditions of further generation. A subsidy can increase productive capacity; the expanded capacity can change market structure; the changed market structure can alter bargaining power and investment incentives; those changes can influence the design of subsequent policy. A technology can alter productivity while also reorganizing skills, ownership, infrastructure, and standards in ways that change which technologies can be developed later. At this point, economic analysis concerns more than a sequence of outcomes. It concerns transformations in the field of future possibility.

This recursive feature explains why GRE pays attention to what later chapters call generative conditions and effective rules of change. The language should remain modest. Many cases can be modeled adequately with fixed rules and changing state variables. Stronger claims about rule transformation require stronger evidence and clearer specification. GRE does not infer meta-level transformation merely because a system changes. It asks whether the mechanisms through which future states are produced have themselves been altered and what observations would support that inference.

Relation and generativity therefore organize research without dictating a single ontology or method. A historical study may reconstruct how property relations generated institutional persistence. A causal design may estimate how access to credit changes later productive capacity. A network model may represent diffusion through relational structure. An ethnography may identify meanings and recognition processes omitted by administrative data. A formal model may examine self-reinforcing dependence under specified assumptions. These inquiries share an orientation while preserving different evidential objects and standards.

The disciplinary identity of GRE resides in this organized plurality. Relation specifies the mediating architecture through which economic processes occur; generativity specifies the downstream production of capacities, constraints, values, structures, and possibilities. Their conjunction turns attention from isolated possession toward economically consequential histories of formation.

3.1.5 Openness, Revisability, and Disciplinary Development

An emerging research programme requires mechanisms for changing itself. GRE therefore treats openness and revisability as constitutive commitments rather than temporary concessions made during an early phase. Its concepts, categories, methods, and boundaries should remain corrigible through empirical failure, theoretical criticism, comparison with competing explanations, normative disagreement, and changes in the historical economy it attempts to understand.

Revisability begins with ontological suspension. GRE can use relational, processual, dynamical, network, field, geometric, or computational representations while leaving open the question of whether any one representation captures the ultimate ontology of economic reality. This stance permits formal development without transforming modeling convenience into metaphysical certainty. A network can be an excellent representation for one mechanism and an inadequate representation for another. A field model can capture distributed conditions while obscuring actor interpretation. A qualitative reconstruction can identify constitutive meanings that are difficult to parameterize while remaining unable to estimate population-level magnitude. Openness protects the programme from identifying one mode of access with reality itself.

Revisability also concerns the programme's own categories. Economic subjects, institutions, technologies, forms of labor, ownership arrangements, and modes of value production change historically. A research language adequate to one economic formation can become less adequate as new infrastructures and relations emerge. Artificial intelligence offers an obvious contemporary example: rapid changes in productive capability, knowledge generation, labor substitution and complementarity, compute ownership, and human-machine interaction may require categories that were less salient in earlier economic analysis. GRE's emphasis on historical generation would be inconsistent if GRE treated its own conceptual vocabulary as historically exempt.

The programme should therefore preserve records of theoretical change. When a category is revised, the earlier formulation should remain intelligible enough for researchers to understand what changed and why. This matters for cumulative inquiry. A field that silently changes the meaning of its central terms can create an appearance of agreement while losing comparability across studies. Explicit versioning of definitions, assumptions, measures, and model classes can make theoretical evolution a source of knowledge rather than a source of confusion.

Openness further requires external correction. GRE should remain answerable to mainstream economics, heterodox economics, economic history, sociology, anthropology, political theory, law, ecology, philosophy, computer science, and other relevant fields. The appropriate correcting discipline depends on the claim. A causal

claim can fail under econometric scrutiny; a historical claim can fail under archival evidence; a legal claim can misunderstand doctrine; an ecological model can omit biophysical constraints; a normative argument can rely on undefended values. Interdisciplinarity is therefore not only a source of concepts. It is a structure of accountability.

Internal pluralism performs a related function. Researchers working within GRE may prefer different ontologies, causal accounts, measures, formal systems, or normative theories. The field should permit such disagreement when the competing formulations remain explicit enough to compare. Productive pluralism differs from unrestricted eclecticism. Competing accounts should specify their domains, assumptions, explanatory targets, evidential support, and points of incompatibility. A programme grows when disagreement creates sharper tests and better distinctions.

Disciplinary development also depends on negative results and limits. A proposed generative mechanism may fail to replicate, operate only under narrow institutional conditions, or add little beyond an existing model. A relational representation may become computationally intractable without improving explanation. A broad concept of value may prove impossible to operationalize for a particular decision. Such findings belong inside GRE rather than outside it. A research programme that records only cases where its preferred vocabulary succeeds would gradually lose contact with the conditions under which that vocabulary is useful.

Finally, GRE should remain historically revisable in its normative orientation. The programme can state commitments to transparency, participation, non-domination, capability, ecological viability, generative justice, or other evaluative principles only by making their justification available for criticism. Historical change can reveal conflicts among values or forms of exclusion that an earlier framework failed to perceive. Normative learning therefore requires both continuity and openness: continuity sufficient to make commitments accountable, and openness sufficient to correct them.

The disciplinary identity proposed in this section is consequently provisional by design. GRE is an emerging economic research programme organized around relational constitution and generative consequence, committed to economics as its primary domain, open to methodological and formal plurality, and structured for revision through evidence and criticism. This identity is strong enough to distinguish a problem-space while remaining incomplete enough to learn from the research it enables. The next section can therefore move from the identity of the programme to the concrete classes of economic problems that give it substantive necessity.

3.2 The Problem-Space of Generative Relational Economics

The role of this section is to delimit the class of economic problems for which Generative Relational Economics (GRE) is intended to provide additional analytical leverage. Its objective is not to claim that these problems belong exclusively to GRE, but to identify the recurring situations in which analysis becomes incomplete when it stops at the immediate recipient, current output, present ownership, or a fixed description of economic actors. The section proceeds through nine problem families: relational

effects of allocation, downstream generation, access to generative capacity and conditions, value beyond possession and exchange, persistent asymmetry and power, changing economic subjecthood, symbolic abundance and representational instability, heterogeneous subjects and value structures, and transformation of future generative possibilities. The method is constitutive and problem-oriented. Each subsection identifies an analytical difficulty that already appears within economic life and states the additional questions that a generative-relational perspective places around it.

The problem-space of GRE begins from a simple observation with wide consequences: an economic intervention rarely terminates at the point where it is administratively recorded. A payment reaches a recipient, a loan enters a balance sheet, an educational opportunity is allocated to a student, infrastructure is installed in a locality, compute is assigned to an organization, legal recognition is granted to a category of actor, or information becomes available to a community. Each event can be represented as an allocation. Yet its economically consequential effects depend on the relations through which the allocated object becomes usable, convertible, reproducible, contestable, shareable, or restrictive. The immediate transfer is therefore one moment within a potentially longer generative process.

This does not make conventional measures irrelevant. Recipient-level outcomes, prices, quantities, income, productivity, ownership, expenditure, and welfare indicators remain indispensable where they answer the question at hand. GRE instead focuses attention on cases in which these measures capture only one layer of the economic transformation. The programme asks what new capacities, dependencies, relations, subject positions, institutional routines, representations, and later possibilities are generated after the administratively visible event. It also asks which possibilities are weakened, foreclosed, extracted, or displaced. The resulting problem-space extends economic analysis temporally, relationally, and across scales without presuming that every problem requires maximal complexity.

The eight problem families below are connected but analytically distinct. An allocation can alter future capability without changing formal ownership. A productive process can generate symbolic standing without generating transferable wealth. A capability asymmetry can remain benign in one relational configuration and become power in another. An artificial system can become economically consequential before its legal or moral subjecthood is settled. Symbolic abundance can expand expressive possibility while making evidence, attribution, and scarcity harder to stabilize. Heterogeneous actors can participate in one economic process while valuing its outcomes through partially incommensurable standards. GRE treats these differences as reasons to preserve a plural problem-space rather than compress them into one master variable.

3.2.1 Allocation beyond the Administrative Recipient

Many economic interventions are administratively organized around identifiable recipients. A household receives a transfer, a firm receives credit, a student receives a scholarship, a municipality receives infrastructure funding, a laboratory receives equipment, or a community receives access to a service. Administrative legibility requires such attribution because institutions must identify who qualifies, who re-

ceives, how much is transferred, and whether the transfer conforms to a rule. This recipient-centered representation is operationally necessary, yet it can be analytically narrower than the economic effects that follow.

An allocation enters a pre-existing relational environment. A monetary transfer can alter bargaining positions within a household, reduce dependence on one employer, enable mobility, change creditworthiness, or increase the capacity to support others. A scholarship can generate knowledge, recognition, networks, migration opportunities, future income, or new asymmetries between the recipient and those who remain excluded. Infrastructure can alter land values, mobility, ecological pressure, political expectations, and patterns of settlement. Access to compute can enable research, automation, surveillance, artistic production, or organizational concentration depending on surrounding capabilities and institutions. The economically relevant object is therefore often larger than the administratively named recipient.

GRE treats the recipient as an important entry point rather than the presumed boundary of analysis. The analytical task is to identify which relations are activated, weakened, or reorganized by an allocation and which downstream effects are sufficiently connected to the intervention to warrant inclusion. This requires boundary discipline. Expanding the field indefinitely would make attribution impossible and turn relational analysis into a description of everything connected to everything else. A GRE inquiry therefore needs to justify why particular relational pathways are economically material to the problem under study.

The extension beyond the recipient also changes how incidence can be understood. Formal receipt and effective benefit can diverge. A subsidy assigned to one actor may partly accrue to landlords, intermediaries, suppliers, creditors, family members, or platforms through price adjustment, contractual dependence, or relational obligation. Conversely, an allocation formally directed at one person can generate benefits for a wider group through care, knowledge sharing, network access, or local demand. Recipient-level accounting remains informative, while the relational incidence of an intervention can require a different map.

This problem becomes especially important where institutions evaluate success shortly after delivery. Immediate uptake can coexist with longer-term dependence, capability loss, market concentration, ecological degradation, or institutional displacement. The reverse is also possible: modest immediate output can generate durable capabilities whose value becomes visible only later. GRE therefore places the administrative recipient inside a wider temporal-relational field and asks how the intervention changes the conditions under which later economic action becomes possible.

The resulting problem is not simply one of externalities. Externality language often begins from a focal transaction and asks which effects fall outside the prices or decisions of the transacting parties. GRE can include such effects, but its concern is broader. Some downstream consequences are constitutive of the recipient's own future capability; others alter the identities and relations through which the original economic categories remain meaningful. The issue is therefore not only what spills outward from a transaction, but how an allocation participates in the production of a subsequent economic configuration.

3.2.2 Generation beyond Immediate Output

Economic analysis frequently evaluates a process through an observable output: units produced, income generated, services delivered, learning achieved, emissions reduced, jobs created, patents filed, or profits realized. Such outputs matter, yet a process can also alter the capacity to produce later outputs. GRE distinguishes these two analytical moments. Immediate output concerns what is produced within a defined interval or activity. Generative effect concerns how the process changes the capacities, relations, constraints, orientations, infrastructures, or rules through which subsequent outcomes may be produced.

The distinction is visible in ordinary economic life. Training can produce a credential while also changing confidence, professional networks, problem-solving capacity, and access to later institutions. A research grant can produce papers while also creating laboratories, datasets, collaborations, techniques, reputations, and future questions. A platform can produce convenience while also establishing standards, behavioral routines, data assets, dependency relations, and barriers to entry. Care can meet an immediate need while also maintaining the bodily, emotional, and social capacities through which later participation remains possible. A failed project can produce little immediate output while still generating knowledge about constraints, new alliances, or institutional learning.

These examples show why generativity cannot be inferred mechanically from output volume. High output can consume the capacities on which future production depends. A firm can raise short-run productivity by exhausting workers, degrading equipment, externalizing ecological costs, or eliminating slack needed for adaptation. An institution can increase publication counts while narrowing intellectual diversity. A resource boom can raise current income while weakening alternative productive capacities. Conversely, a process can appear inefficient in a short horizon because it invests in capacities whose effects are delayed or uncertain.

GRE therefore treats the temporal relation between present production and future productive possibility as a central economic problem. This includes positive generation, maintenance, regeneration, reproduction, depletion, and foreclosure. The relevant question is not whether every activity has downstream consequences; that proposition would be trivial. The research problem is to identify which downstream changes are economically consequential, through what mechanisms they occur, how durable they are, who can access them, and whether they remain reversible.

Generation also differs from simple multiplication. A process is generative in the stronger GRE sense when it changes the conditions under which later states can be produced. Replicating an identical output can matter economically, but repetition alone does not establish transformation of generative capacity. A production system becomes analytically interesting to GRE when participation, accumulated resources, learned practices, institutional recognition, or altered relations change what can subsequently happen. The generated object may be material, organizational, epistemic, symbolic, ecological, juridical, or relational.

This distinction creates a problem of attribution. Later capacities usually have multiple antecedents. A newly capable organization may have received funding, benefited from favorable regulation, recruited skilled members, inherited prior infras-

tructure, and learned from failed experiments. GRE should therefore avoid attributing the whole later capacity to one relation merely because the relation preceded it. Generative claims require mechanism-sensitive reasoning and calibrated scope. The field's interest in downstream effects increases rather than relaxes the burden of specifying how generation is believed to occur.

3.2.3 Access to Generative Capacity and Conditions

A further GRE problem concerns the difference between receiving what has already been generated and gaining effective access to the capacities through which new outcomes can be generated. Conventional distributive questions remain indispensable: who receives income, goods, services, assets, welfare, or other outputs? GRE adds a second layer by asking who can mobilize human, organizational, technical, institutional, or artificial generative capacity. It adds a third by asking who participates in shaping the conditions under which such capacity can exist, be maintained, and develop.

These layers become especially visible in economies organized around infrastructures. A subject can possess equipment yet lack the knowledge, networks, institutional recognition, data access, legal permissions, energy, compute, or organizational support required to make that equipment economically effective. Conversely, access to a powerful generative system can transform what a subject is able to produce even when the subject acquires little conventional property. The economically relevant object is therefore sometimes not the distributed thing itself but effective access to a configuration capable of producing later possibilities.

Artificial intelligence sharpens the problem because it can weaken one form of productive dependence while intensifying another. If artificial systems perform tasks for which subjects previously depended on other people's labor, some forms of human-to-human instrumental dependence may decline. Yet access to the artificial capacity can remain conditional on infrastructures, permissions, ownership, technical standards, energy, compute, or platform governance. A post-labor tendency would therefore not imply a post-political-economic condition. Dependence can migrate from labor-mediated access toward access to generative infrastructure.

GRE does not resolve these questions in advance by treating broad access, common ownership, decentralization, or generative autonomy as automatically desirable. Its constitutive task is narrower. It makes visible a problem that is easily obscured when analysis stops at current output: who can enter, mobilize, influence, maintain, and alter generative processes, and how are the conditions of such participation reproduced? Later chapters develop the associated theories of capital, power, exploitation, justice, and governance. Here the problem is included because it extends political economy from the distribution of generated value toward the organization of generative capacity and generative conditions without replacing the former question.

3.2.4 Value beyond Possession and Exchange

Possession and exchange provide powerful ways of organizing economic value. Ownership establishes claims over resources; exchange reveals willingness to trade un-

der particular conditions; prices coordinate decisions and permit aggregation across many activities. GRE retains these objects while addressing situations in which economically significant value depends on participation, relation, access, recognition, continued circulation, ecological condition, or future capability rather than possession alone.

A resource can have little value to an actor who lacks the relations required to use it. Data require interpretive and computational capacity. Credit requires institutional access and future repayment possibilities. Land depends on legal recognition, infrastructure, ecology, community relations, and permitted uses. Knowledge can gain value through dissemination and recombination rather than exclusion. Membership in a trusted network can create opportunities that cannot be transferred as a discrete owned object. Public infrastructures and commons can generate value through reliable shared availability. Care, reputation, cultural meaning, and institutional legitimacy similarly resist complete description through possession.

Value can also change form as it moves through relations. Economic resources can become educational capability, political access, symbolic standing, health, time, security, knowledge, or ecological resilience. These conversions are neither automatic nor necessarily commensurable. The same monetary amount can generate very different capacities under different institutional, bodily, geographical, or relational conditions. Conversely, forms of value that appear qualitatively different can sometimes be converted into economic advantage through mechanisms such as credentialing, collateralization, monetization, platform visibility, or legal recognition.

GRE treats these conversions as part of the economic problem because they influence who can participate in subsequent generation. The possession of a resource at time one may matter less than whether it can be converted into durable capability at time two. A person may formally possess information without possessing the literacy or authority required to act on it. A community may possess land while lacking political protection against dispossession. A researcher may possess an idea while lacking access to laboratories, collaborators, or publication channels. An organization may own technology whose value depends on ecosystems maintained by others.

This perspective also creates a problem of value trajectories. Value can circulate, recirculate, dissipate, be extracted, be destroyed, or become embedded in relations that outlast the originating exchange. An intervention that appears beneficial at one point may produce a later value transfer away from the original participants through debt service, rent, licensing, platform fees, intellectual-property claims, or unequal bargaining. Conversely, a resource can generate distributed value through open standards, shared knowledge, community infrastructure, or repeated reciprocal use.

The purpose of GRE is not to replace price with a universal alternative measure. Doing so would reproduce the commensuration problem in another form. The programme instead asks which forms of value are relevant to the generative process, how they are recognized or obscured, which conversions occur, and what is lost when heterogeneous values are forced onto one scale. Some studies may use monetary valuation; others may require capabilities, ordinal comparison, qualitative description, multidimensional indicators, or explicit acknowledgement of incommensurability.

The problem-space therefore includes a distinction between current value realiza-

tion and future value generation. An actor can possess valuable assets while occupying relations that reduce future autonomy or capability. Another actor can possess few assets while participating in institutions that generate durable access, learning, security, or collective capacity. GRE does not assume that future generativity should replace present welfare as the evaluative objective. It instead treats the relation between present value and future generative conditions as an economic question requiring explicit normative and empirical analysis.

3.2.5 Persistent Asymmetry and Economic Power

Economic relations routinely contain asymmetries. Actors differ in wealth, productive capability, knowledge, computational capacity, institutional access, bargaining position, vulnerability, mobility, legal recognition, and ability to exit a relation. Difference alone does not establish domination. A doctor and patient, teacher and student, infrastructure provider and user, or advanced technical system and ordinary user can possess highly unequal capabilities while participating in relations that remain mutually beneficial. The analytical problem is to understand when persistent asymmetry becomes economic power and how that power affects later generative possibilities.

GRE approaches power through the conversion of asymmetry into the capacity to shape another actor's options, dependencies, classifications, resources, risks, or future relations. Resource asymmetry can become power when one party controls access to necessities. Knowledge asymmetry can become power when one party can define the relevant evidence or obscure the consequences of a transaction. Institutional asymmetry can become power when one actor controls eligibility, procedure, or recognition. Exit asymmetry can stabilize dependence even where formal participation appears voluntary. Computational or informational asymmetry can allow one actor to predict, rank, personalize, or intervene in another's behavior at a scale the other cannot reciprocate.

This problem is generative because power can reproduce or deepen the conditions from which it arises. Control over capital can generate further capital; control over data can improve prediction and attract further users; institutional authority can shape the categories through which later authority is exercised; reputational advantage can increase access to opportunities that generate additional reputation. Such processes are not inevitable. Competition, law, collective organization, technological change, public infrastructure, and countervailing institutions can interrupt them. GRE is interested in the mechanisms that determine whether an asymmetry decays, persists, becomes self-reinforcing, or changes form.

Persistent asymmetry also complicates simple strategies of equalization. Some differences in skill, knowledge, role, or capability are produced by specialization and may be beneficial. Other differences may be difficult to eliminate or may arise continually through innovation. The problem for GRE is therefore not reducible to making actors identical. It concerns the relational conditions under which unequal capabilities remain compatible with meaningful participation, non-domination, contestability, access to alternatives, and the preservation of future capacity.

This issue becomes especially important under radical capability asymmetry. An

actor may rely on another whose productive, predictive, cognitive, financial, or infrastructural capacity is orders of magnitude larger. Traditional bargaining models can become insufficient when one party cannot meaningfully evaluate the other's capabilities, reproduce the service independently, or exit without severe loss. GRE treats such situations as economic problems of relational architecture. Governance may need to address access, reversibility, auditability, representation, fallback options, common infrastructure, or limits on conversion of capability into control.

The programme also distinguishes power from observable coercion. A relation can shape behavior through dependence, standards, defaults, classification, architecture, or anticipated exclusion without direct commands. Conversely, strong influence can sometimes arise from trust, expertise, or voluntarily delegated authority without amounting to domination. GRE therefore requires local analysis of mechanisms rather than treating every asymmetry as evidence of one universal power relation.

3.2.6 Subjecthood under Changing Productive Relations

Economic theories require some account of the actors who produce, exchange, consume, invest, work, own, decide, cooperate, and bear risk. These actors are often represented as given units for analytical purposes. That representation is frequently useful. Yet productive relations can also change the capacities, roles, identities, and recognition through which an actor counts as an economic subject. GRE treats this instability of subjecthood as part of its problem-space.

Industrialization transformed relations among workers, firms, households, professions, and states. Corporate forms created collective economic actors with legal capacities distinct from their members. Welfare institutions established categories of claimant, beneficiary, dependent, contributor, and protected person. Digital platforms reorganized relations among user, worker, producer, advertiser, seller, and data source. Contemporary artificial systems further complicate the picture by performing economically consequential tasks that were previously associated with human expertise, agency, authorship, coordination, or judgment.

The GRE problem is not to settle the metaphysical status of every possible subject before economic analysis can begin. It is to examine how economic systems assign, stabilize, contest, and transform subject positions. Legal status, contractual capacity, ownership, accountability, recognition, access to institutions, technological mediation, and productive participation can all affect who is treated as an actor and which consequences attach to that treatment.

Changing productive relations can also alter human subjectivity without replacing human subjects. A worker who collaborates with automated systems may become responsible for supervision rather than direct production. A creator working through generative tools may occupy changing relations to skill, attribution, originality, and ownership. A consumer can simultaneously become a source of behavioral data, content, training material, reputation signals, and network effects. A household member can become an economically visible care provider when institutions change the classification of care. Subject positions are therefore partly produced through the categories and relations of economic organization.

This creates problems for models that assume stable preferences, capabilities,

roles, or boundaries of agency across the period being analyzed. Participation in an economic relation can change what an actor knows, wants, can do, expects, or is permitted to become. These changes do not imply that subjecthood is infinitely fluid. Bodies, histories, institutions, legal status, material constraints, and persistent identities provide continuity. GRE's task is to identify which aspects of subjecthood are sufficiently transformed by economic relations to matter to explanation.

The problem also has distributive consequences. When productive systems redefine valued participation, some actors gain recognition while others lose it. Automation can reduce the market value of an existing skill while increasing the value of complementary judgment or coordination. Credential systems can open access while excluding actors whose competence is not institutionally legible. New categories can create rights and protections while also fixing identities in ways that become restrictive. GRE therefore studies subject formation together with the institutional conditions under which recognition generates capability or constraint.

3.2.7 Symbolic Abundance and Representational Instability

Contemporary economies increasingly operate through symbolic objects: data, classifications, scores, rankings, credentials, financial representations, software, models, digital identities, synthetic media, generated text, virtual assets, and machine-produced predictions. Symbolic production has become inexpensive in many domains, while attention, verification, trusted interpretation, and institutional recognition remain scarce. GRE treats this divergence between symbolic abundance and representational stability as a distinct economic problem.

A representation can influence economic reality even when it is incomplete. Credit scores affect access to lending; rankings affect applications and funding; metrics shape organizational behavior; maps and categories determine eligibility; recommendation systems alter visibility; forecasts influence investment; labels affect trust; and digital profiles mediate access to platforms or services. These representations do more than describe pre-existing actors. Once institutions act on them, they can change the relations and opportunities through which those actors subsequently develop.

Symbolic abundance intensifies this process because the cost of producing plausible representations can fall faster than the cost of verifying them. When text, images, claims, reports, credentials, signals, or forecasts can be generated at high volume, scarcity shifts toward provenance, attention, adjudication, trusted institutions, and the ability to distinguish meaningful variation from noise. Economic value can then accumulate around infrastructures that organize visibility and credibility rather than around content production alone.

Representational instability also arises when the underlying object changes faster than the categories used to represent it. Occupational classifications can lag behind new forms of work. Legal categories can lag behind technological capability. Statistical indicators can retain the same name while their social meaning changes. A model trained on historical data can continue producing stable outputs after the relations that made the historical pattern informative have shifted. The representation may remain technically consistent while its relation to the target becomes weaker.

GRE is concerned with this problem because representations participate in generative processes. A classification used to allocate resources can alter behavior, incentives, identities, and institutional structure. A ranking can change the population it was designed to rank. A predictive system can influence the outcome it predicts by affecting who receives attention or opportunity. A narrative about economic risk can alter investment and thereby change the risk environment. Representation is therefore both epistemic and potentially causal.

This does not mean that symbols possess autonomous power outside institutions and practices. Their effects depend on recognition, enforcement, infrastructure, interpretation, and material consequence. A score ignored by all relevant actors remains economically weak; the same score embedded in lending, hiring, insurance, or governance can become highly consequential. GRE therefore studies the relation among symbolic objects, institutional uptake, material allocation, and downstream generation.

The contemporary problem of symbolic abundance also raises questions about knowledge capital. If the production of codified knowledge becomes much cheaper, advantage may shift toward actors who control data, evaluation systems, distribution channels, trusted identities, proprietary infrastructure, or the capacity to convert symbolic output into institutional action. The economic structure of knowledge can therefore change even when information becomes more abundant. GRE treats this as a problem of changing generative conditions rather than assuming that abundance automatically produces equal access or equal capability.

3.2.8 Heterogeneous Subjects and Value Structures

Many economic models gain tractability by representing actors through a common set of variables or a shared metric of preference and welfare. Such representations can be highly informative when the relevant differences are commensurable. GRE also addresses situations in which subjects differ more deeply: in embodiment, cognition, temporal horizon, vulnerability, institutional status, ecological dependence, forms of agency, or the values through which outcomes are interpreted. Heterogeneity then becomes a constitutive feature of the problem rather than a residual variation around one common type.

Heterogeneous subjects can still enter economic relations. A child and guardian, patient and care institution, local community and multinational firm, present generation and future generation, human user and artificial system, or human economy and ecological system may be connected through exchanges, dependencies, constraints, and value creation even where their capacities and evaluative structures differ sharply. The analytical challenge is to represent the relation without pretending that the parties are equivalent or completely mutually intelligible.

Value heterogeneity intensifies this challenge. Economic decisions can involve income, autonomy, cultural continuity, ecological integrity, security, dignity, recognition, knowledge, aesthetic significance, collective identity, and future possibility. Some of these values can be monetized for particular purposes; others resist stable conversion or lose important meaning when reduced to price. Conflict can therefore arise not only over the distribution of one value but over which values should count,

how they should be represented, and who has authority to decide.

GRE approaches heterogeneous value through explicit pluralism. A study may compare several value dimensions, trace conversions among them, identify institutional priorities, or describe conflicts that remain partially incommensurable. The aim is not to prohibit aggregation. Aggregation can be indispensable for decision and coordination. The requirement is to distinguish the practical need for a decision rule from a claim that the underlying values are intrinsically reducible to one scale.

Heterogeneity also affects generative relations because the same intervention can expand one subject's capabilities while narrowing another's. Infrastructure can increase mobility while degrading an ecosystem or displacing a community. Automation can reduce routine labor while expanding organizational capability and concentrating control. Open information can increase public access while exposing vulnerable individuals. A generative process therefore needs to be indexed to subjects, scales, and value dimensions rather than described as generative in an unqualified sense.

The GRE problem-space consequently includes coexistence under incomplete commensurability. Economic relations often need to continue even where actors do not share one ontology, one value function, one time horizon, or one conception of flourishing. Governance then concerns the design of relations that preserve participation, contestability, translation, and revisability under difference. This is an economic issue whenever resources, capabilities, risks, and future possibilities are allocated through those relations.

The problem should also be distinguished from simple diversity. Diversity describes variation among actors or values. Heterogeneity in the stronger GRE sense becomes analytically significant when the differences affect what can be compared, exchanged, represented, or jointly generated. A heterogeneous relation may require several descriptive languages at once. Economic analysis must then resist both premature unification and the opposite conclusion that comparison is impossible.

3.2.9 Transformation of Future Generative Possibilities

The deepest extension in the GRE problem-space concerns interventions that change not only current states or future outcomes, but the space of possibilities from which later economic processes can unfold. An intervention can create new capacities, remove constraints, alter institutions, establish standards, transform expectations, reorganize infrastructures, generate new subject positions, or change the relations through which subsequent innovation and coordination occur. GRE refers to this family of problems as the transformation of future generative possibilities.

The distinction can be illustrated through capability formation. Education does not merely raise an output variable at the moment instruction occurs. It can change which problems a person can recognize, which institutions can be entered, which collaborations become possible, and which future learning can be undertaken. Infrastructure does not merely deliver a service. It can alter settlement patterns, market access, technological adoption, and the feasibility of later investments. Legal reform can change not only current entitlements but the range of organizations, contracts, claims, and collective actors that can subsequently exist.

Technological platforms provide another example. A platform may begin as an intermediary and later become infrastructure on which other actors build businesses, identities, communities, data practices, and standards. At that point, changes to the platform's architecture affect a wide field of downstream possibilities. The economically relevant question extends beyond current user surplus or firm revenue toward the distribution of capacity to create, exit, interoperate, and develop alternatives.

Future possibility can also be narrowed. Debt can finance productive investment while creating obligations that restrict later choices. Monopoly can generate efficient infrastructure while reducing the space for alternative innovation. Environmental degradation can increase present output while eliminating future ecological options. Surveillance infrastructures can improve prediction while normalizing forms of control that become difficult to reverse. Educational standardization can improve comparability while reducing curricular diversity. These processes are generative in the sense that they shape future conditions, even where what they generate is constraint or foreclosure.

GRE therefore distinguishes generation from desirable expansion of possibility. More possibilities are not automatically better, and some constraints are constitutive of valuable order. Legal prohibitions can protect persons and ecosystems; technical standards can make cooperation possible; professional norms can sustain trust; ecological limits can preserve future viability. The analytical problem is to identify which possibilities are enabled or foreclosed, for whom, at what scale, through what mechanism, and according to which evaluative commitments.

Transformation of future possibilities also makes reversibility important. Two interventions with similar current benefits can differ greatly if one preserves exit and revision while the other creates lock-in. Reversible experimentation can support learning under uncertainty. Irreversible infrastructure, ecological change, institutional centralization, or path-dependent standards require stronger attention to long-horizon effects because later actors inherit conditions they did not choose. GRE therefore treats temporal asymmetry between present decision and future revisability as economically significant.

At the strongest level, an economic process can alter the effective rules through which later change occurs. A new legal form can change what organizations may be created. A communication infrastructure can transform how markets and communities coordinate. Artificial intelligence can alter the cost and distribution of cognitive tasks, thereby changing which activities are scarce and which forms of expertise remain economically valuable. Political-economic reforms can change not only allocations but the procedures through which future allocations are decided. The system's later transformations then occur under conditions partly generated by earlier transformations.

This does not imply that future possibility can be mapped exhaustively. Novelty, uncertainty, reflexivity, and incomplete knowledge place limits on prediction. GRE therefore treats generative possibility as an object of inquiry under uncertainty rather than as a fully enumerable state space. Researchers can identify enabling conditions, constraints, path dependencies, option structures, mechanisms of lock-in, and observed capability formation without claiming complete knowledge of the futures that may emerge.

The nine problem families together delimit the initial problem-space of GRE. Allocation can propagate beyond its administrative recipient; production can transform future productive capacity; access to generative capacity and conditions can diverge from receipt of generated outputs; value can depend on relations and conversion rather than possession alone; asymmetry can become self-reinforcing power; productive relations can reshape economic subjecthood; symbolic abundance can destabilize representation and shift scarcity toward verification and institutional recognition; heterogeneous subjects can remain economically connected without complete commensurability; and interventions can reshape the future conditions under which generation itself occurs. These problems share no single mechanism and should not be collapsed into one model. Their common feature is that economically consequential change exceeds the immediate state that conventional accounting or transaction-level description may record.

The next step is therefore conceptual rather than empirical. If GRE is to investigate these problems without presupposing a fixed ontology of entities, agents, relations, or values, it requires a minimal vocabulary from which richer economic objects can later be constructed. The next section introduces that primitive structure through change, structure, constraint, and difference, while retaining ontological suspension regarding their ultimate metaphysical status.

3.3 Primitive Structure for Ontological Emergence

The problem-space specified in the preceding section requires GRE to speak about entities, subjects, relations, capacities, institutions, values, and fields. Treating those objects as unquestioned primitives would, however, reintroduce many of the assumptions that a generative-relational analysis is intended to examine. The role of this section is therefore to establish a weaker conceptual starting point from which richer economic objects can become analytically available. Its objective is to specify four primitive distinctions—change, structure, constraint, and difference—and to explain how their interaction can support the emergence and stabilization of more determinate configurations. The discussion proceeds from each primitive separately to their interaction, the emergence of relative stability, ontological suspension, and multiple realization. Its method is constitutive and minimal: the section states the weakest commitments currently required by GRE while leaving stronger metaphysical claims open.

The term *primitive* is used here in a methodological sense. A primitive is a distinction that the present analytical framework takes as available before introducing more articulated objects. It is not thereby asserted to be metaphysically fundamental, indivisible, timeless, or ontologically prior in every possible theory. Another formalism may decompose one of these primitives further, replace it with a different basis, or represent the same empirical problem through another ontology. GRE's purpose in selecting a primitive structure is practical and epistemic: to begin with concepts weak enough to avoid presupposing the entities and relations whose emergence the programme may later wish to explain.

This choice also prevents a common circularity. If an economic subject is defined

first and its relations are then studied, the analysis can miss processes through which subjecthood itself depends on recognition, law, infrastructure, classification, productive organization, or repeated participation. If a relation is defined first as a link between already constituted nodes, the analysis can miss cases in which the relation contributes to the differentiation or persistence of the nodes. If an institution is treated as a fixed background, the analysis can miss how repeated practices maintain or transform the institution. A minimal primitive structure postpones these commitments. It asks first what changes, what organization makes those changes intelligible, what conditions restrict or enable possible transformations, and what differences become consequential within the configuration.

The four primitives should not be imagined as four substances or four separable components of an economic system. They are analytical dimensions that become meaningful through one another. Change without structure is difficult to identify because change requires some organization within which a transformation can be distinguished. Structure without change becomes analytically inert because structure is known through persistence, variation, reproduction, or transformation. Constraint presupposes a space of possible differences or transitions whose accessibility is conditioned. Difference becomes economically consequential when a structure renders it perceptible, operative, classifiable, or capable of altering later possibilities. Their interaction supplies a minimal grammar for describing ontological emergence while leaving the ontology itself under suspension.

3.3.1 Change

Change is the first primitive because GRE studies economic processes in which later conditions differ from earlier ones. The minimal concept is deliberately broad: change designates a transformation that can be distinguished between configurations, positions, capacities, relations, classifications, rules, or other analytically relevant conditions. This formulation does not presuppose that the thing changing is already an entity with a fixed identity. It permits the identity, boundary, or kind of the relevant object to become part of the change being studied.

Several levels of change should therefore remain distinct. A variable can change while the relations among variables remain similar. A relation can form, intensify, weaken, reverse, or dissolve while the participating terms remain sufficiently stable for the relation to be tracked. A structure can change when patterns among multiple relations are reorganized. A constraint can change when possibilities previously unavailable become accessible, or when previously accessible transitions become costly, prohibited, or practically unreachable. A classificatory or representational regime can change when actors are newly recognized, grouped, valued, or rendered visible. At a still stronger level, the effective rule through which later transformations occur can itself be modified. GRE eventually requires all of these possibilities, yet the primitive concept of change remains weaker than any one of them.

Change is therefore not synonymous with movement along a pre-specified coordinate. Many economic models legitimately represent change in exactly that way: price changes, employment changes, output changes, wealth changes, or probabilities change within a stable variable system. GRE retains such representations wher-

ever they answer the research question. Its additional interest appears when the variable system itself is historically unstable. A category such as employment may change in prevalence while retaining a stable legal meaning, or the legal and organizational meaning of employment may itself be transformed by platform work, contracting arrangements, automation, or new institutional classifications. The first case can be represented as change within a category; the second includes change in the category's constitutive conditions.

This distinction also separates state change from generative change. A state can differ at two times without the transition altering the capacity to produce later states. By contrast, a generative change modifies some condition through which subsequent possibilities are produced, selected, stabilized, or foreclosed. Training that raises a measured skill level is a state change; when the training also alters future access to occupations, networks, credentials, confidence, or learning capacity, the economic significance includes a generative dimension. A regulation that changes a current price is one kind of intervention; a regulation that changes entry conditions, bargaining institutions, or the incentives through which future market structure develops reaches a different level of change.

The concept must also accommodate maintenance. Persistence across time can require continuous activity. A bridge remains usable because inspection and repair occur; a currency remains accepted through continuing institutional and social practices; an organization persists through recruitment, routines, accounting, authority, and repeated recognition; a relation of trust can remain stable because encounters repeatedly confirm expectations. In such cases, apparent sameness at the level of an outcome is produced through ongoing change at other levels. GRE should therefore avoid equating observable stability with absence of process.

Change also carries no intrinsic normative direction. Transformation can enlarge capability, reduce vulnerability, create knowledge, or regenerate ecological conditions. It can equally generate dependency, exhaustion, exclusion, concentration, ecological loss, or irreversible foreclosure. Even a change described as innovation is not thereby beneficial to all affected subjects. The primitive records transformation; the normative evaluation of that transformation requires additional criteria developed later in the programme.

Finally, change is always specified relative to an analytical resolution. A firm may appear unchanged because it retains the same legal identity while its workforce, technology, ownership, dependencies, and internal authority are transformed. A person may appear occupationally unchanged while the meaning and security of the occupation are altered. A market may display stable aggregate shares while the underlying network of suppliers becomes more concentrated. GRE therefore requires the researcher to state which differences count as changes for the local question and which dimensions are being held provisionally constant. This dependence on resolution will become important when the programme later treats scale, boundary selection, and representation.

3.3.2 Structure

Structure provides the organization within which changes and differences become intelligible. In its minimal GRE sense, a structure is a pattern of organization that relates distinguishable components, positions, transitions, or conditions with sufficient regularity to support analysis. The term does not require a single formal representation. A structure may be institutional, relational, spatial, temporal, legal, organizational, symbolic, ecological, computational, or represented through several of these descriptions at once.

This minimal definition matters because structure is often confused with rigidity. GRE instead treats structure as compatible with extensive internal change. A labor market can preserve a recognizable structure while workers and firms enter and exit. A legal system can preserve institutional continuity while rules are amended. A network can preserve a degree distribution or community pattern while particular ties change. A household can remain an administratively recognizable unit while roles and resource flows are reorganized. Structural persistence therefore concerns patterned organization at a selected resolution, not immobility of every constituent.

Structure can also exist at several analytical levels. A local structure may concern the arrangement of a small number of actors or resources. A higher-order structure may concern patterns among relations, institutions, or categories. Structures can be nested, overlapping, or partially incompatible. The same economic subject may simultaneously occupy a workplace hierarchy, a household division of care, a credit relation, a legal status, a platform ranking system, and an ecological dependency. No single structure necessarily exhausts the subject's economic position.

For GRE, structure becomes especially important when it shapes how an intervention propagates. The same allocation can have different effects under different structures because access, conversion, visibility, bargaining, and recirculation differ. A cash transfer received within a predatory debt relation may partly flow to creditors. A research grant enters a university structure that conditions hiring, procurement, intellectual-property ownership, publication, and career recognition. Access to compute can generate different capacities depending on whether technical knowledge, electricity, data, institutional permission, and collaborative networks are available. Structure therefore mediates the relation between an initial resource and the later configuration it helps produce.

Structure also helps distinguish a merely repeated occurrence from a stabilized pattern. Repetition alone can result from coincidence or independent causes. A structural claim is stronger: it proposes that the recurrence reflects an organization of relations, positions, rules, or constraints that makes certain patterns more likely, durable, or reproducible. Such claims require evidence appropriate to the domain. GRE should not infer structure from visual regularity alone; qualitative mechanisms, institutional rules, historical evidence, statistical relationships, network organization, formal models, or combinations of evidence may be needed.

Importantly, structure can itself be an outcome of prior generation. Infrastructure, property regimes, professional categories, organizational routines, standards, market conventions, and technical architectures are historically produced. Once established, they can condition later behavior and appear to subsequent actors as part

of the environment. This temporal layering is central to GRE because generated structures can become conditions of future generation. The analytical movement is therefore recursive: processes generate structures; structures condition later processes; later processes may reproduce, erode, or transform those structures.

Structure should consequently be treated as relative to both scale and time. A relation that looks transient at one temporal scale may contribute to a stable pattern at another. A structure that appears fixed during a short intervention study may be historically recent. A national institution can function as background in a firm-level analysis while becoming the primary object in a comparative institutional study. GRE's minimal concept of structure supports these shifts without requiring that one level be declared ontologically fundamental.

3.3.3 Constraint

Constraint concerns the conditioning of possible transformation. A constraint limits, channels, raises the cost of, delays, redirects, or otherwise modifies which changes are available to a configuration under specified conditions. This definition is intentionally broader than prohibition. Constraints can be hard or soft, formal or informal, material or symbolic, local or distributed, immediate or historically accumulated. They can reduce some possibilities while enabling others by stabilizing expectations, protecting boundaries, supplying standards, or coordinating action.

The enabling dimension is important. A legal rule constrains conduct while also making contracts, organizations, ownership claims, or collective action more reliable. A technical standard restricts admissible designs while enabling interoperability. A professional norm narrows acceptable practice while supporting trust. A budget constraint restricts expenditure while helping define feasible planning. Physical infrastructure limits movement to available routes while making high-volume movement possible along those routes. GRE therefore treats constraint as a transformation of an option space rather than as a synonym for oppression or deprivation.

Constraints differ in the mechanisms through which they operate. A material constraint may arise from energy, time, geography, bodily capacity, or resource availability. An institutional constraint may arise from law, organizational authority, eligibility criteria, property rights, or administrative procedure. A relational constraint may arise from dependence on another actor, obligations, network position, reputation, or bargaining asymmetry. A cognitive or epistemic constraint may arise from limited knowledge, inaccessible information, uncertainty, interpretive categories, or attention. A technological constraint may be embedded in interfaces, protocols, platforms, or computational architectures. These forms can interact, and the same observed limitation can often be generated through several different mechanisms.

Constraint is therefore relational in a weak but important sense: a condition constrains only relative to some possible transformation of a specified configuration. The absence of advanced compute does not constrain a task that requires none. A licensing rule may constrain an unlicensed entrant while enabling established professionals to coordinate around a recognized standard. A language barrier can constrain access in one institution and become irrelevant in another with translation infrastructure. The researcher must specify whose possibilities are conditioned, which

possibilities are at issue, and through what mechanism the conditioning occurs.

Constraints can also be inherited. Present actors confront conditions generated by earlier processes that they did not choose: debt structures, infrastructures, ecological degradation, historical exclusions, educational systems, legal categories, standards, and accumulated concentrations of capital or knowledge. Such inherited constraints can be highly durable even when no current actor intends their continuation. GRE's concern with generation therefore includes the production and transmission of constraints across time.

At the same time, constraints are often transformable. Actors can acquire resources that relax a constraint, organize collectively to alter a rule, invent technologies that change material limits, reinterpret categories, create new infrastructures, or exit relations that previously restricted them. An intervention can also exchange one constraint for another. Credit can relax a liquidity constraint while introducing repayment obligations. Digital platforms can reduce search costs while increasing dependency on ranking systems or data infrastructures. Automation can relax labor bottlenecks while creating new capital, compute, energy, or skill dependencies. Analysis should therefore trace transformations of the constraint structure rather than classify interventions simply as constraint-reducing.

GRE also distinguishes constraint from deterministic closure. A constraint can make a transition improbable without making it impossible, and it can make a transition formally possible while rendering it practically inaccessible. Conversely, the absence of a known constraint does not imply that a possibility will be realized. Capacities, orientations, coordination, chance, and additional conditions also matter. This distinction will later be important for economic power: asymmetry can influence option spaces and the conditions under which choices are made without reducing action to mechanical determination.

3.3.4 Difference

Difference supplies the discriminations through which change, structure, and constraint can be described. In its minimal GRE sense, a difference is a non-equivalence, contrast, distinction, gradient, or differentiation that is relevant to a specified analysis. The primitive does not assume that every observable variation is economically meaningful. A difference becomes analytically consequential when it participates in identification, interaction, selection, valuation, constraint, or subsequent generation.

This distinction between variation and consequential difference is central. Two actors can differ in height without that difference affecting a particular credit relation. They can differ in legal status in a way that radically alters eligibility, bargaining, mobility, or vulnerability. Two firms can differ in size without that difference determining market power in one industry, while in another industry scale can transform access to data, compute, distribution, or finance. GRE therefore asks how a difference enters the relational configuration and what later effects follow from its recognition or operation.

Difference can be prior to a relation, produced through a relation, or amplified by a relation. Participants may enter an exchange with different resources or capabilities. The exchange may itself create new differentiation through learning, reputa-

tion, debt, ownership, or access. Repeated interactions can amplify an initially small difference through cumulative advantage or self-reinforcement. Conversely, institutions can reduce the economic consequences of a difference through insurance, universal provision, accessibility design, anti-discrimination rules, redistribution, or shared infrastructure. The economic significance lies in the generative trajectory of the difference, not merely in its presence.

Difference also participates in the constitution of categories. Economic systems routinely classify workers, firms, borrowers, residents, consumers, citizens, dependents, owners, professionals, risks, assets, and forms of labor. Such classifications make some differences institutionally salient while suppressing others. A category can convert a continuous variation into a discrete administrative distinction, or combine heterogeneous cases under one label. Once institutionalized, the classification can affect access, rights, prices, obligations, visibility, and self-understanding. Representational differences can thereby become causally effective within economic life.

The primitive must remain distinct from inequality. Inequality is a more specific relation involving unequal quantities, positions, opportunities, burdens, capabilities, recognition, or powers. Difference is logically weaker. Heterogeneity can be economically valuable, neutral, complementary, conflictual, or unjust depending on how differences are organized and evaluated. GRE's later treatment of heterogeneous subjects depends on preserving this distinction; a plural economy need not aim at eliminating difference, while justice may require intervention when particular differences are converted into avoidable domination or exclusion.

Difference is also scale-relative. Two configurations can be equivalent for one analytical purpose and different for another. Two households may have the same income while differing in care burdens, health needs, legal status, housing security, social networks, or exposure to environmental risk. Two firms may have identical revenue while differing in ownership, dependence on a platform, ecological footprint, or accumulated knowledge. An economic representation always selects which differences to preserve. GRE therefore treats the choice of relevant difference as part of the epistemic architecture of inquiry rather than as a transparent property of the world.

This point prevents the primitive from becoming an unlimited invitation to complexity. A research design cannot preserve every difference. The analytical task is to justify which distinctions matter to the proposed generative mechanism and to test whether omitted differences undermine the explanation. Difference thus supports pluralism while remaining disciplined by the local research question.

3.3.5 Interaction among the Four Primitives

The analytical value of the primitive structure lies primarily in interaction among its terms. Change, structure, constraint, and difference should rarely be interpreted as independent explanatory variables. Each modifies the meaning and operation of the others. A difference can alter a transition; repeated transitions can stabilize a structure; a structure can convert some differences into effective constraints; a constraint can preserve a structure by narrowing available transitions; and structural change can create new differences and remove old ones.

Consider a simple economic sequence. Two actors begin with a difference in access

to finance. An institutional structure determines which forms of collateral are recognized. That structure constrains borrowing possibilities differently across the actors. The resulting difference in investment capacity alters later income, asset ownership, reputation, and access to finance. Repetition can stabilize a configuration in which the original difference is amplified and incorporated into a more durable structure. The example does not require the researcher to declare wealth, creditworthiness, institutions, or even the actors themselves to be ontological primitives. It can begin from transformations, patterned organization, conditioned possibilities, and consequential distinctions, then introduce richer objects as the analysis becomes empirically specific.

The same primitive structure can describe generative expansion. Shared infrastructure may reduce a constraint on participation. Increased participation can create new differences in specialization and knowledge. Those differences can support a more complex division of labor. The emerging structure can generate additional resources, standards, and coordination capacities, which further relax some constraints while creating new ones. Generativity therefore need not mean monotonic liberation from constraint. New capabilities often depend on newly stabilized structures whose operation introduces obligations, dependencies, standards, or maintenance requirements.

The interaction among primitives also permits recursive analysis. A structure can constrain change, while changes can transform the structure. A difference can be produced by a constraint, while the resulting difference can later modify the constraint through political organization, market power, technological innovation, or institutional recognition. Constraint structures can become objects of economic investment; differences can become commodities, credentials, rankings, or legal statuses; structures can be deliberately designed; and change itself can be governed through procedures that determine how rules may be revised.

This recursion provides a bridge to the stronger GRE question concerning transformation of effective rules of change. At an initial analytical level, a researcher may ask how a configuration changes under a specified structure and set of constraints. At a second level, the inquiry can ask how those structures and constraints themselves change. At a third level, the procedures or mechanisms through which structures and constraints are transformed may become objects of inquiry. The primitive vocabulary can therefore support increasingly reflexive analysis without assuming that a single immutable law governs every level.

A useful discipline follows from this interaction: explanations should specify which primitive role a concept is playing at a given moment. The same institution can be treated as structure when its internal organization matters, as constraint when it conditions an actor's options, as difference when membership distinguishes eligible from ineligible actors, and as an object of change when reforms alter its operation. These descriptions are compatible because they answer different analytical questions. Confusion arises when movement among them occurs without being stated.

The primitive framework is therefore better understood as a grammar than as a taxonomy. It organizes questions about transformation without assigning each empirical object to one permanent category. This flexibility is important for economic

inquiry because the same phenomenon can change analytical status across scale and time. Money can be a resource in one analysis, a relation of credit in another, an institutional structure in a third, a symbolic representation in a fourth, and a constraint through liquidity requirements in a fifth. The primitives do not replace these richer categories; they clarify how such categories can be introduced without assuming their universality in advance.

3.3.6 Emergence of Stable Configurations

GRE requires relatively stable objects because economic inquiry cannot proceed by treating every moment as ontologically unique. Contracts, firms, households, states, currencies, property rights, professions, platforms, resources, and subjects must often be tracked across time. The primitive framework therefore needs an account of how stability can become analytically legitimate without turning stability into primordial substance. The concept of *stable configuration* supplies that bridge.

A stable configuration is a patterned organization whose continuity is sufficient for a specified analytical purpose across a relevant interval, scale, or set of transformations. Stability can arise through several mechanisms: material durability, repeated interaction, institutional recognition, legal enforcement, habit, technical standards, ecological reproduction, feedback, coordinated expectations, memory, documentation, or continual maintenance. These mechanisms need not produce permanence. They produce enough persistence or recurrence for the configuration to function as an identifiable object within the inquiry.

The phrase *sufficient for a specified analytical purpose* is crucial. A corporation can be treated as the same legal entity across changes in personnel and assets, while an organizational ethnography may treat those same changes as constitutive transformations. A currency can remain nominally the same while inflation alters its purchasing power and institutional reforms alter its governance. A household can persist administratively while membership changes. Entityhood is therefore resolution-dependent. GRE treats an entity as analytically real where the stability of a configuration supports explanation, measurement, interpretation, intervention, or coordination at the chosen scale.

Relations can stabilize in the same way. A relation need not be continuously active in order to persist. A debt relation remains operative between payments; a property relation persists while the owner is absent; a professional relation can survive periods without interaction; an institutional hierarchy can remain in force outside moments of explicit command. Persistence can depend on documents, expectations, enforcement, memory, infrastructure, or recognized roles. A stable relation is therefore more than repeated contact, yet it need not be a metaphysically independent object.

Stable configurations can also acquire causal and generative efficacy. Once a classification is institutionalized, it can govern eligibility. Once a platform becomes infrastructure, it can condition market access. Once a professional credential stabilizes, it can shape labor-market sorting. Once a norm becomes widely expected, deviations can become costly even without formal enforcement. An emergent configuration can thus become part of the structure and constraint environment faced by later actors.

Ontological emergence and generative recursion meet at this point: what was produced through earlier processes becomes a condition of later processes.

Stability should also be distinguished from desirability, efficiency, and equilibrium. A configuration can persist because exit is costly, alternatives are suppressed, coordination failure prevents change, or power reproduces the relevant conditions. Another configuration can be beneficial yet fragile because its maintenance depends on scarce resources or voluntary cooperation. GRE therefore treats persistence as an empirical property requiring explanation rather than as evidence of optimality.

The emergence of stable configurations gives GRE a principled basis for introducing richer objects in the next section. Entities, subjects, relations, resources, values, fields, institutions, and symbolic objects can be treated as first-class economic objects when their organization is sufficiently stabilized and their distinctions matter to the research problem. Their status remains historically and analytically conditioned. Stability licenses local objecthood; it does not establish final ontology.

3.3.7 Ontological Suspension

Ontological suspension is the discipline that keeps this primitive framework from becoming a dogmatic metaphysics. It means withholding claims about the ultimate constitution of economic reality when stronger ontological commitments are unnecessary for the local inquiry. Suspension permits the researcher to use entities, relations, processes, fields, networks, states, events, or other representations where they are analytically productive while keeping open the possibility that another representation may reveal different aspects of the same empirical configuration.

Suspension differs from ontological denial. GRE does not claim that entities are unreal because they are relationally constituted, that relations are unreal because they are represented through models, or that institutions are mere descriptions because they depend on recognition. A bank account, legal status, debt, organization, or technical standard can have robust economic consequences. Ontological suspension concerns the level of metaphysical assertion attached to those consequences. The researcher can treat an object as real and causally relevant within an inquiry without claiming that its current representation exhausts what the object is.

This position also differs from unrestricted constructivism. Economic objects can resist interpretation, produce unexpected effects, and impose material constraints regardless of the researcher's preferred description. A bridge has load limits; an ecosystem can be degraded; a debt contract can be enforced; a platform can deny access; a person can become exhausted. Ontological suspension does not dissolve these realities into discourse. It requires the analyst to distinguish the empirical resistance of a configuration from the categories used to describe it.

The discipline is especially important when formal methods are used. A graph can represent relations among nodes, a state space can represent possible configurations, a field can represent distributed conditions, and a simulation can explore consequences of specified rules. Each representation can be rigorous within its assumptions. None acquires metaphysical authority merely from mathematical precision. GRE therefore asks what distinctions the representation preserves, what it suppresses, which mechanisms it assumes, and whether alternative representations

change the substantive conclusion.

Ontological suspension also supports interdisciplinary communication. Economics, law, sociology, history, ecology, computer science, and philosophy can represent the same situation through different objects. A platform worker can appear as a labor supplier, contractual party, legal claimant, network node, data-generating user, organizational participant, or historically situated subject. These representations can conflict in specific claims while remaining jointly informative. GRE should compare their explanatory consequences before treating one vocabulary as universally privileged.

Finally, suspension creates a condition for theory revision. If entities, relations, and categories were fixed as final primitives, evidence that their boundaries change would threaten the coherence of the framework. A suspended ontology permits categories to be reconstructed when historical change reveals their limits. This revisability is particularly important to a programme concerned with the generation of new economic objects, technologies, institutions, and forms of subjecthood.

3.3.8 Multiple Realizations and Ontological Plurality

A minimal primitive structure also allows economically meaningful objects to have multiple realizations. The same functional or institutional role can be sustained through different material, organizational, legal, or relational configurations. Payment systems can be realized through cash, bank deposits, cards, mobile platforms, or other infrastructures. Collective production can be organized through firms, cooperatives, public institutions, households, commons, or loosely coordinated networks. Credentialing can be performed by universities, professional bodies, states, platforms, or community institutions. What counts as the same economic object therefore depends partly on the level at which equivalence is being claimed.

Multiple realization should not be confused with identity. Two configurations can perform similar functions while differing in power relations, vulnerability, ecological cost, accessibility, governance, or downstream generativity. A public payment infrastructure and a proprietary platform may both enable transactions while generating different dependencies and data relations. Two educational systems may produce comparable test scores while differing in social networks, institutional recognition, stress, curiosity, or future opportunity. GRE consequently treats functional equivalence as one possible relation among configurations rather than as proof that their broader economic consequences are equivalent.

The converse problem also occurs: similar manifestations can arise from different generative structures. Two workers can report the same income while one depends on a stable employment relation and the other on volatile platform work. Two firms can display the same output while one relies on durable local capabilities and the other on fragile external supply chains. Two communities can exhibit similar consumption while differing in debt burdens, ecological dependencies, public infrastructure, or informal care. Observable similarity therefore does not guarantee generative similarity.

Ontological plurality follows from these possibilities. GRE can permit several ontologies or representational schemes to coexist when they preserve different distinc-

tions relevant to the research question. An entity-centered model may be adequate for one task, a network representation for another, a process account for a third, and a field-like description for a fourth. Plurality is disciplined by explanatory and evidential adequacy rather than by an assumption that every representation is equally useful.

This pluralism has limits. Representations can contradict evidence, conceal relevant mechanisms, or impose categories that systematically misdescribe the subjects they classify. A plurality of possible descriptions does not eliminate standards of criticism. GRE should ask whether a representation preserves the differences relevant to the claim, whether its boundaries are justified, whether its entities remain stable enough for the inference being made, and whether alternative representations produce materially different conclusions. Ontological plurality therefore increases the burden of comparison rather than removing it.

Multiple realization also matters normatively. Policies often target administratively standardized objects such as households, firms, jobs, schools, or regions. If those categories have heterogeneous realizations, identical interventions can generate unequal effects. A household with the same measured income can face different care obligations; a firm of the same size can possess different network dependencies; a school with similar resources can operate within different linguistic, social, or infrastructural conditions. GRE's later analysis of heterogeneous subjects and values depends on recognizing that categorical sameness can coexist with generatively consequential difference.

The primitive structure developed in this section therefore establishes a deliberately modest ontological foundation for the programme. Change identifies transformation without presupposing a fixed bearer. Structure identifies patterned organization without requiring stasis. Constraint identifies the conditioning of possible transformation without implying deterministic closure. Difference identifies relevant non-equivalence without equating difference with inequality. Their interaction can generate relatively stable configurations that become legitimate objects of economic inquiry at specified scales and times. Ontological suspension prevents these objects from hardening prematurely into universal primitives, while multiple realization and ontological plurality preserve the possibility that comparable economic functions can be sustained through different configurations and that similar observations can arise from different generative histories.

This architecture is intentionally incomplete. It supplies the minimal conceptual conditions under which richer objects can be introduced; it does not yet specify which objects GRE should study. The next section can therefore move from primitive structure to the heterogeneous economic objects that become available once relative stability, analytical scale, and ontological suspension have been established.

3.4 Objects of GRE Inquiry

The primitive structure developed in Section 3.3 allows GRE to introduce richer objects without treating their present boundaries as metaphysically final. The role of this section is to specify the principal classes of objects that GRE may take as eco-

nomically relevant once relative stability, analytical scale, and ontological suspension have been established. Its objective is taxonomic rather than exhaustive: to identify a working repertoire of objects through which relational and generative economic processes can be investigated. The discussion proceeds from emergent entities and subjects to relations, resources and capacities, value, conditions and constraints, fields, temporal objects, institutions, and symbolic or representational objects. Its method is constitutive and pluralist. Each category is defined by the analytical work it can perform, while overlap among categories remains permissible where an empirical configuration supports several descriptions.

An *object of inquiry* in GRE is therefore an analytically stabilized referent around which a research question, body of evidence, mechanism claim, comparison, or intervention can be organized. Objecthood in this sense is local to an inquiry. A firm may be treated as an entity when the question concerns ownership or output, as a relational configuration when the question concerns authority and contracting, as an institutionally recognized subject when the question concerns legal responsibility, and as a trajectory when the question concerns organizational transformation. These descriptions are compatible when they preserve different economically consequential distinctions. GRE does not require a single vocabulary to carry every explanatory burden.

The admissibility of an object depends on several disciplines. Its boundary should be sufficiently explicit for the claim being made. Its persistence should be adequate to the temporal resolution of the inquiry. The evidence used to characterize it should correspond to the dimensions under discussion. Its role in a mechanism should be distinguished from the representation through which that role is inferred. Finally, the analyst should remain attentive to whether the object itself changes through the processes being studied. A category useful at the beginning of an inquiry can require revision if its constitutive relations, internal heterogeneity, or practical meaning change during the relevant history.

The categories below are therefore best understood as a research grammar. They help determine what GRE can study without implying that economic reality is naturally partitioned into ten mutually exclusive classes. Many of the most important GRE questions arise precisely where an object moves across categories: a resource becomes a capability, a repeated relation stabilizes into an institution, a symbolic classification becomes a material constraint, an event redirects a trajectory, or a distributed field of conditions contributes to the emergence of a new economic subject. The taxonomy is designed to preserve those transformations rather than eliminate them through premature classification.

3.4.1 Emergent Economic Entities

Economic analysis routinely refers to persons, households, firms, states, markets, sectors, technologies, assets, platforms, infrastructures, and other entities. GRE retains these objects while treating their entityhood as historically and analytically conditioned. An emergent economic entity is a relatively stabilized configuration that can be tracked as a distinguishable unit because some combination of boundary, continuity, recognition, organization, or causal coherence persists across the interval rel-

evant to the inquiry.

Relative stability is central. A corporation can remain the same legal entity while employees, ownership shares, technologies, contracts, products, and internal authority change. A household can remain administratively recognizable while membership, dependency relations, income sources, and care obligations vary. A market can persist as a named domain while its technologies, participants, rules, and geographic reach are transformed. GRE can treat each as an entity when the continuity is sufficient for the local question, while preserving the possibility that another question requires decomposition of the apparent unit.

Entity boundaries can arise through several mechanisms. Law creates juridical boundaries around corporations, contracts, property, and public authorities. Accounting creates reporting boundaries around organizations and transactions. Technical architectures distinguish users, devices, accounts, services, and platforms. Social recognition can stabilize occupations, communities, or organizational identities. Material organization can generate boundaries through infrastructure, geography, or ecological dependence. These boundaries differ in durability and authority. A legal boundary may remain stable while operational relations cross it extensively; an informal organization may have no independent legal personality while displaying strong internal continuity.

The economic significance of entityhood therefore depends partly on what the boundary permits the entity to do. Recognition can make ownership, contracting, taxation, liability, borrowing, representation, or participation possible. Entity formation can pool resources, concentrate decision rights, create collective capabilities, or separate responsibility. It can also obscure internal asymmetries by presenting a heterogeneous configuration as a single actor. Treating a firm, household, state, or community as one unit can be analytically efficient while suppressing differences in who decides, who bears risk, who receives value, and who remains unrepresented.

Entity emergence can itself become an object of explanation. A group of workers can become an organization; a technical project can become a firm; a loose exchange environment can become a recognized market; a digital protocol can acquire institutional governance; a collective practice can become a sectoral standard. GRE is interested in the conditions through which such configurations become sufficiently stable, recognized, resourced, and reproduced to acquire economic consequences as entities. The transition from diffuse activity to recognized entity can alter access to finance, law, infrastructure, legitimacy, and bargaining power.

Entities can also dissolve, fragment, merge, or migrate across classifications. Insolvency can dissolve a firm while parts of its productive capacity survive elsewhere. A public service can be privatized while its infrastructure remains materially continuous. A platform can reclassify workers without changing the practical dependence through which labor is organized. These cases show why GRE treats entity identity as a question of maintained distinctions rather than a self-evident fact.

The category of emergent economic entity consequently supplies a practical unit of analysis while keeping three questions open: which relations stabilize the entity, which boundaries make the entity economically actionable, and which transformations would make the existing entity description inadequate. These questions con-

nect entity analysis to the remaining object classes rather than isolating entities from them.

3.4.2 Subjects and Subject Positions

Subjects form a distinct class because economic participation involves more than the persistence of an entity. A subject occupies positions from which action, claim-making, evaluation, vulnerability, responsibility, recognition, or experience becomes economically consequential. GRE therefore distinguishes the existence of an entity from the constitution of a subject position. A corporation can be a juridical subject for some purposes without possessing human experience; a person can exist as a biological and social individual while being denied effective recognition as a worker, claimant, owner, borrower, resident, or political participant.

A *subject position* is a relationally and institutionally organized location from which rights, expectations, obligations, opportunities, exposures, or forms of agency become available. Employment status, citizenship, tenancy, creditor status, professional accreditation, platform membership, consumer classification, and eligibility for public support are examples of positions that configure economic possibilities. Such positions are often produced jointly by law, organizational rules, records, classifications, infrastructures, and recognition by other actors.

Subject positions can therefore change without the underlying person or organization disappearing. A worker can move from employee to contractor; a resident can gain or lose eligibility for a service; a borrower can be reclassified by a credit system; a community can become formally recognized as an eligible governance unit; a software agent can be delegated limited transactional authority. Each change modifies what the subject can do, what others may demand from it, and which relations become economically available.

GRE is especially interested in the generative consequences of these positions. A position can enable access to income, credit, education, information, legal remedies, social networks, or institutional voice. It can also create dependency, surveillance, liability, exclusion, or constrained exit. Because positions mediate later capacities, subject formation is not merely a descriptive question about identity. It can become part of the economic mechanism through which future options are generated or foreclosed.

This perspective also preserves the difference between subjecthood and agency. A subject can be strongly constrained while remaining economically consequential. Children, persons under guardianship, refugees, patients, dependents, or algorithmically classified users can occupy economically important positions even where their formal decision authority is limited. Conversely, an actor with substantial operational agency can remain weakly recognized within a legal or moral order. GRE should therefore specify which dimension of subjecthood matters to the inquiry: capacity to act, capacity to experience, standing to claim, institutional recognition, representation, accountability, or exposure to consequences.

Heterogeneity within subject categories is equally important. Administrative categories such as household, worker, consumer, student, patient, migrant, or firm can contain subjects with markedly different capacities and dependencies. Treating cat-

egory membership as sufficient description can obscure differences in language, disability, care obligations, wealth, access to networks, legal status, technical literacy, or exposure to institutional power. A GRE analysis can preserve the usefulness of the category while examining how its practical realization varies among subjects.

Subject positions can also be collectively constituted. A union, cooperative, community association, indigenous polity, professional body, or informal collective can acquire forms of representation and bargaining capacity that are unavailable to isolated members. Collective subjecthood can reorganize the field of negotiation, create shared resources, and alter the conversion of individual grievances into actionable claims. The relevant object is then neither a simple aggregate of persons nor a timeless collective substance. It is a stabilized configuration of representation, recognition, organization, and capacity.

The category will later support GRE's more detailed inquiry into human and artificial economic subjects. At the constitutional level, the key point is narrower: subjecthood is an economic object whenever the positions from which actors participate, experience consequences, make claims, or become governable are themselves generated, maintained, or transformed through economic relations.

3.4.3 Relations and Relational Configurations

Relations are central objects of GRE because economic consequences frequently depend on how actors, resources, institutions, and conditions are connected. A relation can involve exchange, authority, dependence, care, credit, ownership, recognition, information, obligation, trust, competition, cooperation, representation, access, or other structured forms of connection. GRE treats the relation itself as analytically available when its persistence, terms, or consequences matter to the research question.

Relations vary in their constitution. Some are formally specified through contracts, law, accounting, organizational rules, or technical protocols. Others depend on repeated practice, trust, custom, shared expectations, social proximity, or tacit coordination. Some are symmetric in a relevant dimension; others distribute authority, information, risk, or exit options asymmetrically. A relation can remain formally unchanged while its practical content shifts because one party's outside options, dependence, knowledge, or institutional protection changes.

Dyadic representation is useful for many questions, yet GRE also recognizes relational configurations that cannot be adequately decomposed into independent pairs. Supply chains, families, teams, communities, standards ecosystems, financial systems, platform markets, and public infrastructures often involve higher-order or multilayer dependencies. The significance of one tie can depend on the presence of several others. A credit relation, for example, can depend on legal enforceability, informational infrastructure, collateral arrangements, reputational systems, and monetary institutions. A labor relation can depend on household reproduction, immigration status, local labor demand, professional credentials, and collective bargaining institutions.

A *relational configuration* therefore refers to an organized set of relations whose joint structure has economically consequential properties. Concentration, brokerage,

segregation, reciprocity, redundancy, hierarchy, mutual dependence, and network closure can arise at the configuration level. These properties may affect bargaining power, diffusion, resilience, access, vulnerability, and capacity formation even when no single relation carries the full explanation.

GRE also distinguishes relations that connect already stabilized objects from relations that contribute to the constitution of those objects. A contract between two established firms may primarily coordinate exchange. Repeated recognition relations can help constitute a professional status. Care relations can contribute to the maintenance of persons' capabilities. Membership relations can constitute an organization. Legal relations can create ownership or corporate personality. The analytical question is therefore whether the relation is external to the identity relevant for the model, partly constitutive of it, or generative of a new stabilized object.

Relations can persist through material and symbolic infrastructures. A debt relation may be maintained through records and enforcement institutions; a platform relation through accounts, interfaces, ranking systems, and data; a professional relation through credentials and reputational networks. These mediating objects matter because they can change the relation without changing its nominal category. Digitization, automation, or legal reform can intensify monitoring, alter bargaining positions, reduce transaction costs, or enable new forms of exclusion within an apparently familiar relationship.

Relation formation and relation removal are themselves economically consequential events. Access to a mentor, lender, market, transport system, care network, professional community, or knowledge infrastructure can transform later opportunity. Loss of a relation can destroy capability even when material possessions remain unchanged. GRE therefore studies relational portfolios and configurations alongside stocks of individually held resources.

This category supplies the most direct bridge between the programme's relational commitment and ordinary economic inquiry. GRE does not require every explanation to be relation-first. It requires the analyst to make relation-dependent mechanisms visible where they materially alter economic outcomes, value trajectories, subject positions, or future generative conditions.

3.4.4 Resources and Capacities

Resources and capacities are distinct objects because possession or access does not by itself determine what an economic subject can do. A resource is something that can be mobilized, accessed, consumed, transferred, invested, preserved, or combined within an economic process. A capacity concerns an ability or practical possibility to act, produce, learn, adapt, participate, maintain, transform, or generate further possibilities. The relation between the two is mediated by context, institutions, skills, relations, infrastructure, bodily conditions, ecological conditions, and other conversion factors.

Resources can be material, financial, informational, institutional, social, technical, ecological, or symbolic. Land, equipment, money, time, data, legal rights, public infrastructure, credentials, reputation, access to a network, and environmental quality can each function as resources under appropriate conditions. Their resource char-

acter is relational because usefulness depends on what a subject can access and convert within a particular configuration. A database inaccessible to a community, a credential unrecognized by employers, or capital without complementary infrastructure can have limited practical value despite nominal possession.

Capacities likewise occur at several levels. Individuals can possess capacities for work, learning, judgment, mobility, communication, care, and political participation. Organizations can possess capacities for production, coordination, innovation, maintenance, adaptation, compliance, or collective learning. Communities can possess capacities for mutual support, governance, cultural reproduction, ecological stewardship, and collective action. Infrastructures can support capacities by making transport, communication, payment, identification, or knowledge access possible across many subjects.

GRE gives special attention to *generative capacity*: the ability of a configuration to produce or support further economically consequential possibilities. Education can generate later learning capacity; institutional trust can reduce coordination costs and enable cooperation; a research infrastructure can generate future knowledge; public health can preserve productive and participatory capacity; ecological regeneration can sustain future material possibility. Generative capacity is therefore temporally extended and often distributed across relations rather than located wholly inside a single actor.

The distinction between resource and capacity also clarifies why equal allocation can produce unequal outcomes. Subjects receiving identical monetary transfers can face different housing markets, care obligations, health conditions, legal statuses, network access, or local infrastructure. The same nominal resource can therefore generate different effective possibilities. Conversely, subjects with different resource bundles can sometimes realize comparable capabilities through different conversion arrangements. GRE is interested in the relational conditions that mediate these transformations.

Resources and capacities can also be depleted, captured, transferred, or rendered obsolete. Skill can lose market value after technological change; social capital can erode through displacement; ecological capacity can be exhausted; institutional capacity can decay through underinvestment; a public infrastructure can become inaccessible through privatization or pricing. These processes matter even when short-run output or consumption remains stable because they alter the future space of action.

Collective and relational capacities deserve separate attention. Some capacities exist only through coordination among several subjects. A payment system, scientific community, emergency-response network, common resource regime, or democratic institution cannot be reduced to the sum of individual skills. Their capability depends on maintained relations, standards, trust, interoperability, authority, and shared infrastructures. Disruption of those relations can destroy a collective capacity while leaving individual resources physically intact.

GRE therefore treats resources and capacities as related but non-equivalent economic objects. Resource analysis asks what is available and under whose control. Capacity analysis asks what actions or transformations become practically possible.

Generative analysis adds a further temporal question: how does the use, distribution, or transformation of present resources and capacities alter the production of later capacities?

3.4.5 Value and Forms of Value

Value is an object of GRE inquiry whenever economic relations create, recognize, transform, circulate, convert, preserve, capture, dissipate, or contest something treated as valuable. The category includes monetary price while extending beyond price to forms of value whose realization depends on use, relation, recognition, institutional standing, ecological condition, cultural meaning, capability, or future generativity. GRE therefore studies both valued objects and the processes through which value becomes intelligible, actionable, and convertible.

Forms of value should remain differentiated. Market value can be expressed through exchange prices under specified institutional conditions. Use value concerns usefulness relative to purposes and users. Social and relational value can depend on participation, belonging, trust, recognition, reciprocity, or the quality of continuing relations. Cultural and symbolic value can depend on meaning, status, heritage, identity, or collective recognition. Ecological value can concern the maintenance of living systems and material conditions that support present and future activity. Generative value concerns the production or return of capacities, resources, relations, knowledge, infrastructures, or other conditions that enable further generation.

These forms can interact without becoming automatically commensurable. A forest can carry market value as timber, ecological value as habitat and water regulation, cultural value for a community, and generative value through the capacities it sustains over time. A university can generate wages and patents while also producing credentials, knowledge, networks, civic capacity, and symbolic standing. A care relation can involve paid labor, emotional significance, capability maintenance, and institutional responsibility. GRE's task is to track these dimensions with enough separation to avoid converting plurality into a single metric before the research question justifies such conversion.

Valuation is therefore as important as value. Institutions, markets, professional communities, households, algorithms, legal systems, and cultural practices establish procedures through which some properties become visible and comparable. Accounting standards recognize certain assets and liabilities; credit systems assign risk categories; rankings convert heterogeneous characteristics into ordered representations; markets translate bids and offers into prices; communities maintain values that remain outside formal exchange. These valuation processes can affect the objects being valued by changing access, incentives, recognition, or behavior.

Value conversion creates a particularly important object of inquiry. Economic processes frequently transform one form of value into another: knowledge into income, reputation into access, public infrastructure into private profit, ecological resources into commodities, care into labor-market participation, or symbolic recognition into political and economic influence. Conversion interfaces distribute power because actors differ in their ability to authorize, measure, appropriate, or resist conversion.

The same relation can generate value for several parties while allowing only some of that value to be captured or monetized.

Value can also propagate beyond the initial transaction. Education provided to one person can contribute to household well-being, organizational capability, future teaching, or community knowledge. A technological standard can create value for complementary producers. A public transport investment can alter labor-market access and land values. These effects need not be reducible to externalities in a narrow sense; GRE can examine the pathways through which value becomes distributed across relational configurations and time.

Normative value requires additional care. Something can be economically valued without being normatively desirable, and a normatively important condition can remain weakly priced or administratively invisible. Profitability, efficiency, social importance, justice, and generativity are separate evaluative dimensions. Later normative sections of the programme can specify how such dimensions are assessed. At the object level, GRE preserves their distinction so that descriptive value processes do not silently determine normative conclusions.

Value thus enters GRE as a heterogeneous and dynamic object. The central questions concern which form of value is at issue, who recognizes it, through which relations it is produced or realized, how it moves or converts, who can capture it, what is lost in conversion, and how present valuations alter future generative conditions.

3.4.6 Conditions and Constraints

Economic action unfolds within conditions that shape which transitions are feasible, costly, legitimate, intelligible, or sustainable. GRE treats these conditions as objects when their distribution or transformation materially affects economic possibility. A *constraint* is a condition that restricts, redirects, or differentially prices possible action; an enabling condition expands or stabilizes practical possibility. The same configuration can perform both roles for different subjects, actions, or timescales.

Conditions can be material, ecological, institutional, legal, technical, social, epistemic, temporal, or spatial. Transport infrastructure affects geographic access; legal status conditions eligibility and enforceability; technical standards condition interoperability; language affects participation in institutions and markets; ecological limits shape production possibilities; time scarcity constrains care and learning; data access conditions computational capability; public safety affects mobility and investment. These conditions often operate before any explicit transaction occurs.

Constraints vary in strength. Some prohibit action through law or physical impossibility. Others increase cost, uncertainty, delay, or risk. Still others operate probabilistically by making some pathways easier to reproduce than others. A weak broadband connection, lack of childcare, inaccessible documentation, reputational stigma, or absence of collateral may not formally prohibit participation, yet each can substantially reduce practical access. GRE therefore studies the topology of feasible action rather than equating freedom with formal permission alone.

Constraints can also be relationally generated. Bargaining dependence can restrict exit; debt can condition future income allocation; platform design can constrain vis-

ibility; organizational hierarchy can restrict decision rights; social obligations can direct resource use; network position can limit access to information or opportunities. These constraints arise through relations and can persist even where no single actor consciously designs them.

Enabling conditions deserve equal analytical standing. Public infrastructure, trust, open standards, education, legal protection, care systems, stable ecological conditions, and interoperable institutions can make action possible across broad populations. Their economic contribution may be difficult to assign to individual transactions because they operate as background capacities. GRE can bring such enabling structures into view by asking which later activities depend on their continued reproduction.

Conditions can become endogenous to the processes they condition. Industrial activity can degrade ecological conditions; investment can improve infrastructure; repeated discrimination can reshape expectations and network access; successful coordination can build trust; institutional reform can alter transaction costs and enforcement. A condition that is treated as fixed in one local model can therefore become an outcome in a wider temporal or system boundary.

This category is especially important for intervention analysis. Policies frequently act by changing conditions rather than directly producing final outcomes. A guarantee changes perceived risk; a public option changes outside alternatives; a legal recognition changes standing; a subsidy changes relative cost; an information system changes observability. GRE can study these interventions by tracing how modified conditions alter relations, capacities, subject positions, and later trajectories.

Conditions and constraints thus provide the connective tissue between current configuration and future possibility. Treating them as first-class objects allows GRE to examine why identical resources or formal rights can generate different practical outcomes across subjects and contexts.

3.4.7 Fields and Distributed Structures

Some economic conditions are best represented as distributed structures rather than as possessions or pairwise relations. GRE uses the term *field* cautiously for configurations in which opportunities, pressures, meanings, incentives, risks, or capacities vary across a domain and affect actors partly through their position within that distribution. The field concept is an analytical resource rather than a commitment that social reality literally instantiates a physical field.

A distributed structure can be spatial. Land prices, transport access, pollution exposure, labor demand, public services, broadband quality, and ecological conditions vary across geographic space. It can also be institutional or social. Prestige, professional opportunity, credit access, political influence, or informational visibility can vary across positions in a social or organizational configuration. Digital environments add further domains in which ranking, recommendation, search visibility, platform rules, and data access are unevenly distributed.

Field-like representation is useful when the relevant condition cannot be assigned cleanly to a single actor or relation. A local labor market exerts pressures that emerge

from many employers, workers, institutions, transport networks, regulations, and expectations. A scientific field distributes prestige and attention through journals, institutions, funding systems, peer networks, and disciplinary categories. A financial environment shapes borrowing conditions through monetary policy, risk assessment, regulation, liquidity, and market expectations. No isolated tie carries the entire condition.

GRE can therefore study how distributed structures affect the formation and transformation of local relations. A person entering a region with abundant public transport and dense employment opportunities faces a different opportunity structure from an otherwise similar person in a poorly connected region. A small firm operating within an interoperable technical ecosystem faces different generative possibilities from one locked into a proprietary infrastructure. A researcher positioned in a highly visible institutional environment encounters different pathways for recognition and collaboration.

Fields can also be produced by accumulated local actions. Residential sorting can generate spatial concentrations; repeated investment can create technological clusters; platform participation can generate data advantages; institutional prestige can become self-reinforcing through hiring, funding, and citation. The distributed condition then feeds back into later local decisions. GRE is especially interested in these recursive situations because a field generated by past relations becomes a condition for future relation formation.

Boundaries of a field require explicit justification. The relevant domain may be a neighborhood, labor market, profession, platform ecosystem, jurisdiction, linguistic community, supply network, or ecological region. Different boundaries can reveal different gradients and dependencies. The researcher should therefore state what is distributed, across which domain, how position is measured, and which mechanism links the distributed structure to observed outcomes.

Field representations also help avoid attributing every effect to intentional action by identifiable actors. Unequal opportunity can arise through distributed historical structures even when no single current actor controls the whole configuration. At the same time, distributed structure does not imply absence of power. Some actors may possess disproportionate capacity to shape the field through infrastructure ownership, rule setting, investment, standardization, or control of classification systems.

Fields and distributed structures therefore enter GRE as meso- and macro-level objects that connect local relations with wider conditions. They prepare the transition to the next section's analysis of levels and scales by showing that the same economic process can be experienced locally while depending on structures distributed across a much larger domain.

3.4.8 Processes, Events, and Trajectories

GRE requires temporal objects because generation is inherently concerned with how present configurations produce later conditions. Processes, events, and trajectories provide three complementary ways of organizing temporal analysis. A process is an extended pattern of transformation or reproduction; an event is a temporally localized occurrence that changes or reveals a configuration; a trajectory is an ordered

history through a sequence of states, positions, relations, or regimes.

Processes can include accumulation, learning, institutionalization, technological diffusion, ecological degradation, care, maintenance, financialization, organizational growth, migration, professionalization, or the reproduction of inequality. Their identity depends on a pattern that persists through time even though the participating entities and local actions can change. Process analysis asks which mechanisms sustain the pattern, what inputs and relations it requires, and under which conditions its direction or intensity changes.

Events are analytically useful when temporally concentrated occurrences reorganize later possibilities. A bankruptcy, legal judgment, policy reform, infrastructure failure, technological release, merger, protest, disaster, discovery, or institutional recognition can redirect relations and expectations. The significance of an event is relational to its surrounding history. The same formal event can have different effects depending on preparedness, institutional capacity, network structure, or prior accumulation.

Trajectories preserve ordered history. Two subjects can arrive at similar present outcomes through different paths that leave different capacities, obligations, networks, expectations, or vulnerabilities. Equal current income can follow stable professional advancement, volatile gig work, inherited wealth, debt-financed education, or recent displacement. A cross-sectional measure can therefore conceal generatively important histories. GRE uses trajectory analysis to ask how sequences of relations and events shape present and future possibility.

Path dependence can arise through several mechanisms. Earlier choices can create switching costs, complementary investments, habits, classifications, reputational effects, or network structures that condition later choices. Institutional arrangements can make some transitions progressively easier and others harder. Learning can create cumulative capability. Trauma or depletion can reduce future adaptability. These mechanisms differ, so trajectory dependence should be specified rather than invoked as a generic explanation.

Temporal objects also allow GRE to distinguish maintenance from change. A stable institution or capacity may require continuous process. Public infrastructure must be repaired; professional competence maintained; ecosystems regenerated; trust reproduced; data updated; organizations staffed. A snapshot can therefore make a dynamically maintained condition appear static. Process analysis reveals the labor, resources, relations, and constraints required for persistence.

The timescale of a trajectory matters. A policy can improve short-run consumption while weakening long-run fiscal capacity; a technology can raise output while generating ecological or skill dependencies; a cost-cutting strategy can increase current profit while degrading organizational knowledge. GRE consequently studies trajectories across timescales rather than treating the immediate effect as a sufficient description of economic consequence.

Processes, events, and trajectories can themselves interact. An event can initiate a process; a process can accumulate conditions that make an event consequential; a trajectory can cross a threshold that changes the process governing subsequent evolution. These temporal objects therefore provide the language needed to connect cur-

rent intervention with future generative structure.

3.4.9 Institutions and Social Facts

Institutions and social facts are objects of GRE because economic possibilities are stabilized through rules, roles, classifications, expectations, conventions, recognized statuses, and recurring practices that exceed isolated transactions. Institutions organize who may act, under what authority, through which procedures, with which forms of recognition, and under which expectations of continuity. Social facts include collectively sustained realities whose economic consequences depend on shared recognition, repeated practice, or institutional support.

An institution should be distinguished from an organization. An organization is a relatively bounded collective entity; an institution is a stabilized pattern of rules, roles, norms, or practices that can operate across many organizations. A university is an organization, while credentialing practices, academic tenure, disciplinary review, or degree recognition are institutional arrangements. A bank is an organization, while money, deposit insurance, accounting standards, or secured lending involve wider institutions. The distinction matters because organizational change can occur within persistent institutions, and institutional change can reorganize many organizations simultaneously.

Institutions stabilize expectations. Contract law affects the expected consequences of agreement; property regimes organize control and transfer; professional licensing structures entry; welfare systems define eligibility; labor law configures employment relations; standards coordinate interoperability. This stabilization can reduce uncertainty and make complex cooperation possible. It can also preserve historically produced asymmetries by assigning differential rights, burdens, recognition, or access.

Social facts can become economically real through collective recognition and practical enforcement. Currency, credentials, corporate status, property claims, rankings, occupational categories, and reputations depend partly on recognition while producing material consequences. Their socially constituted character does not weaken their reality. A person denied a credential, account, license, or legal status can face direct material exclusion even though the relevant object exists through institutional and representational practices.

GRE is interested in how institutions are generated and reproduced. Repetition can stabilize conventions; law can formalize existing practices; administrative categories can create new subject positions; technical infrastructures can embed rules into routine action; organizations can reproduce institutions through hiring, reporting, and compliance. Institutional persistence therefore requires material, symbolic, and relational supports that can themselves become objects of economic analysis.

Institutions also transform the value and meaning of other objects. A dwelling becomes mortgageable property under specific legal and financial institutions. Data become tradable or restricted through regulatory and contractual regimes. A skill becomes economically valuable when recognized by employers or credentialing systems. A relationship becomes taxable, insurable, or legally protected when institutional categories recognize it. Institutions thus participate in converting material and social differences into economically actionable distinctions.

Institutional change can produce generative effects that extend far beyond the immediate rule modification. A new legal status can enable contracting, borrowing, inheritance, representation, or access to public support. A new technical standard can create markets for complementary products. A revised accounting rule can alter investment behavior. Because institutions condition many later relations simultaneously, their generative reach can be large even when the initiating intervention appears administrative.

The institutional object category therefore links GRE's analysis of stable social reality with its interest in historical transformation. Institutions provide continuity while remaining generated, maintained, contested, and revisable. Their durability makes them analytically powerful; their historical production prevents their present form from being treated as timeless.

3.4.10 Symbolic and Representational Objects

Economic life increasingly depends on symbolic and representational objects: prices, money, accounts, contracts, rankings, scores, categories, models, forecasts, identities, records, credentials, tokens, indices, dashboards, and algorithmic classifications. GRE treats such objects as economically consequential when representations mediate access, coordinate action, allocate attention, stabilize expectations, or alter the behavior of the subjects represented.

A representation should be distinguished from its referent. A credit score is not identical to a borrower's full financial condition; a ranking is not identical to institutional quality; a market price is not identical to every form of value; a model is not identical to the system modeled. The distinction matters because economic action often responds to the representation. A lender can deny credit because of a score, investors can respond to a rating, students can choose universities through rankings, managers can reorganize work around performance indicators, and public agencies can allocate resources through administrative categories.

Representations can therefore become performative or generative. Once a category is used for allocation, subjects may adapt behavior to satisfy it. Once a metric determines funding, organizations may reorganize activity around the metric. Once a risk model affects pricing, the resulting prices can alter the behavior on which future risk estimates are based. Representation enters the causal structure because institutions and actors use it to make decisions.

Symbolic objects also permit coordination across distance and scale. Money represents transferable claims; contracts encode obligations; accounting records organize complex organizations; technical standards encode compatibility; credentials communicate institutional recognition; databases preserve histories that can be acted upon by subjects who never directly observed the original events. These symbolic infrastructures expand economic coordination while creating dependencies on classification, record integrity, interpretability, and institutional trust.

The production of representations is therefore itself an economic process. Data must be collected, categories designed, models trained, records maintained, standards negotiated, and interpretations authorized. These activities require labor, infrastructure, expertise, and institutional power. Actors controlling representation

systems can shape which differences become visible and which forms of value become actionable. In data-intensive economies, control over classificatory and representational infrastructure can become a major source of economic power.

Representations also have error structures. Measurement can be noisy; categories can be incomplete; models can be misspecified; historical records can be biased; proxies can drift as behavior changes. A representation can remain administratively stable while becoming less adequate to the underlying configuration. GRE therefore treats representational validity as historically revisable. The question is not only whether a representation was accurate when introduced, but whether the relations between indicator, referent, and institutional use remain sufficiently stable for current decisions.

Symbolic objects can move across contexts and acquire new effects. A credential issued for educational recognition can become a labor-market filter. A social-media metric can become an advertising asset. A legal category can become a database field used in automated decision systems. A scientific indicator can become a policy target. Such movements can alter the meaning of the representation and the incentives surrounding it.

GRE's interest in symbolic and representational objects is consequently broader than a study of information. It concerns the economic relations through which representations are created, authorized, circulated, interpreted, converted into decisions, and recursively connected to the realities they describe. The distinction between relation and representation remains central: a representation can reveal a relation, simplify it, distort it, or participate in generating a new one.

The ten object classes developed in this section provide GRE with a plural repertoire for empirical and theoretical inquiry. Emergent entities supply relatively stable units; subjects and subject positions identify locations of participation, standing, experience, and exposure; relations and relational configurations make interdependence explicit; resources and capacities distinguish what is available from what can practically be done; forms of value identify heterogeneous objects of production, recognition, conversion, and evaluation; conditions and constraints organize feasible possibility; fields capture distributed structures; processes, events, and trajectories preserve temporal organization; institutions and social facts explain stabilized collective realities; and symbolic or representational objects make visible the classificatory infrastructures through which economic action is coordinated.

These categories should remain permeable. A corporation can simultaneously be an entity, a juridical subject, an institutional configuration, a bundle of capacities, a node in relational fields, and a trajectory. Money can be a resource, an institutionally stabilized social fact, a symbolic object, and a medium through which value is represented and converted. A platform can be an organization, technical infrastructure, field, relation-generating environment, classificatory system, and economic subject under different legal arrangements. GRE gains explanatory power from selecting the representation that preserves the distinctions relevant to the local question, while comparing alternative representations when conclusions depend on that choice.

Object selection is therefore inseparable from scale. An object stable at one level can decompose into heterogeneous relations at another; a relation local to one scale

can appear as a distributed field at another; an event for one subject can be part of a long institutional process at a wider temporal resolution. The next section turns explicitly to these levels and scales of inquiry, establishing how GRE can move among individual, organizational, collective, institutional, ecological, and transnational domains without assuming that the same objects retain identical boundaries across them.

3.5 Levels and Scales of GRE Inquiry

The objects identified in the preceding section become analytically meaningful only relative to a level and scale of inquiry. A household can be treated as an economic subject in one analysis, as a field of interpersonal relations in another, as a node in a credit or welfare network in a third, and as part of a larger demographic, ecological, or transnational configuration in a fourth. Generative Relational Economics therefore requires an explicit account of scale selection. The role of this section is to specify the principal levels at which GRE inquiry can be organized and to clarify how movement among levels affects what counts as an entity, relation, condition, mechanism, and consequence. Its objective is neither to impose a fixed micro–meso–macro hierarchy nor to deny the usefulness of scalar distinctions. It is to make scale an explicit analytical choice whose adequacy depends on the research question, the generative mechanism under study, and the evidential resolution available to the researcher.

Scale in GRE has several dimensions. A *spatial scale* concerns the geographic or material extent of a configuration. A *temporal scale* concerns the duration over which formation, persistence, transformation, or consequence is observed. An *organizational scale* concerns the level at which coordinated action is stabilized, from interpersonal relations to firms, states, transnational institutions, or distributed infrastructures. A *juridical scale* concerns the reach of rights, duties, jurisdictions, and recognized authority. An *ecological scale* concerns the material and living systems within which economic activity is embedded. An *analytical scale* concerns the resolution at which a researcher constructs objects and causal or generative claims. These dimensions can align, but they often diverge.

The distinction between *level* and *scale* is useful even when their boundaries remain context-dependent. A level identifies a position within a layered description, such as person, organization, institution, or transnational system. Scale identifies the extent or resolution of the phenomenon being observed. An organizational process can have a local spatial scale but a long temporal scale; an interpersonal relation can be embedded in a global platform infrastructure; a juridical rule can operate nationally while being produced through transnational negotiation. GRE therefore treats levels as analytical locations within an inquiry and scales as dimensions of extent, duration, or resolution. Neither should be assumed to map onto a single natural hierarchy.

This section proceeds across six recurrent domains of analysis—individual and interpersonal, organizational, community and collective, institutional and juridical, ecological and more-than-human, and inter-system and transnational—before turning to two cross-cutting issues: scale-relative entityhood and cross-scale generative

effects. The method is constitutive rather than classificatory in a rigid sense. The purpose is to define a usable architecture for GRE research while preserving the possibility that empirical cases require different or additional levels.

3.5.1 Individual and Interpersonal Scales

Individual and interpersonal scales concern persons, households, dyads, small groups, and recurrent relations whose immediate organization is accessible at the level of situated interaction. At this scale, GRE can study how economic capacities, constraints, expectations, obligations, identities, and values are generated through relations among concrete subjects. The focus is wider than individual choice in isolation. Choice remains important, but the inquiry asks how the conditions under which choices become available, intelligible, affordable, legitimate, or sustainable are relationally formed.

An individual can be analyzed as an economic subject with resources, preferences, capabilities, legal standing, knowledge, vulnerabilities, and temporal commitments. Yet these attributes frequently depend on relations that exceed the individual. Income can depend on employment relations; credit access can depend on institutional classification and social history; capability can depend on care, education, infrastructure, or recognition; preference formation can depend on social learning and available categories of action. GRE therefore treats individual-level observations as legitimate without treating the individual as analytically self-sufficient.

Interpersonal relations can themselves generate economic effects. Trust can reduce monitoring costs and make cooperation feasible. Care can maintain or expand another person's practical capacities. Advice can alter information, confidence, or opportunity. Repeated exchange can create expectations of reciprocity. Family relations can redistribute resources across time and persons. Friendship and professional ties can provide access to information, employment, finance, or institutional navigation. These effects can be valuable without being fully priced, and they can generate dependency or unequal obligation as well as support.

Households illustrate the importance of distinguishing the administrative recipient from the relational field. A transfer formally delivered to one household member can alter bargaining power, care allocation, educational investment, consumption, savings, mobility, or future exit options for several people. A wage increase can change household time allocation and dependency patterns. Debt undertaken by one member can constrain future resources of others. The relevant unit therefore depends on the mechanism being studied rather than on the administrative unit through which a programme or transaction is recorded.

Temporal scale is especially important at the interpersonal level. Some effects are immediate, such as payment, consumption, or access. Others accumulate through repeated interaction. Trust, skill, reputation, dependency, and caregiving capacity are often generated through histories rather than single encounters. A relation that appears beneficial over one month can create vulnerability over several years; a costly educational investment can generate capabilities whose effects become visible much later. GRE inquiry should therefore specify the time horizon over which an interpersonal relation is being evaluated.

The individual and interpersonal scale also reveals the difference between formal equality and relational position. Two persons may hold the same legal right while facing different exit costs, knowledge, network access, or dependence. Equal monetary transfers can have different generative effects because subjects occupy different relational configurations. This does not imply that every analysis must reconstruct the full social history of each person. It means that the scale of analysis should be broad enough to capture the relations necessary for the specific generative claim.

At this level, evidence can include interviews, ethnography, surveys, administrative records, experiments, transaction histories, diaries, social-network data, or mixed-method designs. The appropriate evidence depends on whether the claim concerns subjective meaning, observed behavior, resource flow, causal effect, relational structure, or long-horizon change. Individual-scale data do not automatically support interpersonal or institutional claims, just as aggregate data can conceal mechanisms operating through concrete relations.

The individual and interpersonal scale is therefore a legitimate entry point rather than a privileged foundation. GRE can begin with persons and direct relations when that resolution is adequate, while remaining prepared to enlarge the analytical boundary when the observed capacities, constraints, or trajectories depend on organizational, institutional, ecological, or transnational structures.

3.5.2 Organizational Scales

Organizational scales concern coordinated configurations that stabilize roles, procedures, decision rights, resource pools, routines, information flows, and boundaries of participation. Firms, public agencies, universities, hospitals, cooperatives, nongovernmental organizations, platforms, laboratories, and project teams can all become objects at this scale. The relevant question is not simply whether an organization exists as a legally recognized entity. GRE asks how organizational arrangements generate capacities and constraints for participants and how those arrangements reproduce or transform their own conditions of operation.

Organizations can pool resources that individuals cannot mobilize alone. They can create specialized roles, accumulate knowledge, establish infrastructure, coordinate long production processes, and distribute risk. They can also concentrate decision authority, create informational asymmetries, and determine access to opportunities. An organization therefore appears simultaneously as an emergent entity and as a relational architecture through which people, technologies, rules, and resources become coordinated.

Organizational boundaries are analytically important because many contemporary production processes extend beyond formal employment or ownership. A platform can rely on independent contractors, users, complementors, cloud providers, advertisers, moderators, data-labeling workers, and public infrastructure. A manufacturing firm can depend on suppliers distributed across jurisdictions. A university can rely on temporary researchers, publishers, funders, accreditation systems, and digital services. The legal boundary of the organization is one relevant boundary, but it may not coincide with the generative boundary of the economic process.

GRE can therefore distinguish between organizational membership and organiza-

tional dependence. A person may depend economically on an organization without being an employee. A community may bear environmental or infrastructural consequences of organizational activity without participating in governance. A supplier may become technologically locked into a dominant buyer. A public institution may depend on proprietary software whose provider sits outside its formal hierarchy. These relations affect the organization's generative reach and the distribution of benefits, risks, and future options.

Organizational scale also makes internal heterogeneity visible. Departments, teams, occupational groups, and technical systems can operate under different incentives and temporalities. A firm can appear coherent at the market level while containing conflicts over investment, labor conditions, safety, innovation, and accounting. An organization can therefore be treated as a unit for one research question and decomposed into internal relational configurations for another. The adequacy of aggregation depends on which mechanisms matter to the inquiry.

Organizational learning is one important generative process. Routines, archives, training systems, informal norms, and technological infrastructures can preserve knowledge beyond individual tenure. Conversely, turnover, outsourcing, or fragmentation can dissipate capabilities even when short-term financial indicators improve. Investment in organizational capacity can therefore generate future possibilities that are not visible in current output, while extraction from organizational knowledge or trust can reduce later adaptability.

Governance within organizations is similarly generative. Decision procedures determine whose information enters deliberation, which risks become visible, how conflict is resolved, and who can revise rules. Participation can create knowledge and legitimacy; concentrated authority can accelerate decisions in some contexts while suppressing local information in others. GRE does not presume one organizational form to be normatively superior across cases. It studies how specific governance architectures shape the production, distribution, and transformation of future capacities.

Organizational scale thus mediates between interpersonal relations and wider institutional structures. Organizations translate law, markets, technologies, and cultural expectations into local procedures, while their actions can reshape sectors, communities, standards, and political economies. Their analysis requires attention both inward to internal relational architecture and outward to the fields in which they operate.

3.5.3 Community and Collective Scales

Community and collective scales concern forms of coordination and shared dependence that do not necessarily coincide with formal organizational boundaries. Neighborhoods, professional communities, scientific fields, cultural groups, commons, mutual-aid networks, open-source communities, social movements, informal markets, and distributed publics can exhibit patterns of collective action without constituting a single organization. GRE includes these formations because economically consequential capacities can emerge through repeated participation, shared norms, common infrastructures, and distributed recognition.

A community can generate resources that are difficult to assign to individual producers. Shared knowledge, reputation systems, linguistic conventions, safety expectations, informal credit, professional standards, and norms of reciprocity can enable action across many participants. Their value often depends on continued collective reproduction. If participation declines, trust erodes, common infrastructure deteriorates, or knowledge ceases to circulate, the resource itself can weaken even when no discrete asset has been destroyed.

Collective scale also matters for the formation of economic subjects. Membership in a professional, cultural, or local community can provide categories through which people understand opportunities and obligations. Collective narratives can shape expectations about work, entrepreneurship, education, debt, care, or acceptable risk. These processes need not imply homogeneous values. Communities can contain disagreement, hierarchy, exclusion, and multiple overlapping memberships. GRE therefore treats collective identity as an empirical configuration rather than an assumption of unity.

Commons provide a particularly useful illustration. A resource can be collectively used and governed through rules that define access, contribution, monitoring, sanction, and adaptation. The relevant economic object is then neither only the resource nor only the individual user. It includes the relation among resource conditions, user practices, governance arrangements, and external pressures. Changes in any of these can alter the viability of the collective system.

Digital communities extend these issues beyond geographic proximity. Open-source projects, online knowledge communities, creator networks, and platform-mediated groups can generate software, information, cultural value, reputation, and social support through dispersed participation. Their infrastructures can nevertheless remain privately owned or technically centralized. A community can therefore be distributed at the level of participation while depending on concentrated control at the infrastructural level. This asymmetry becomes visible only when multiple scales are analyzed together.

Collective action can also produce public or quasi-public capacities. Community organizing may improve bargaining power; professional associations may establish standards; neighborhood networks may coordinate disaster response; scientific communities may produce shared methods and repositories. These capacities can benefit participants unevenly and can create boundaries around membership or recognition. GRE can study both the generative contribution of collective organization and the distribution of access to what is collectively generated.

The temporal scale of communities often exceeds individual participation. Institutions of memory, ritual, documentation, mentorship, and repeated practice can transmit norms and capacities across cohorts. At the same time, a community can transform rapidly under migration, technological change, political conflict, or economic restructuring. Analyses that treat collective structure as fixed can miss the processes through which membership, meaning, and governance are continually reproduced.

Community and collective scales therefore provide a middle range in which distributed relations acquire partial stability without necessarily becoming formal organizations. They are especially important for GRE because generation frequently

occurs through participation that is economically consequential yet only partially represented in contracts, prices, or administrative categories.

3.5.4 Institutional and Juridical Scales

Institutional and juridical scales concern relatively stabilized systems of rules, recognized roles, procedures, classifications, rights, duties, jurisdictions, and authorized decisions. At this scale, GRE studies how economic possibility is structured through the formal and informal arrangements that determine what can be owned, exchanged, licensed, enforced, recognized, taxed, subsidized, inherited, represented, or contested. Institutions are not merely background conditions. They actively generate categories of action and subject positions.

Law provides one especially explicit architecture of economic possibility. Corporate law makes certain collective entities legally actionable. Property law organizes claims over resources. Contract law structures enforceable commitments. Labor law defines employment relations and protections. Bankruptcy law redistributes consequences of failure. Immigration law can shape access to labor markets and public support. Intellectual-property law conditions the circulation and appropriation of knowledge. These arrangements alter incentives, but they also constitute the legal identities and relations through which economic action proceeds.

Juridical scale should not be reduced to national legislation. Municipal regulations, administrative agencies, courts, professional licensing bodies, treaty regimes, private arbitration systems, technical standards, and organizational rules can each exercise authority over different domains. Jurisdictions overlap, and actors can move or strategically position activity among them. GRE therefore asks which authority is operative for the relation under study and how jurisdictional boundaries affect the distribution of rights, risks, and generative opportunities.

Institutional categories can have constitutive effects. Eligibility rules determine who counts as a beneficiary. Accounting standards determine which assets and liabilities become visible. Educational credentials authorize access to professions. Credit classifications influence borrowing conditions. Statistical categories shape policy populations. Once institutionalized, such classifications can alter behavior and resource flows, thereby contributing to the reality they purport to describe.

Institutional scale also introduces temporal depth. Rules inherit prior conflicts and compromises; administrative routines accumulate; precedents stabilize expectations; legal categories outlive the conditions under which they were formed. Economic actors adapt to these structures, and repeated adaptation can create constituencies that support their continuation. Institutional persistence can therefore be generated through feedback among rules, investments, expectations, and organized interests.

Change at this scale can be discontinuous. A legal recognition, regulatory decision, court judgment, or policy reform can rapidly transform the feasible set of actions for many actors. Yet implementation remains relational. Formal change can produce uneven effects when local administrative capacity, information, infrastructure, or social recognition differs. GRE consequently distinguishes institutional rule change from the distributed processes through which a rule becomes effective in practice.

Institutional and juridical scales also mediate normative questions. Rights, procedural protections, and public obligations can constrain economically efficient arrangements for reasons of justice, dignity, or political legitimacy. Conversely, legal authority can stabilize extractive or exclusionary relations. GRE does not infer normative validity from institutional existence. It treats institutions as economically generative structures whose consequences and justification require separate evaluation.

This scale is indispensable whenever the relevant causal or generative mechanism depends on recognized authority. A transaction between two persons may appear interpersonal, yet its enforceability, tax treatment, property consequences, and admissible terms can be institutionally constituted. The juridical environment therefore enters GRE inquiry whenever it materially changes what relations can exist and what they can generate.

3.5.5 Ecological and More-than-Human Scales

Ecological and more-than-human scales concern the living, material, energetic, climatic, and technological systems through which economic activity becomes possible and consequential. GRE includes these scales because economic relations are embedded in conditions that are neither produced solely by human exchange nor adequately represented as passive inputs. Soil fertility, water systems, biodiversity, atmospheric conditions, energy infrastructures, animal populations, computational systems, and built environments can shape and be transformed by economic processes.

Ecological scale complicates conventional boundaries around the economic unit. A factory can be analyzed as an organization, but its production may depend on watersheds, energy grids, mineral extraction, transport corridors, and waste sinks distributed across large regions. Agricultural production can depend on pollination, soil microbiomes, climate patterns, seed systems, and water availability. The relevant generative configuration can therefore extend far beyond the spatial boundary of the producing organization.

Temporal scale becomes especially consequential here. Ecological regeneration, depletion, contamination, and climate effects can unfold over decades or generations. Short accounting periods can therefore classify an activity as productive while externalizing degradation of the conditions that make later production possible. GRE can address this mismatch by treating ecological conditions as part of the generative system rather than only as exogenous constraints encountered by economic actors.

More-than-human inquiry also raises questions about agency and subjecthood. GRE need not resolve a general metaphysics of non-human agency in order to study how animals, ecosystems, technical systems, or artificial agents participate causally in economic configurations. A river can constrain settlement and transport; a disease vector can alter labor and health systems; an algorithm can allocate visibility or credit; an automated system can modify production decisions. The analytical status of these participants should be specified relative to the claim being made rather than predetermined by a universal hierarchy of subjects.

Technological systems illustrate the overlap between ecological and organizational scales. Energy networks, communication infrastructures, logistics systems,

and machine-learning platforms have material footprints, operational dependencies, maintenance requirements, and failure modes. Their economic effects emerge through coupled human and technical relations. Treating technology as a neutral tool can obscure how technical architecture redistributes practical capacities and how its maintenance depends on resource extraction, labor, standards, and institutional support.

Ecological relations also generate value that can resist simple monetization. A wetland can support flood protection, habitat, cultural practice, recreation, and future ecological resilience. Assigning a price to one service can assist a particular decision while leaving other forms of value unrepresented. GRE therefore permits multiple valuation registers at ecological scales and requires transparency about which dimensions are included in a given economic representation.

More-than-human scales also expand the population affected by economic decisions. Future people, non-human organisms, and ecosystems can bear consequences without participating in present transactions. This creates a temporal and representational problem: current subjects make decisions under institutions that may weakly represent distant or non-speaking affected parties. GRE can study the mechanisms through which those absences become economically consequential without assuming that a single metric resolves the normative problem.

Ecological and more-than-human scales thus prevent the research boundary from stopping where conventional organizational or market boundaries stop. They make visible the material conditions, distributed dependencies, and long-duration transformations through which present economic generation can either sustain or erode future possibility.

3.5.6 Inter-System and Transnational Scales

Inter-system and transnational scales concern relations that cross organizational fields, institutional orders, jurisdictions, sectors, infrastructures, or national boundaries. Contemporary economic processes frequently operate through such crossings. Finance, migration, supply chains, digital platforms, scientific collaboration, humanitarian assistance, trade, energy systems, taxation, and data governance can connect actors governed by different rules and situated within different value structures. GRE therefore requires a scale at which interactions among systems become objects in their own right.

A transnational supply chain illustrates the problem. Production may involve design in one jurisdiction, components from several others, assembly elsewhere, finance through global institutions, shipping through international logistics, and consumption in distant markets. Labor rights, environmental rules, currencies, tax regimes, and political risks differ across locations. The economic relation cannot be understood fully through the bilateral transaction between buyer and seller because value generation and vulnerability are distributed across the chain.

Inter-system analysis is broader than geographic internationalization. Health systems can interact with labor markets; education systems with migration regimes; financial systems with housing; scientific systems with intellectual-property institutions; humanitarian systems with border governance. Each system can maintain

its own classifications, objectives, and evaluative criteria. Their coupling can create gaps, contradictions, or conversion points through which subjects gain or lose access.

Conversion across systems is therefore a central object. A qualification recognized in one jurisdiction may not convert into professional standing elsewhere. Financial capital can cross borders more easily than labor. Data can be generated in one legal environment and processed in another. Carbon emissions can be produced locally while their climatic effects are globally distributed. Humanitarian categories can determine access to assistance but interact imperfectly with immigration categories. GRE can study these interfaces as generative sites where differences among systems produce new capacities or constraints.

Transnational scale also changes the distribution of governance capacity. Some actors can choose jurisdiction, route investment, relocate data, restructure ownership, or negotiate directly with states. Others remain territorially or institutionally fixed. Mobility itself therefore becomes an economic capability. The ability to cross boundaries can alter bargaining power even when formal rules are equal within each jurisdiction.

Distributed infrastructures further complicate territorial analysis. Payment networks, cloud computing, communications, shipping, and digital identity systems can operate across many jurisdictions while being controlled by a limited number of organizations or standards bodies. Failure or policy change at one infrastructural node can propagate across distant systems. The relevant scale is then neither purely national nor simply global; it follows the architecture through which dependence and coordination are organized.

Transnational processes also operate across heterogeneous temporalities. Trade agreements, infrastructure investments, migration histories, debt contracts, and climate commitments can bind actors over long periods. Short-term political cycles may interact with long-term obligations. GRE can therefore examine how institutional time horizons become coupled and how present decisions distribute future adjustment costs across places and populations.

Inter-system and transnational scales are consequently necessary whenever the generative relation crosses the boundary of the system in which the initial action is recorded. They direct attention to interfaces, conversions, jurisdictional differences, infrastructural dependencies, and the unequal capacity to move among systems.

3.5.7 Scale-Relative Entityhood

The preceding scales reveal a central constitutional principle of GRE: entityhood is often scale-relative. A configuration that functions as a coherent entity at one analytical level can become a field of heterogeneous relations at another. A household can be a unit in a national survey and a contested relational configuration in an ethnographic study. A corporation can be a market actor in industrial analysis and a network of departments, contracts, algorithms, workers, and investors in organizational analysis. A state can be treated as an actor in international negotiation and decomposed into agencies, courts, political coalitions, infrastructures, and administrative practices in institutional analysis.

Scale-relative entityhood does not imply that entities are unreal. It specifies the conditions under which treating a configuration as an entity is analytically productive. Relative stability, boundary persistence, coordinated action, recognized identity, and causal integration can justify entity-level analysis. The same configuration can nevertheless be decomposed when internal structure becomes relevant to the question. Ontological suspension therefore supports practical realism: the analyst can work with entities while remaining open to changing the level of resolution.

Aggregation is one mechanism through which entities appear. Individual transactions can produce market-level regularities; organizational decisions can produce sectoral patterns; local ecological changes can accumulate into regional effects. Yet aggregation alone does not guarantee that the higher-level object has independent explanatory value. GRE asks whether higher-level patterns feed back into lower-level behavior, constrain possible transitions, or stabilize classifications and expectations. When they do, the higher-level configuration can become causally or generatively relevant in its own right.

Decomposition likewise requires care. Explaining an organization through individuals alone can omit rules, infrastructures, and emergent coordination. Explaining a legal order through statutes alone can omit administrative practice and social recognition. Explaining a market through transactions alone can omit standards, network effects, and institutional conditions. Reduction to a finer scale can therefore lose structure just as aggregation can conceal heterogeneity.

The choice of scale also affects attribution. If a worker acquires a skill, the generative contribution may involve individual effort, teachers, organizational training, public education, family support, digital infrastructure, and prior scientific knowledge. Different scales reveal different contributors. GRE should therefore match attribution to the level of the claim and avoid converting a multi-scale generative process into a single-agent narrative without justification.

Scale-relative entityhood also matters for normative evaluation. Benefits and harms can reverse appearance across scales. A firm-level efficiency gain can impose community-level unemployment; a household-level coping strategy can reproduce gendered burdens; a national growth policy can create ecological costs elsewhere; a local conservation rule can restrict livelihoods while sustaining long-run regional resilience. Evaluation should therefore state the population, temporal horizon, and scale to which a conclusion applies.

Remark 3.1 (Scale-relative entityhood)*.* Treating a configuration as an entity is a modeling and evidential commitment justified by the local inquiry. It does not require the same configuration to remain indivisible, homogeneous, or equally salient at other scales.

This principle gives GRE a disciplined way to move among levels without declaring one level ultimately fundamental. The research question determines the initial resolution, while empirical anomalies, mechanism evidence, or downstream effects can require expansion or decomposition of the analytical boundary.

3.5.8 Cross-Scale Generative Effects

Cross-scale generative effects occur when processes organized at one level alter capacities, constraints, structures, or possibilities at another. These effects are central to GRE because economic generation often propagates beyond the scale at which an intervention, transaction, or decision is initially observed. A scholarship allocated to one person can affect a household, professional network, organization, or future community. A local technological innovation can reshape industry standards. A national regulation can reorganize firm behavior and interpersonal opportunities. A transnational platform rule can alter the visibility and income of individual creators.

Cross-scale effects can move upward through accumulation, coordination, diffusion, or institutionalization. Repeated individual behavior can create market conventions. Local experiments can become organizational routines. Collective practices can become recognized standards. Distributed demand can support an industry. Social expectations can become politically salient and eventually codified. The relevant mechanism should be specified rather than assumed from the observation that lower-level and higher-level change occur together.

Effects can also move downward. Institutional classifications shape individual eligibility; organizational rules structure team behavior; market concentration alters bargaining conditions; national monetary policy changes borrowing costs; ecological degradation constrains household livelihoods. Higher-level patterns can therefore become conditions of lower-level action even when they originated historically from distributed processes.

Horizontal propagation across scales is equally important. A change in one sector can alter another through labor, finance, infrastructure, or regulation. A technological standard adopted by one industry can create complementary markets elsewhere. A health crisis can transform education, transport, employment, and care. These processes are not captured adequately by a single vertical hierarchy because the relevant systems can be partially autonomous yet strongly coupled.

Cross-scale generation can also involve delayed effects. Investment in early childhood can influence educational trajectories years later; infrastructure can shape settlement and productivity over decades; ecological damage can accumulate before crossing thresholds; institutional reforms can alter expectations gradually. A local analysis may therefore be accurate within its immediate horizon while incomplete for longer generative consequences.

Feedback among scales creates additional complexity. An organizational policy can alter worker behavior; aggregated behavior can change organizational performance; performance can lead to a revised policy. A legal reform can change market practices; those practices can generate new political coalitions; the coalitions can reshape subsequent law. In such cases, scale is part of the mechanism because causal influence circulates among levels rather than traveling in one direction.

Cross-scale effects also create attribution difficulties. When value or harm propagates across several levels, assigning the outcome to the initial actor alone can overstate individual contribution, while attributing it only to structure can erase situated agency. GRE therefore treats generative attribution as potentially distributed. The relevant task is to identify the relations through which capacities or constraints were

produced and the points at which different actors or structures materially altered the trajectory.

Measurement should reflect this distributed character. Data collected at one scale can miss effects at another. Firm-level productivity data may not reveal household care burdens; household income data may not reveal ecological depletion; national statistics may not capture transnational tax shifting; platform-level engagement metrics may not capture community-level cultural effects. Multi-level designs, linked data, comparative cases, qualitative tracing, and simulation can each contribute where appropriate, provided the relation between evidence and claim remains explicit.

Cross-scale analysis finally has a governance implication. Interventions aimed at one level can generate consequences elsewhere, so institutional responsibility may need to follow generative reach rather than administrative jurisdiction alone. This does not imply unlimited responsibility for every remote consequence. It creates a research question about which downstream effects are sufficiently connected, foreseeable, material, or governable to enter evaluation and design.

The architecture established in this section therefore gives GRE a way to specify where an inquiry begins, how far its analytical boundary extends, and when movement among scales becomes necessary. Individual, organizational, collective, institutional, ecological, and transnational levels are recurrent sites of inquiry rather than a closed hierarchy. Entityhood remains relative to analytical scale, and generative effects can propagate upward, downward, horizontally, and across time. With these levels clarified, the next task is to state the characteristic questions through which a GRE inquiry can interrogate a concrete economic situation.

3.6 Illustrative Questions in Generative Relational Economics

The preceding sections have specified the disciplinary identity, problem-space, methodological primitives, objects, and scales of Generative Relational Economics. Those elements define a field of possible inquiry, but they remain abstract until translated into questions that can organize empirical, historical, formal, interpretive, and normative research. The role of this section is therefore illustrative. It identifies recurrent question-forms that make the distinctive concerns of GRE operational without turning them into a mandatory sequence or a closed checklist. The objective is to show how a researcher can move from a conventional economic problem toward a generative-relational formulation by asking what relations constitute the situation, what is generated through them, how value and capacity travel, where asymmetries are converted into power, and how present arrangements alter later conditions of possibility.

These questions are intentionally broader than particular methods. A question concerning value propagation might be studied through administrative data, interviews, network analysis, accounting records, historical archives, ethnography, simulation, or some combination of these. A question concerning subject formation may require interpretive evidence that differs from the evidence required to identify a re-

source flow. GRE therefore treats the question-form as analytically prior to method selection. Methods are chosen according to the object, scale, mechanism, and evidential problem rather than according to a presumption that one technique defines the field.

The questions are also non-exclusive. A single research project may begin with one and encounter several others. An analysis of a training subsidy may ask who formally receives the subsidy, which household or organizational relations mediate its use, what capacities are generated, how those capacities propagate through employment networks, which forms of value are realized or lost, and whether the programme changes the future bargaining position of workers. The value of the GRE perspective lies partly in making these connections available for investigation while preserving distinctions among them.

The thirteen question families below should consequently be read as an open repertoire. They do not exhaust GRE inquiry, and they do not imply that every project must answer all twelve. Their function is to reveal characteristic directions of attention: constitution, displacement beyond the administrative recipient, generation, propagation, conversion, recirculation, capacity transformation, access to generative capacity and conditions, subject formation, power formation, orientation, foreclosure, and recursive transformation of the conditions of change.

3.6.1 Which Relations Constitute the Economic Situation?

A GRE inquiry can begin by asking which relations make the observed economic situation possible and intelligible. The question directs attention away from treating visible entities as analytically self-sufficient. A worker, firm, household, platform, loan, public service, or market transaction enters an already organized field of legal, infrastructural, contractual, social, technical, ecological, and symbolic relations. Some of these relations are proximate and observable; others operate as background conditions. The task is to identify which of them materially affect the phenomenon under investigation.

This question is selective rather than totalizing. GRE does not require reconstruction of every relation surrounding an object. The relevant relations are those whose inclusion changes explanation, evaluation, or intervention. A study of household energy insecurity, for example, may need to include income, housing quality, tenancy status, energy pricing, family composition, climate exposure, and access to public support. The entire history of the household is unnecessary unless some part of that history affects the mechanism under study. Relational analysis becomes useful when it improves the adequacy of the inquiry rather than when it simply multiplies context.

The question also encourages distinctions among kinds of relation. A legal relation of entitlement differs from an interpersonal relation of trust; a supply relation differs from an ownership relation; a technical dependency differs from a political authorization; an ecological dependency differs from a contractual obligation. Several may intersect in one case without being reducible to one another. Mapping constitution therefore requires enough conceptual resolution to preserve the mechanism carried by each relation.

Relational constitution can also be asymmetric. One party may depend on another

without reciprocal dependence of the same magnitude or kind. A small supplier can depend heavily on a dominant buyer whose dependence on that supplier is negligible. A migrant worker can depend on an employer for income, legal sponsorship, housing, or information. A municipality can depend on a private platform for an infrastructure it does not control. Asking which relations constitute the situation therefore prepares later analysis of bargaining position, exit, capture, and power.

The practical result is a boundary decision. Once the constitutive relations have been identified, the researcher can justify why some actors, institutions, infrastructures, temporal histories, or ecological conditions are inside the analytical frame and others remain outside it. The boundary remains revisable as evidence accumulates. GRE thus treats relational mapping as a disciplined way to construct the object of inquiry rather than as a demand for unlimited contextual description.

3.6.2 What Changes beyond the Administrative Recipient?

Economic programmes and transactions are frequently recorded through an administrative recipient: the person receiving a transfer, the firm receiving a subsidy, the borrower named on a loan, the patient receiving a service, or the organization holding a grant. GRE asks what changes beyond that formally designated unit. The question matters because economic effects often propagate through relations that administrative data do not treat as recipients.

A cash transfer received by one person may alter household consumption, bargaining power, care responsibilities, debt repayment, education, mobility, or support to relatives. A grant to a small firm can affect employees, suppliers, clients, landlords, local tax revenue, or competing firms. A scholarship can transform not only the student's education but household expectations, future remittances, professional networks, and the aspirations of younger family members. The administrative recipient remains an important object, but it does not automatically define the boundary of effect.

This question is not equivalent to measuring conventional spillovers alone. GRE is interested in the relational pathways through which effects move. Two programmes with similar average indirect effects can operate through different mechanisms. One may propagate through knowledge sharing, another through household redistribution, another through changes in bargaining position, and another through infrastructure created for the initial recipient. Identifying the pathway helps distinguish incidental correlation from generated consequence.

The question also exposes burdens that move beyond the recipient. A policy that expands employment for one group can transfer unpaid care to another group. Debt relief for a firm can preserve jobs while imposing losses on pension funds or public budgets. Digital convenience for consumers can shift risk and time costs onto gig workers. The analysis therefore follows both enabling and constraining consequences beyond the administrative unit.

A useful GRE design can make this boundary extension explicit at the outset. The researcher can specify the formal recipient, identify connected subjects and systems likely to be affected, determine which effects are theoretically relevant, and select evidence capable of observing those pathways. The resulting analysis does not reject

administrative categories; it treats them as one layer within a wider relational field.

3.6.3 What Is Generated through an Economic Relation?

A central GRE question asks what an economic relation produces beyond its immediate exchange or recorded output. The relevant generated objects can include income, knowledge, capability, trust, dependency, reputation, infrastructure, organizational routine, institutional legitimacy, ecological burden, expectations, data, symbolic standing, or new relations. Generation concerns the production of later conditions and possibilities, not merely the transfer of an already existing object from one holder to another.

Consider employment. A wage relation transfers income in exchange for labor, but it can also generate skill, professional identity, social networks, credentials, routines, health effects, dependence, bargaining experience, or exclusion from alternative opportunities. Which of these effects matters depends on the research question. A GRE analysis does not assume that every employment relation generates the same bundle. It asks which outputs are produced in this case, through which mechanisms, for whom, and with what temporal persistence.

The distinction between output and generation is especially useful where the immediate output is easy to measure but longer-term transformation is economically important. A training programme can produce a certificate immediately while generating later confidence, network access, occupational mobility, or employer recognition. A public library can provide books and space while generating study routines, weak ties, civic participation, or access to digital services. An open technical standard can coordinate present interoperability while generating an ecosystem of future complementary production.

Generated effects can be intended or unintended. Organizations can deliberately build capability, loyalty, or infrastructure, while other consequences emerge from repeated interaction without centralized design. Some generated effects become visible only retrospectively. GRE therefore distinguishes the existence of a generated consequence from claims about intention. The question concerns the causal or constitutive production of a later condition, not whether an actor planned that condition.

Generation can also be negative in practical or normative terms. A predatory credit relation may generate debt dependency and reduced future exit options. Repeated precarity may generate risk aversion or the erosion of professional capacity. An extractive production process may generate ecological degradation that constrains later economic activity. The category of generation is therefore descriptive before it is evaluative. Evaluation requires additional criteria concerning whose capacities, values, or futures are affected.

3.6.4 How Does Value Propagate?

Value produced or realized in one relation can travel through a wider configuration. GRE asks how that propagation occurs, which pathways carry it, where it amplifies or decays, and who becomes able to use or capture it. The question begins from the observation that valuable effects rarely remain confined to the site at which they first

appear.

Knowledge provides a clear example. A skill acquired by one worker can improve team performance, be taught to colleagues, contribute to organizational routines, support innovation, or become embodied in a product used elsewhere. Public infrastructure can raise the productivity of many firms and households. Trust accumulated through repeated cooperation can reduce coordination costs for later projects. A scientific result can enable downstream technologies, standards, or educational materials. The original site of value generation and the later sites of value realization can therefore be separated in space, time, and institutional ownership.

Propagation has a topology. Some value moves through direct exchange; some through imitation, learning, standards, networks, public goods, reputation, or price changes. Some pathways require institutional authorization. A professional qualification becomes valuable partly because employers and regulators recognize it. A digital protocol becomes valuable as adoption expands. A neighborhood amenity can propagate into land prices through property markets. Mapping the pathway helps determine whether value is widely distributed, locally concentrated, or captured at a bottleneck.

Propagation can also be blocked. Intellectual-property restrictions, incompatible standards, discriminatory networks, lack of infrastructure, language barriers, licensing rules, organizational secrecy, or geographic isolation can prevent generated value from reaching potential users. A GRE analysis can therefore investigate not only how value travels but which relations determine its transmissibility.

This question does not require that heterogeneous forms of value be collapsed into a common unit. Monetary gains, capability expansion, ecological support, recognition, and relational trust can propagate through different mechanisms and may require different measurements. The analytical task is first to identify the form of value and its pathway. Comparison or aggregation comes later, if the research purpose justifies it.

3.6.5 How Does Value Convert across Forms?

Economic life contains interfaces at which one form of value becomes convertible into another. GRE asks how those conversions occur, which institutions authorize them, whose valuations determine the rate or terms of conversion, and what is lost or created in the process. Conversion is analytically distinct from propagation. Propagation concerns movement of value through a relational configuration; conversion concerns a change in the form through which value is recognized or realized.

Education can be converted into credentials, credentials into employment access, employment into income, income into housing security, and housing security into educational opportunity for another generation. Reputation can become credit access. Cultural attention can become advertising revenue. Publicly produced knowledge can become private intellectual property. Ecological capacity can be converted into commodity production, while financial resources can sometimes be converted into restoration or conservation capacity. Each conversion requires a specific institutional and relational interface.

Conversion interfaces are often sites of asymmetry. Actors differ in their ability to define categories, certify equivalence, set prices, control access, or refuse conversion. A platform may convert user attention into advertising income while users lack a comparable mechanism for realizing the monetary value of their data. A credentialing institution can translate learning into recognized status. A financial system can translate property into collateral and collateral into borrowing capacity, thereby privileging subjects who already possess assets recognizable by that system.

Conversion can be lossy. Meaning, context, ecological complexity, or relational quality can disappear when translated into a scalar metric. Conversely, conversion can create new practical possibilities by making heterogeneous resources interoperable. Monetization can enable exchange across distance; standardized credentials can enable mobility; technical standards can connect previously incompatible systems. GRE therefore treats conversion neither as inherently exploitative nor as inherently beneficial. Its consequences depend on the forms involved, the terms of translation, and the distribution of authority over the interface.

Research can make these interfaces explicit. Instead of asking only how much value exists, it can ask which forms are recognized, which remain invisible, who can perform conversion, what conversion costs arise, who captures the resulting surplus, and whether repeated conversion changes the source form itself. Such questions are especially important when policy seeks to make previously unrecognized value legible to markets or administrative systems.

3.6.6 What Recirculates, Dissipates, or Is Extracted?

Generated resources and value can return to the relations that produced them, spread elsewhere, decay, or be extracted by actors positioned to capture them. GRE therefore asks what recirculates, what dissipates, and what leaves the generative configuration. This question focuses on reproduction through time. A relation can remain productive only if enough of the conditions supporting it are replenished, repaired, or renewed.

Recirculation occurs when generated value or capacity contributes to the maintenance or expansion of the relations that produced it. A cooperative can reinvest surplus in shared infrastructure. A university can use research income to support laboratories and training that enable later research. A community enterprise can return part of its income to local services and networks. Trust generated through successful cooperation can make later cooperation easier. Recirculation can therefore create self-reinforcing dynamics without implying that the resulting configuration is socially desirable.

Dissipation concerns loss through time, friction, obsolescence, leakage, neglect, or ecological degradation. Skills can decay when unused; infrastructure can deteriorate without maintenance; trust can erode; institutional knowledge can disappear through turnover; ecological capacity can be depleted; attention can fragment. Some dissipation is unavoidable, while some reflects institutional choices about maintenance and renewal. An analysis focused only on gross production can miss the cost of replacing dissipated conditions.

Extraction occurs when generated value or capacity is appropriated in ways that

weaken the configuration from which it arises or concentrate its benefits elsewhere. Rent extraction from a local economy, uncompensated appropriation of community knowledge, financial distributions that undermine productive investment, or platform capture of user-generated value can all become candidates for investigation. The concept requires mechanism evidence. The fact that one actor gains more than another does not by itself establish extraction; the analysis must identify the relation through which value is captured and the effect on the generative configuration.

Recirculation, dissipation, and extraction can coexist. A profitable firm can reinvest some surplus, distribute some to workers or suppliers, lose some through depreciation, and transfer some to distant owners. A public programme can generate local capacity while trained workers later migrate. The question is therefore compositional: what proportion or form of generated value follows each pathway, and how do those pathways alter future capability?

3.6.7 How Are Future Capacities Transformed?

GRE places particular emphasis on the transformation of future capacity. An economic arrangement matters not only because of what it produces now but because it changes what subjects and systems can do later. This question links present allocation and relation to the future space of feasible action.

Capacity transformation can occur through learning, infrastructure, health, care, institutional reform, ecological change, debt, technological dependency, network formation, or depletion. A loan can expand productive capacity by financing equipment, while repayment obligations can constrain future cash flow. Employment can build skill and reputation while narrowing alternative career paths. A subsidy can help an industry acquire capabilities that persist after the subsidy ends. Environmental degradation can generate present income while reducing the future productive capacity of an ecosystem.

The temporal profile matters. Some interventions impose immediate costs in order to generate later capacity. Others create immediate gains by drawing down capacities that become scarce only later. A short evaluation window can therefore reverse the apparent ranking of alternatives. GRE does not prescribe one universal horizon, but it requires the horizon to be explicit and adequate to the mechanism claimed.

Capacity is also subject-specific and relational. The same infrastructure can expand the capacity of one group while reducing another's control over land or resources. A technology can increase organizational capacity while deskilling particular workers. A regulatory change can expand consumer choice while increasing compliance burdens for small producers. Asking whose future capacity changes prevents aggregate improvement from automatically standing in for distributed capability.

The question also creates an interface with uncertainty. Future capacities cannot always be observed directly at the time of intervention. Researchers may need intermediate indicators, historical comparison, simulation, qualitative evidence, or repeated observation. GRE therefore treats claims about future generativity as evidentially demanding. The more distant the claimed effect, the more explicit the mechanism and uncertainty should become.

3.6.8 Access to Generative Capacity and Conditions

A further GRE question asks who can enter, mobilize, influence, maintain, and modify the processes through which economic generation occurs. The question is related to allocation but is not exhausted by it. Receiving an output is different from being able to call upon the capacity that produces further outputs, and both are different from participating in the formation of the conditions under which that capacity develops.

The distinction can be organized through three analytical layers. The first concerns generated outcomes: who obtains what has already been produced? The second concerns generative capacity: who can mobilize labor, knowledge, organizations, machines, artificial systems, or institutional capabilities to produce something new? The third concerns generative conditions: who can shape infrastructures, legal permissions, standards, education, data, compute, energy, networks, recognition, and other conditions that make particular forms of generation possible? A GRE project may focus on any one layer, but it should avoid assuming that access at one layer entails access at the others.

Artificial intelligence makes the distinction unusually visible. If increasingly capable artificial systems reduce the need to obtain some goods or services through another person's direct labor, the political-economic problem does not necessarily disappear. It can shift toward access to the artificial generative system and toward control over the conditions under which that system operates and evolves. The relevant research question therefore becomes less exclusively who receives the product and more broadly who can make use of, influence, and participate in the development of generative capacity.

This question opens later analysis of capital, power, exploitation, common infrastructure, and generative autonomy without deciding those issues here. Its role in the present repertoire is diagnostic. It asks whether an observed distribution of outputs conceals a more consequential distribution of capacities and conditions, and whether apparently abundant production remains organized through asymmetrical dependence on access to future generation.

3.6.9 How Are Economic Subjects Generated and Stabilized?

Economic analysis often begins with subjects already defined as workers, consumers, owners, borrowers, firms, entrepreneurs, citizens, beneficiaries, or investors. GRE asks how such positions are generated, recognized, stabilized, and transformed. The question concerns practical economic subjecthood rather than a final theory of personhood.

Subject positions can be produced through legal categories, contracts, organizational roles, technologies, data systems, professional standards, markets, and social expectations. A person becomes a borrower not simply by possessing an individual preference for credit but through eligibility rules, identity documentation, scoring systems, collateral conventions, and lender recognition. A platform worker occupies a subject position shaped by contract classification, algorithmic management, customer ratings, payment infrastructure, and labor regulation. A firm becomes an investable object through legal incorporation, accounting practices, governance ar-

rangements, and financial representation.

Stabilization requires continuity. Roles persist because institutions recognize them, records maintain them, counterparties respond to them, and subjects often organize their own expectations around them. This continuity can enable planning and rights while also producing path dependence. A classification that initially facilitates coordination can later restrict access or define subjects in ways that no longer fit their circumstances.

Economic subjects can also be generated through participation. Repeated saving can produce a recognized credit history; apprenticeship can produce professional identity; membership in a cooperative can develop capacities for collective decision-making; long-term unemployment can alter institutional classification and self-expectation. Subject formation is therefore partly an economic process because access to resources, roles, and relations can reshape practical identity and future action.

The question becomes especially important under technological change. Artificial agents, automated systems, platforms, and hybrid human-machine arrangements can perform functions previously associated with human economic subjects. GRE can ask which dimensions of subjecthood are relevant in each domain: productive agency, control over resources, capacity to enter recognized relations, continuity across time, liability, representation, or normative standing. These dimensions need not coincide, and functional capability does not settle moral or legal status.

3.6.10 How Does Asymmetry Become Economic Power?

Differences in resources, knowledge, capability, network position, or technical capacity are ubiquitous. GRE asks when such asymmetries become economic power. The question prevents a simple equation between difference and domination. Power arises when asymmetry is connected to relations through which one actor can shape another's feasible actions, terms of participation, exposure to risk, access to resources, or future capacities.

A firm with superior technology does not automatically hold power over every other actor. Power emerges when that capability is linked to ownership, market position, contractual authority, infrastructure control, legal privilege, dependency, standard-setting, or capture of a bottleneck. Likewise, information asymmetry becomes power when one party can use informational advantage to determine terms, classify others, restrict alternatives, or impose costs that the other party cannot readily avoid.

Exit and dependence are therefore central. A relation can be formally voluntary while one side faces much higher exit costs. Workers may be able to leave an employer in principle but lose legal sponsorship, health insurance, housing, or accumulated benefits. Users may be free to leave a platform but face network effects, data lock-in, or loss of professional visibility. Suppliers may be free to reject a dominant buyer while lacking alternative markets. Power analysis asks how these relational conditions transform nominal options into practical constraints.

Power can also be infrastructural and impersonal. No single actor may intention-

ally dominate others, yet standards, algorithms, payment systems, zoning rules, or inherited property structures can distribute capacities asymmetrically. GRE can therefore examine power embedded in relational architectures as well as direct command. Identifying power does not require attributing malicious intention; it requires showing how a configuration systematically shapes the options or capacities of differently positioned subjects.

The question naturally leads to generative consequences. Power can reproduce itself by generating the resources, information, legitimacy, or dependency that sustain the original asymmetry. It can also erode its own conditions when extraction undermines cooperation or when concentrated authority produces institutional resistance. GRE therefore studies power not only as a present relation but as a potentially self-reinforcing or self-transforming generative configuration.

3.6.11 What Orients the Direction of Generation?

Generation has direction because economic systems selectively develop some possibilities while leaving others unrealized. GRE asks what orients that selection. Markets, institutions, professional communities, public policy, cultural expectations, metrics, aesthetic judgments, scientific questions, organizational goals, and individual aspirations can all influence which objects receive attention and investment.

The question is broader than incentive analysis while remaining compatible with it. Prices and expected returns orient activity, but so do legal mandates, research agendas, rankings, reputational systems, narratives of desirable futures, and perceptions of what is interesting or feasible. A research organization can direct resources toward questions regarded as scientifically significant even when immediate commercial returns are uncertain. A city can prioritize mobility, housing, tourism, or environmental restoration according to institutional and political judgments that structure later investment.

Orientation can operate before explicit choice by shaping salience. Subjects do not evaluate every imaginable possibility. They encounter a selected field of options made visible by institutions, technologies, language, education, and social experience. Recommendation systems, professional curricula, funding categories, procurement rules, and media attention can influence which possibilities become thinkable or practically available. GRE can therefore study the production of the option field as well as selection within it.

Orientation is also heterogeneous. Different subjects can pursue incompatible forms of value or imagine different desirable futures. Economic coordination then involves negotiation, conflict, coexistence, or institutional procedures for selecting among directions. The presence of plural orientations means that generativity alone cannot supply a normative criterion. A system can be highly generative while producing futures that some affected subjects reject.

Research on orientation can ask who participates in defining goals, which signals are amplified, which possibilities are rendered invisible, what feedback modifies priorities, and how orientation changes after new capacities or knowledge emerge. These questions prepare the more systematic treatment of orientation later in Chapter 3 while showing why the direction of generation is already an economic question.

3.6.12 Under What Conditions Does Generation Produce Foreclosure?

Generation can expand future possibility, but it can also close alternatives. GRE therefore asks under what conditions the production of one pathway forecloses others. Foreclosure can arise through irreversible investment, ecological depletion, institutional lock-in, debt, standardization, network effects, path-dependent learning, spatial development, or the concentration of control over key resources.

A technology can create new capabilities while making older infrastructures uneconomic to maintain. An urban development project can generate housing and commercial value while eliminating community uses of land that cannot easily be reconstructed. A standardized platform can enable broad interoperability while reducing space for alternative technical architectures. Specialized education can generate high competence in one domain while increasing the cost of changing fields later. These examples show why generation and foreclosure can occur together.

Foreclosure is not identical to constraint. Every realized choice excludes some alternatives simply because resources and time are finite. The analytical question concerns consequential closure of future possibilities, especially where the closure becomes difficult to reverse or is imposed unevenly across subjects. The degree of reversibility, distribution of exit costs, and availability of alternative pathways therefore become relevant indicators.

Some foreclosure can be justified or desirable. Safety regulation intentionally eliminates dangerous production methods; environmental rules can close destructive extraction pathways; technical standards can reduce costly incompatibility. GRE does not treat openness as an unconditional good. It asks which possibilities are being closed, for whom, by what authority, with what reversibility, and in pursuit of which values.

The question is particularly important for policy evaluation. An intervention can appear successful according to immediate outcomes while narrowing later adaptability. Conversely, a policy that preserves optionality can look inefficient in a short horizon because it maintains redundant capacity or multiple institutional pathways. GRE can therefore include future option structure as part of economic evaluation when the case warrants it.

3.6.13 How Do Relational Structures Transform Their Own Conditions of Change?

The final illustrative question concerns recursive transformation. Economic relations can generate outcomes that alter the mechanisms through which later change occurs. A market can produce firms that reshape regulation; a platform can generate network effects that change entry conditions; a labor arrangement can produce new worker organizations; a financial innovation can change the infrastructure through which future credit is allocated. The object of inquiry is therefore not only change within a structure but change in the conditions that organize subsequent change.

This question requires careful separation among levels of transformation. A system can move from one state to another while its basic rules remain stable. Parameters can change while the form of the mechanism remains intact. Institutions can

revise rules while preserving their authority structure. More strongly, actors, categories, boundaries, or mechanisms can be reconstituted so that the previous model of change no longer describes the later situation adequately. GRE is especially interested in the transition among these cases because historical economic development often involves several simultaneously.

Recursive transformation can be deliberate. Legislators can redesign institutions, firms can alter governance, communities can create new property arrangements, and regulators can modify market rules in response to observed outcomes. It can also emerge without centralized design as repeated practices create new conventions, standards, expectations, or dependencies. In either case, the researcher should identify the pathway through which earlier relations modify later generative conditions.

Reflexivity intensifies the problem. Economic subjects can observe models, policies, forecasts, and classifications and respond to them. A credit score changes behavior because actors know that the score affects access. A policy target can reorganize organizational reporting. A market forecast can affect expectations and transactions. Representation can therefore enter the causal field it describes. GRE treats such reflexive loops as empirically investigable rather than as a reason to abandon formal or causal analysis.

The evidential standard should remain demanding. Claims that a system has transformed its own rules can easily become rhetorical if the relevant rule, boundary, or mechanism is left unspecified. A strong analysis identifies what changed, which earlier relations contributed to that change, how the new arrangement differs operationally from the previous one, and what consequences follow for later possibilities. The concept is useful precisely when it distinguishes ordinary state change from transformation in the organization of change itself.

Taken together, these thirteen question families define a characteristic style of GRE inquiry without establishing a closed doctrine. They invite researchers to move beyond the immediate recipient, transaction, or output when doing so materially improves explanation; to track generation, propagation, conversion, and recirculation across heterogeneous relations; to examine future capacities, access to generative capacity and conditions, subject formation, power, orientation, and foreclosure; and to remain alert to recursive changes in the conditions of change. A project can enter this problem-space through any one of these questions and combine them according to the object and evidence at hand.

The next section converts this repertoire of questions into a more explicit analytical sequence. It distinguishes allocation, relational mediation, generation, propagation, conversion, recirculation, extraction, structural transformation, and changes in generative conditions. That sequence is not intended as a universal causal chain. Its role is to provide GRE with a reusable perspective for deciding which stages of an economic process require attention in a particular inquiry.

3.7 The Distinctive Analytical Perspective of GRE

The preceding sections have specified the problem-space, primitive structure, admissible objects, scales, and illustrative questions of Generative Relational Economics

(GRE). The role of the present section is to state more explicitly the analytical perspective that organizes those elements into a characteristic mode of economic inquiry. Its objective is to describe a sequence of analytical moves through which an allocation, transaction, policy, institution, or other economic event can be followed beyond its immediate recipient and immediate output into the relations, generated capacities, value pathways, structural changes, and altered conditions of future change that it helps produce. The sequence is presented as a research grammar rather than a universal causal law. A concrete study may enter at any point, omit stages that are irrelevant, distinguish several parallel pathways, or discover feedbacks that make the ordering recursive. The analytical value of the sequence lies in keeping distinct processes that conventional evaluation can easily compress into a single outcome measure.

The perspective begins from allocation because allocation remains a central economic operation. Resources, rights, attention, credit, land, labor, data, infrastructure, authority, and institutional recognition are distributed through decisions and arrangements that place something somewhere under particular terms. GRE treats that placement as an initial intervention into a relational configuration. The allocation changes access, bargaining positions, expectations, dependencies, opportunities for coordination, and sometimes the identities or capacities of the participants. Those changes can generate new resources and forms of value, which may propagate through a wider configuration, convert across forms, recirculate into the relations that produced them, dissipate, or become subject to extraction. Repeated or sufficiently consequential processes can alter institutional and relational structure, transform the conditions that enable future generation, and in some cases change the effective rule through which subsequent transformations occur.

This perspective therefore extends the temporal and relational horizon of economic analysis without prescribing one metric of success. Monetary return, productivity, capability, recognition, ecological capacity, knowledge, trust, security, autonomy, and other forms of value can remain heterogeneous. GRE asks how they are generated and connected before deciding whether comparison, aggregation, or normative judgment is warranted. It also keeps mechanism claims separate from moral evaluation. A self-reinforcing process can be economically powerful while normatively objectionable; a process that dissipates one form of value can generate another; a structural transformation can expand some future possibilities while foreclosing others. The following subsections develop the ten analytical moments in this perspective.

3.7.1 Allocation as an Initial Intervention

Allocation is the analytical point of departure because many economic processes become administratively visible at the moment when a resource, entitlement, burden, opportunity, or authority is assigned. Public budgets allocate funds to programmes. Firms allocate capital and labor. Banks allocate credit. Households allocate time and care. Platforms allocate visibility. Legal institutions allocate rights and liabilities. Educational institutions allocate credentials and access. These operations remain central to GRE, yet GRE reads them as interventions into already structured relations

rather than as terminal distributions among self-contained recipients.

An allocation changes more than possession. Receiving credit can alter a firm's bargaining position with suppliers, its ability to hire, its exposure to debt service, and the confidence of other financiers. A housing subsidy can change household security, neighborhood demand, landlord expectations, and local land values. Allocation of research funding can change laboratory composition, collaboration networks, training capacity, and the future distribution of expertise. Even an apparently simple transfer enters a field of existing institutions, expectations, power relations, and conversion mechanisms.

The analytical unit is therefore the allocation-in-context. A useful GRE study specifies what is allocated, under which institutional conditions, to whom or to which configuration, at what time, with what duration, and through which rights or obligations. It also identifies the baseline relations into which the allocation enters. These relations determine what the allocation can become. The same monetary amount can have different generative effects when recipients possess different infrastructure, debt burdens, social recognition, legal status, network access, or ecological conditions.

Allocation can also concern non-scarce or symbolically abundant objects. Attention, rankings, reputational signals, software, information, and institutional recognition can be allocated through procedures that differ from the allocation of rival material goods. Their economic significance often arises from the relations that make them consequential. A search ranking matters because users, advertisers, platforms, and firms respond to it. A credential matters because institutions recognize it. A dataset matters because actors possess complementary computational and organizational capacities. GRE therefore treats allocation as a broad intervention category whose meaning depends on the relational conditions of use.

Starting from allocation preserves continuity with established economic analysis while widening the subsequent inquiry. The initial question remains who receives what, under which conditions. GRE then asks what relations are activated or reconfigured by that placement, what becomes possible because of it, and which downstream effects remain outside the administrative boundary of the allocation itself.

3.7.2 Relational Mediation

An allocation acquires practical significance through relational mediation. Resources rarely produce identical effects independently of the relations through which subjects can use, interpret, exchange, protect, combine, or transform them. Relational mediation names the set of pathways through which an initial intervention becomes economically operative. These pathways can include contractual relations, kinship and care relations, organizational routines, infrastructures, legal recognition, technical standards, reputational systems, financial arrangements, ecological dependencies, and informal networks of trust or exclusion.

Mediation can enable use. A loan becomes productive when a borrower can purchase equipment, hire workers, obtain permits, reach customers, and sustain repayment. A public dataset becomes generative when users have the skills, computational infrastructure, legal permission, and institutional incentives required to employ it.

A school meal programme can affect educational participation through household budgets, health, attendance routines, and parental expectations. The intervention therefore passes through a configuration of relations whose structure conditions the realized effect.

Mediation can also redirect or neutralize an intervention. A subsidy intended for tenants can be partly captured through rent increases. A wage increase can produce limited household security when debt obligations absorb the gain. New infrastructure can intensify land speculation and displace the population whose mobility it was intended to improve. These outcomes do not imply that the allocation itself is analytically irrelevant. They show that its effect is co-produced by the relations through which it travels.

GRE therefore distinguishes administrative recipient from relational incidence. The person or organization named in a programme may be only one node in a larger set of affected relations. Suppliers, creditors, family members, competitors, property owners, workers, public institutions, ecosystems, or future participants can experience consequential effects. The boundary of relevant incidence should follow the mechanism under investigation rather than the accounting category alone.

Relational mediation also includes interpretation. Economic subjects respond to signals through historically and institutionally formed meanings. A tax incentive can be interpreted as temporary or durable. A guarantee can change perceived risk. A government purchase can signal future market demand. A platform rule can alter expectations about visibility and participation. Such interpretive mediation affects behavior without requiring that every actor hold the same belief.

The analytical task is to identify which relations materially condition the pathway from intervention to effect. GRE does not require exhaustive mapping of an entire social world. It requires enough relational specification to explain why the intervention produced the observed or anticipated consequences and why those consequences differ across subjects, sites, or periods.

3.7.3 Generation

Relational mediation can produce new capacities, resources, meanings, institutions, practices, identities, expectations, and forms of value. GRE uses *generation* for this productive moment. Generation concerns the emergence or augmentation of economically relevant possibilities through a relation or configuration. The generated object may be material, symbolic, institutional, ecological, epistemic, or relational. Its significance lies in the fact that later action becomes possible, easier, harder, or differently organized because the configuration has changed.

Production and generation overlap in many cases, yet their analytical emphases differ. Production commonly directs attention toward an output: goods, services, income, knowledge, or measurable performance. Generative analysis asks what further capacities and conditions are created in producing, using, distributing, or maintaining those outputs. A training programme produces instruction and credentials; it can also generate professional networks, self-confidence, recognized status, organizational routines, and future learning capacity. A transport project produces mobility services; it can generate new patterns of settlement, commercial access, land valua-

tion, and ecological pressure. A cooperative produces goods or services while potentially generating shared governance capability and durable norms of reciprocity.

Generation can occur without an intended designer. Repeated market exchange can generate conventions. Repeated platform participation can generate data and reputational histories. Shared exposure to risk can generate mutual-aid institutions. Competitive pressure can generate organizational routines or technological standards. Conversely, deliberate interventions can fail to generate the capacities they target because the necessary relational conditions are absent.

Generated outcomes are frequently distributed unevenly. A technology can generate organizational productivity while reducing the bargaining power or skill development of particular workers. A financial instrument can generate liquidity for one group while creating systemic exposure elsewhere. Public infrastructure can generate collective access while simultaneously generating private land rents. The generative question therefore includes the location and distribution of newly created capacities and constraints.

A GRE analysis should identify the mechanism through which generation occurs. The presence of a later capacity after an intervention does not establish that the intervention generated it. Competing pathways, background trends, selection effects, and independent causes remain relevant. Historical, qualitative, quantitative, comparative, causal, formal, and computational methods can each contribute depending on the problem. Generative language becomes analytically useful when it sharpens mechanism and temporal structure rather than merely redescribing change.

Generation also includes the production of constraints. Debt can generate purchasing capacity and repayment obligations. Digital infrastructure can generate access and dependency. Standardization can generate interoperability and exclusion of incompatible practices. Institutional recognition can generate rights and categories that narrow alternative forms of identity. GRE therefore treats generativity as directionally open: what is generated may expand, stabilize, redirect, or constrain future possibility.

3.7.4 Propagation

Generated effects can move beyond the relations in which they first appear. Propagation concerns the transmission, diffusion, amplification, attenuation, or replication of resources, capacities, constraints, meanings, and forms of value through a wider relational configuration. It extends the analysis from local generation to the pathways through which generated effects become consequential elsewhere.

Propagation can occur through exchange, learning, imitation, network contact, infrastructure, standards, prices, legal precedent, organizational replication, migration, ecological flows, media, or technical interoperability. A skill acquired within one workplace may spread through labor mobility. A protocol developed by one organization may become an industry standard. A reputation produced in one network may affect credit access in another. An innovation can diffuse through suppliers and competitors. Pollution can propagate across ecological and jurisdictional boundaries.

The structure of the pathway matters. Dense networks can accelerate some forms

of diffusion while creating redundancy. Centralized networks can enable rapid dissemination while producing bottlenecks or concentrated control. Institutional filters can privilege particular carriers and suppress others. Spatial distance can be reduced by digital infrastructure for information while remaining decisive for housing, care, logistics, or ecological impact. A GRE account therefore asks through which relations the effect propagates and how topology, access, and institutional authority condition that movement.

Propagation is also selective. An intervention that generates knowledge may propagate technical information more easily than tacit practice. Monetary gains may cross organizational boundaries through payments while trust remains locally embedded. Recognition can travel across institutions only when credentials or reputational signals are mutually accepted. Ecological damage can propagate physically even when financial liability does not. The form of what moves and the medium through which it moves should therefore be distinguished.

Amplification and attenuation are important possibilities. A small innovation can become economically large when network effects, complementary investment, or standardization amplify adoption. A substantial local intervention can dissipate as effects pass through weak or incompatible connections. The magnitude observed at the origin gives limited information about the magnitude realized elsewhere.

GRE also considers the distribution of access to propagation pathways. Actors positioned at interfaces, platforms, logistics hubs, standards bodies, financial intermediaries, or institutional gateways can influence what travels and under which terms. Propagation can therefore become a source of power as well as a mechanism of diffusion. The relevant inquiry concerns the relational architecture through which generated effects acquire reach.

3.7.5 Conversion

Propagation frequently encounters interfaces at which one form of resource or value is translated into another. Conversion concerns these transformations among forms. Income can become education, housing security, political access, or health. Knowledge can become credentials, intellectual property, technical standards, or market advantage. Attention can become advertising revenue. Reputation can become creditworthiness. Land can become collateral. Ecological capacity can become commodity output, while financial resources can sometimes become restoration capacity.

Conversion differs from movement within a single form. A payment transferred between accounts remains monetary propagation. A credential used to obtain employment converts recognized educational achievement into labor-market access. A public research result licensed into proprietary technology passes through an institutional conversion interface that changes the rights and forms through which its value can be realized. The distinction helps identify where commensuration, authorization, pricing, certification, or institutional recognition becomes necessary.

Conversion interfaces are rarely neutral. Actors differ in their ability to define categories, establish equivalence, set prices, issue credentials, certify quality, recognize claims, or deny access. A bank decides which assets count as acceptable collateral. A university determines which learning qualifies for a degree. A platform determines

which forms of attention can be monetized and by whom. A legal system determines which interests can become enforceable rights. Control over conversion can therefore become a source of economic power.

Conversions can be partial or lossy. Rich forms of knowledge can be reduced to a credential or score. Ecological complexity can be translated into a carbon metric. Care can be monetized without preserving every relational quality attached to unpaid care. Standardization may sacrifice contextual detail while enabling interoperability across institutions. GRE therefore keeps the source form and converted form analytically distinguishable and asks what information, capacity, meaning, or control is gained or lost in translation.

Conversion can also generate additional value. A technical standard can make separate systems interoperable. A recognized qualification can enable geographic mobility. Monetization can permit resources to be exchanged across otherwise disconnected contexts. Legal incorporation can allow a collective project to contract, borrow, or hold assets. The normative significance of conversion depends on the terms, distribution, reversibility, and consequences of the transformation rather than on conversion as such.

Because heterogeneous values may resist full commensuration, GRE does not assume a universal conversion metric. Some forms may be partially convertible, institutionally incomparable, or normatively protected from exchange. The analytical task is to identify the interface, the actors who govern it, the terms under which conversion occurs, and the effects of repeated conversion on both the source and destination forms.

3.7.6 Recirculation

Generated and converted value can return to the relations and capacities that helped produce it. Recirculation concerns this return and the possibility that an economic configuration reproduces or expands its own generative conditions through the value it creates. Recirculation provides a bridge from one-time effects to recurrent economic dynamics.

A firm may reinvest earnings in productive equipment, worker training, research, or supplier development. A cooperative may return surplus to shared infrastructure. A university may use research income to support laboratories and students who enable later research. A community institution may reinvest revenue in local services and networks. Trust produced through successful collaboration can reduce the cost of subsequent collaboration. In each case, an output contributes to the maintenance or enlargement of a condition that supports later generation.

Recirculation is broader than financial reinvestment. Knowledge can return through teaching and mentorship. Institutional capacity can return through improved procedures. Ecological value can return through restoration. Recognition can return through strengthened membership and participation. Data generated by users can be used to improve a service that then attracts further users. The relevant object is the pathway by which generated value reconnects to a generative configuration.

The rate, distribution, and governance of return matter. An organization can generate large value while returning little to the workers, communities, infrastructures, or ecosystems that sustain it. Another can deliberately allocate returns to maintain those conditions. The existence of some recirculation does not by itself establish sufficiency or justice. A system can remain self-reinforcing while distributing benefits unequally or depleting unmeasured conditions outside its accounting boundary.

Recirculation can create positive feedback. Additional capability increases later generation, which supplies further resources for capability formation. Such loops can support cumulative development, institutional persistence, or technological lock-in. Their effects depend on the underlying configuration. A virtuous cycle for one group can become an exclusionary barrier for another when access to the loop is restricted. Self-reinforcement is therefore a dynamical property to be analyzed separately from normative desirability.

GRE uses recirculation to ask whether generated value contributes to the reproduction of the capacities and relations on which future generation depends. This question is especially important where conventional accounts register output or profit while leaving maintenance, care, learning, ecological renewal, and institutional reproduction analytically peripheral.

3.7.7 Dissipation and Extraction

Generated value does not necessarily return to its generative configuration. Some of it dissipates through depreciation, obsolescence, friction, neglect, entropy, institutional turnover, loss of trust, or ecological degradation. Some is extracted by actors positioned to appropriate value without proportionately sustaining the conditions from which it arises. GRE treats dissipation and extraction as distinct pathways because their mechanisms and policy implications differ.

Dissipation can occur without an appropriating beneficiary. Infrastructure decays when maintenance is deferred. Skills weaken when unused. Organizational memory disappears through turnover. Trust erodes after repeated coordination failures. Ecological capacity can decline through cumulative pressure. Data lose relevance. Knowledge becomes obsolete. These processes imply that the maintenance of a generative configuration often requires recurrent inputs rather than a one-time investment.

Extraction involves a relational mechanism of capture. Rent can be appropriated because ownership or control over a bottleneck allows an actor to claim part of the value generated elsewhere. A platform can capture value from user activity through control of infrastructure and monetization interfaces. A financial arrangement can transfer returns away from productive reinvestment. A firm can rely on public education, care work, or ecological capacity while externalizing part of the cost of reproducing those conditions. The analytical claim requires evidence of the pathway through which value is captured and of its relation to the generative configuration.

Unequal distribution alone does not establish extraction. A participant can receive a large return because it supplies scarce capital, bears risk, contributes specialized knowledge, or performs coordination. GRE therefore asks what relation supports the claim, what alternative arrangements are feasible, whether the captured value weak-

ens or sustains the source configuration, and how bargaining power and institutional rights shape the terms of appropriation.

Dissipation and extraction can interact. Deferred maintenance can make an organization dependent on external financing, which can increase opportunities for future extraction. Extractive arrangements can reduce resources available for training or ecological renewal, accelerating dissipation. Conversely, some forms of external appropriation can finance infrastructure that improves the source configuration. Mechanism and temporal sequence matter more than categorical labeling.

The analytical purpose is to account for where generated value goes. A process that appears productive at one accounting boundary may look fragile once maintenance requirements, externalized costs, and captured returns are traced over time. This wider accounting remains plural: GRE need not translate every dissipated or extracted form into money in order to analyze its economic significance.

3.7.8 Structural Transformation

Repeated allocations, mediations, generation, propagation, conversion, recirculation, dissipation, and extraction can alter the relational structure within which later economic action occurs. Structural transformation concerns changes in relatively persistent configurations of access, authority, dependency, coordination, classification, ownership, infrastructure, and institutional recognition. The analytical horizon therefore moves from flows through a structure to changes in the structure itself.

A credit programme can gradually create new financial histories that alter who is considered bankable. Platform adoption can reorganize market access and bargaining relationships. Public infrastructure can change settlement patterns and land values. Repeated outsourcing can transform organizational boundaries and labor relations. An educational expansion can change occupational competition and credential requirements. Long-term extraction can concentrate ownership sufficiently to reshape political and market power. These effects persist because the relations through which later actors operate have changed.

Structural transformation can be cumulative. Small changes in network access, standards, expectations, or institutional categories may become mutually reinforcing. Once a technical standard reaches broad adoption, complementary investments increase switching costs. Once a legal category becomes embedded in administrative systems, data structures, and organizational routines, later decisions may reproduce it. Such persistence does not imply irreversibility, yet reversal can require interventions different in kind from those that produced the initial change.

Structure is scale-relative. A transformation that appears structural for a household may be local from the perspective of a national economy. A regulatory change can be structural for an industry while leaving broader institutional arrangements intact. GRE therefore specifies the scale and boundary at which structural transformation is claimed. The term should signal a change in the organization of relations relevant to the inquiry rather than function as a synonym for any large effect.

Structural transformation can redistribute generative capacity. New infrastructure can enable some actors to participate while making others dependent on cen-

tralized systems. Consolidation can create investment capacity and reduce diversity of organizational forms. A new property regime can make resources legible and tradable while displacing customary claims. GRE asks how the changed structure reorganizes the possibilities available to different subjects and which later pathways become easier, harder, visible, or inaccessible.

At this stage, the analytical perspective begins to become recursive. Structures mediate later allocations and generation, while those processes can further transform structure. The economy is therefore approached as historically layered: present relations carry residues of earlier allocations, conversions, institutions, conflicts, and generative cycles.

3.7.9 Transformation of Generative Conditions

Structural change becomes especially significant when it alters the conditions that make later generation possible. Generative conditions include capacities, infrastructures, ecological resources, legal permissions, institutional trust, knowledge bases, standards, networks, interpretive categories, and other background arrangements through which new economic possibilities can emerge. Transformation of generative conditions concerns changes in this enabling and constraining environment.

The distinction between generated output and generative condition is temporal and relational. A research project can produce a paper as an output while training researchers who become a condition for later inquiry. A transportation system can provide current mobility while also changing the accessibility structure through which future firms and households choose locations. A legal reform can resolve a present dispute while changing the institutional expectations that shape later contracting. Restoration can generate present employment and rebuild ecological capacity that supports future livelihoods.

Conditions can become more or less diverse. An economy can accumulate specialized capabilities that deepen productive potential within one technological trajectory while reducing adaptability to alternative trajectories. Standardization can create broad interoperability while narrowing variation. Concentrated infrastructure can generate scale economies while increasing dependency on a small number of providers. GRE therefore examines the composition of generative capacity, including redundancy, diversity, reversibility, and dependence.

Generative conditions are distributed. The capacity to innovate may depend on public education, care systems, research institutions, finance, standards, migration regimes, energy infrastructure, social trust, and ecological stability. No single actor needs to own these conditions for them to shape economic possibility. This distributed character makes attribution and governance difficult: benefits may be privatized while maintenance costs remain collective, or collective institutions may fail to recognize contributions occurring outside formal accounting systems.

Changes in generative conditions can also alter who counts as an economic subject. Digital identity systems can enable participation for some subjects and exclude others. New organizational forms can recognize collective actors. Artificial systems can acquire delegated decision capacities that change the distribution of agency in markets and institutions. Educational and technical infrastructures can transform

the capacities through which persons become able to participate in particular forms of production or exchange. These questions prepare the more focused treatment of economic subjecthood in the following section, while the present subsection keeps attention on the background conditions through which such subject positions become possible.

The GRE perspective therefore evaluates interventions partly by their effects on future generativity. Immediate welfare or output remains important, yet an intervention can also be assessed by whether it expands, concentrates, diversifies, depletes, or forecloses the conditions from which later value and action can emerge. Such evaluation requires an explicit temporal horizon and awareness that future uses cannot be fully specified in advance.

3.7.10 Transformation of the Effective Rule of Change

The deepest analytical extension concerns situations in which economic processes transform the effective rule through which subsequent change occurs. A structural configuration can change while the basic mechanisms governing adjustment remain similar. In other cases, the mechanisms themselves are reorganized: new institutions redefine permissible transactions, technologies create new categories of action, collective learning changes how actors respond, platforms redesign market matching, legal reforms alter rights and enforcement, or artificial systems introduce new forms of automated selection and adaptation. GRE treats such cases as transformations of the effective rule of change.

The phrase *effective rule* is deliberately modest. It does not imply that an economy possesses one literal master equation. It refers to the locally relevant mechanisms, institutional procedures, response functions, selection environments, and constraints through which changes in the studied configuration are produced. Different methods can represent these rules differently. A historian may reconstruct them through institutional sequences, an economist through behavioral or equilibrium relations, a network analyst through evolving topology, an ethnographer through changing practices, and a computational model through explicit update procedures.

Rule transformation occurs when later dynamics cannot be adequately described by holding those mechanisms fixed. A market governed by bilateral bargaining can become a platform-mediated market in which ranking algorithms and platform rules shape matching and price formation. A monetary system can acquire new instruments that change transmission mechanisms. A labor process can move from human supervision to algorithmic allocation, altering how performance is measured and how workers adapt. A regulatory reform can change the criteria through which organizations become eligible, compliant, or sanctionable. The later system is connected historically to the earlier one while operating through modified mechanisms.

Rule transformation is especially important under reflexivity. Economic subjects learn, anticipate policies, reinterpret categories, and adapt to models used to govern them. Institutions respond to observed behavior. Firms redesign strategies when competitors imitate them. Regulators revise rules when existing rules generate unintended effects. The object of analysis can therefore react to the representations and interventions applied to it. A stable rule may remain a useful local approximation, yet

GRE keeps open the possibility that repeated interaction changes the mechanisms on which the approximation depended.

The transformation of effective rules also raises a governance problem. Interventions can influence more than outcomes within a given system; they can shape the procedures through which future outcomes will be produced. A procurement rule can determine which organizational forms survive long enough to compete later. A data standard can define what becomes measurable and therefore governable. Intellectual-property rules can influence the future distribution of innovation incentives and knowledge access. Educational assessment can alter what institutions teach and what learners treat as valuable. These interventions operate partly at the level of the future change process itself.

This final analytical moment does not make every economic change a case of rule transformation. The claim requires evidence that the mechanisms generating later transitions have materially changed. Maintaining this threshold preserves the distinction among movement within a structure, transformation of structure, transformation of generative conditions, and transformation of the effective rule of change.

Taken together, the ten moments of the GRE perspective provide a layered way to follow economic action through time and relation. Allocation identifies an initial placement of resources, rights, burdens, or attention. Relational mediation specifies the configuration through which that placement becomes operative. Generation identifies newly produced capacities, constraints, values, subjects, or possibilities. Propagation follows their movement; conversion follows changes of form; recirculation follows return to generative configurations; dissipation and extraction account for loss and capture. Structural transformation asks how persistent relations are reorganized. Transformation of generative conditions asks how the capacity for later generation changes. Transformation of the effective rule of change asks whether the mechanisms producing future transitions have themselves been altered.

The sequence remains a heuristic research architecture. Empirical cases can contain loops, branching pathways, simultaneous processes, and multiple scales whose temporal order is only partially recoverable. GRE's distinctive perspective lies in making these layers available for explicit inquiry while preserving the possibility that a narrower established economic analysis may be sufficient for a particular question. The next section turns from this analytical architecture to one of its most consequential objects: the economic subject itself, whose identity, recognition, capacities, and persistence can be treated as historically and relationally generated rather than analytically fixed in advance.

3.8 GRE and the Economic Subject

Generative Relational Economics (GRE) requires a conception of the economic subject that is sufficiently stable for analysis and sufficiently open to account for historical transformation. The role of this section is to specify that conception after the preceding sections have established GRE's objects, scales, problem families, and distinctive analytical sequence. Its objective is to explain how persons, organizations, artificial systems, and other configurations can occupy economically consequential sub-

ject positions without assuming that subjecthood is a timeless property given prior to economic relations. The discussion proceeds through eight connected problems: the movement from given agents to relationally situated subjects; institutional recognition; relational persistence; the coexistence of human and artificial economic subjects; heterogeneity among subjects; capability asymmetry and ontological distinction; participation under conditions in which productive necessity may decline; and subject formation itself as an economic process. The method is constitutive rather than taxonomic. GRE does not attempt to settle the metaphysics of personhood, consciousness, or agency. It specifies a working analytical conception of subjecthood adequate to economic inquiry while preserving ontological suspension and explicit normative separation.

Within this framework, an *economic subject* is a relatively stabilized locus of economically consequential participation that can be identified within a relational configuration. Such participation may include choosing, claiming, producing, consuming, owning, borrowing, contracting, coordinating, representing, interpreting, allocating, governing, bearing risk, receiving recognition, or being made answerable for an economic event. Different forms of subjecthood need not contain the same capacities. A human worker, a household, a corporation, a public agency, and an automated trading system can occupy very different kinds of economic subject position. Their inclusion within a common analytical vocabulary records their participation in economic relations; it does not establish metaphysical, experiential, juridical, or moral equivalence among them.

This distinction is especially important because economic theory often gains tractability by beginning with an already individuated agent. GRE can use such models when the research question warrants them, yet its broader programme keeps open the prior question of how the agent became recognizable, durable, capable, and economically situated. The economic subject can therefore be treated both as a participant in economic dynamics and as a possible product of those dynamics. Wage relations, property regimes, credit systems, organizational membership, legal classifications, technical infrastructures, educational institutions, platforms, and systems of representation can all help constitute which subjects exist for an economic process, what they can do, how they are recognized, and which futures become available to them.

3.8.1 From Given Agent to Relationally Situated Subject

A large class of economic models begins with agents whose identities, preferences, feasible actions, and relevant resources are specified before the modeled interaction begins. This abstraction can be highly productive. It makes possible clear analysis of choice, exchange, strategic interaction, allocation, and equilibrium. GRE retains these analytical resources while adding a complementary question: under which relations did the modeled agent become the kind of subject for whom those preferences, capacities, resources, and feasible actions are available?

The move from a given agent to a relationally situated subject changes the analytical starting point. A worker enters a labor market with skills formed through education, family relations, health, language, migration status, credentialing, and previous

employment. A firm enters a market through legal incorporation, ownership arrangements, financing, supplier relations, infrastructure, standards, and accumulated organizational routines. A consumer appears in a platform economy through accounts, payment systems, identity verification, recommendation systems, device access, and categories through which demand is represented. In each case, the subject remains a meaningful analytical unit, while its capacities and boundaries are understood as relationally conditioned.

Relational situatedness does not imply that a subject is reducible to its relations. GRE requires enough analytical independence to speak about a subject's actions, interests, experiences, holdings, or capabilities when those categories are warranted. The point is that such independence is historically and institutionally achieved to varying degrees. A property owner can act independently with respect to an asset because institutions stabilize ownership claims. A worker can negotiate because labor law, organizational rules, scarce skills, collective representation, or outside options provide a position from which negotiation is possible. A household can plan because some flows of income, care, residence, and obligation persist through time. Subjecthood therefore contains a relation between relative individuation and continuing dependence.

This approach also prevents agency from being treated as a single scalar quantity. A subject may possess substantial agency in one relation and little in another. A highly skilled employee may exercise considerable control over technical decisions while possessing limited bargaining power over employment conditions. A small firm may choose its product design while remaining strongly constrained by a dominant platform or creditor. A government agency may have formal authority but limited informational or implementation capacity. GRE therefore asks which dimensions of agency are operative, through which relations, and at which scale.

Relational situatedness further allows preferences and objectives to be historically formed without assuming that they are infinitely malleable. Education, advertising, professional communities, organizational cultures, social norms, technologies, and repeated interactions can affect what subjects attend to, expect, desire, or regard as feasible. A research programme can study these processes without denying that subjects also exhibit persistence, reflection, resistance, and internally organized commitments. GRE's analytical interest lies in the conditions through which orientation is formed and revised, a problem developed more directly in the following section on the orientation of generation.

The relationally situated subject therefore supplies an intermediate analytical position. It is more structured than an undifferentiated relational field because it permits attribution of action, capacity, burden, and value to relatively stabilized participants. It is more historically open than a permanently given agent because its boundaries, capacities, orientations, and recognized positions can themselves become objects of inquiry. This duality is central to GRE's treatment of subjecthood.

3.8.2 Subjecthood and Institutional Recognition

Economic subjecthood depends partly on recognition. Institutions specify who can open an account, hold property, enter a contract, receive a payment, owe a tax, reg-

ister a company, claim a benefit, represent an organization, access a market, or be counted within an administrative category. Recognition converts a potential participant into a legible participant for a particular institutional process. The resulting subject position can carry rights, obligations, expectations, records, and pathways for future action.

Recognition is distributed across institutions rather than concentrated in a single act. Legal systems recognize persons, organizations, property titles, and contractual capacities. Firms recognize employees, managers, vendors, customers, and authorized representatives. Financial institutions recognize account holders, borrowers, guarantors, and beneficial owners through their own procedures. Platforms recognize users, creators, advertisers, sellers, developers, and automated processes through technical accounts and permissions. Public programmes recognize beneficiaries through eligibility categories. Statistical systems recognize populations through classifications that subsequently shape policy and resource allocation.

These forms of recognition need not coincide. A participant can be economically active while remaining weakly represented in administrative data. A person can be recognized by one institution and excluded by another. An organization can exist juridically while possessing limited practical capacity to act. A platform account can exercise extensive economic functions while the relevant legal obligations remain assigned to a human or organizational principal. GRE therefore treats recognition as relation-specific. It asks who or what recognizes the subject, for which purpose, under which criteria, and with which consequences.

Institutional recognition can also generate capacities. Registration can permit access to banking, procurement, insurance, or legal enforcement. A professional credential can authorize entry into a labor market. A credit history can create or restrict borrowing possibilities. A platform reputation can affect visibility and transaction opportunities. Recognition is therefore more than descriptive classification. Under some conditions it becomes a productive resource whose possession changes future possibilities.

The converse process is economically consequential as well. Misrecognition, weak recognition, or exclusion from relevant categories can constrain participation even when material capacity exists. A skill that lacks accepted certification may command less value. Informal work can remain economically important while receiving limited legal protection or statistical visibility. Care activities can sustain productive systems while remaining weakly represented in monetary accounts. GRE can analyze these situations by separating material contribution, institutional recognition, representational visibility, and normative valuation rather than treating them as a single dimension.

Recognition also creates subject positions that may reshape conduct. A person classified as debtor, beneficiary, employee, high-risk customer, eligible applicant, or verified creator encounters a different opportunity structure and may respond to the expectations associated with that position. The category becomes economically generative when it affects access, incentives, treatment by others, or self-understanding. The same mechanism applies to organizations. Classification as a regulated institution, nonprofit entity, startup, contractor, or systemically significant actor can alter available strategies and obligations.

GRE therefore treats institutional recognition as one mechanism through which economic subjecthood becomes stabilized. It remains distinct from ultimate personhood or moral status. Institutional categories can be revised, contested, strategically used, or shown to be inadequate. Their analytical importance lies in the fact that economies operate through such acts of recognition, and those acts participate in generating the subjects that economic analysis subsequently encounters.

3.8.3 Subjecthood and Relational Persistence

Recognition at one moment is insufficient for many economic processes. Credit, employment, ownership, reputation, insurance, investment, planning, responsibility, and cooperation depend on some capacity to identify a subject across time. GRE therefore treats relational persistence as another condition of economic subjecthood. Persistence means that a configuration can remain sufficiently identifiable across a sequence of interactions for expectations, records, obligations, capacities, and value to accumulate around it.

Persistence does not require immutability. A corporation can change employees, owners, strategies, and assets while remaining recognizable as the same juridical organization for relevant purposes. A household can change membership while retaining continuing obligations and resources. A person can change occupation, preferences, health, wealth, and social position while maintaining biographical and institutional continuity. An artificial system can be updated or retrained while an operational identity, account, mandate, or deployment context persists. Subjecthood therefore depends on criteria of continuity that vary by domain.

Different institutions stabilize continuity through different devices. Names, identifiers, contracts, registries, records, credentials, accounts, signatures, organizational charts, audit trails, reputational histories, and technical logs can all support persistence. These devices allow past interactions to influence present treatment. They make possible credit histories, employment records, accumulated reputation, continuing ownership, delegated authority, and accountability. In this sense, memory is partly institutionalized in economic relations.

Persistence has generative consequences because accumulated history changes future opportunities. Trust can deepen through repeated cooperation. Debt can compound. Reputation can open or close markets. Skills can accumulate through practice. Organizational routines can increase coordination capacity. A history of exclusion can constrain later access even when formal rules change. Economic subjecthood therefore has a temporal dimension: the subject is often a carrier of selectively preserved history.

The preservation is always partial. Institutions decide which past events remain legible and which disappear. Credit systems preserve some payment histories while ignoring many contextual circumstances. Employment records preserve formal roles while omitting informal contribution. Platform metrics preserve selected traces of participation. Historical records may be unequally available across groups and organizations. GRE therefore treats persistence as an epistemic and institutional construction as well as a temporal fact. The subject that appears stable to an analyst may be stabilized by selective recording.

Relational persistence can also fail. Organizations dissolve, identities become contested, records disappear, contractual relations end, platforms remove accounts, or political and technological transformations invalidate previous classifications. Such failures can release subjects from prior constraints, erase accumulated value, disrupt responsibility, or create opportunities for reconstitution. Subject dissolution is therefore part of the economic analysis of subjecthood rather than a mere exception to stable identity.

This temporal view enables GRE to analyze subject formation without assuming a permanent core that economic relations simply reveal. A subject can become more or less coherent, legible, capable, autonomous, or constrained through time. The relevant question is which mechanisms sustain continuity, what they preserve, what they suppress, and how persistence alters the subject's future generative possibilities.

3.8.4 Human and Artificial Economic Subjects

The increasing delegation of economically consequential tasks to artificial systems makes the category of economic subject more complex. Software already performs functions such as ranking, pricing, matching, forecasting, bidding, recommending, filtering, scheduling, allocating attention, and executing transactions under specified conditions. More capable artificial systems can also participate in extended sequences of planning, communication, and decision support. GRE requires a vocabulary that can analyze such participation without presuming that functional capability settles questions of consciousness, personhood, moral standing, or legal status.

A useful distinction is between *human subjecthood* and *artificial operational subjecthood*. Human economic subjects are embodied, vulnerable, temporally finite participants whose economic lives are connected to experience, welfare, social membership, care, rights, and material dependence. Artificial operational subjects can occupy functionally stabilized positions in economic processes when systems are authorized, configured, or institutionally treated as loci through which actions are selected and executed. Their economic relevance can be substantial even when ultimate responsibility, ownership, or legal personality remains assigned elsewhere.

Operational subjecthood can arise through delegation. An organization may authorize a software system to execute trades within limits, set prices, route logistics, select advertisements, or communicate with customers. The system then becomes a proximate locus of economically consequential action. The relevant GRE questions concern the relations that enable this delegated position: who defines the objective, who supplies data, who controls deployment, who bears losses, who can override the system, how actions are attributed, and how generated value returns to the surrounding organization.

This approach avoids a binary choice between treating artificial systems as mere passive tools and treating them as equivalents of human persons. The appropriate analytical status can vary with the inquiry. For a study of market microstructure, an automated trading agent may be a meaningful economic subject because its decisions affect prices and counterparties. For a study of moral injury, welfare, or distributive justice, the same system may be better analyzed as infrastructure or delegated mechanism while the human and organizational subjects bearing consequences remain

central. Subject classification is therefore question-relative.

Artificial systems can also become components of hybrid subjects. A professional using advanced decision support may acquire capacities unavailable to either the human or the system considered independently. A firm can reorganize around automated coordination. A scientific team can distribute cognitive work across researchers, instruments, databases, and models. A platform can combine algorithms, human moderators, sellers, and users into an operational configuration. GRE can treat such configurations as composite subjects when the composite exhibits sufficient persistence, coordination, and causal relevance for the local question.

The distribution of agency within hybrid configurations is a separate problem from identifying the composite. Delegation can obscure responsibility when an outcome is attributed to "the algorithm" despite organizational choices concerning data, objectives, thresholds, deployment, monitoring, and recourse. Conversely, attributing every artificial action directly to one human decision-maker can ignore emergent behavior, organizational fragmentation, and the practical autonomy created by scale and speed. GRE therefore encourages mechanism-specific attribution across the relations that produce the action.

The coexistence of human and artificial economic subjects also changes the ecology of capability. Artificial systems can amplify the productive and cognitive capacity of some human or organizational subjects more than others. Access to compute, proprietary data, infrastructure, legal expertise, capital, and distribution can determine who benefits from artificial capability. The economic significance of artificial subjecthood consequently lies not only in what a system can do, but in how its capability is situated within ownership, institutional recognition, delegation, and return structures.

3.8.5 Heterogeneous Subjects

GRE treats heterogeneity among economic subjects as a constitutive feature of inquiry rather than a residual deviation from a representative agent. Subjects can differ in material needs, bodily vulnerability, temporal horizon, information, attention, cognitive style, social recognition, bargaining position, legal status, technological access, organizational scale, ecological dependence, and forms of value they regard as significant. These differences shape both immediate economic behavior and the generative consequences of economic relations.

Heterogeneity matters even when subjects receive formally identical resources. A monetary transfer can have different effects depending on debt, housing security, health, care obligations, local prices, social networks, or access to complementary services. The same information can be useful to one subject and unusable to another because complementary knowledge or infrastructure differs. The same employment opportunity can expand freedom for one person and intensify constraint for another because mobility, care responsibilities, or legal status differ. GRE therefore asks how an intervention interacts with subject-specific and relation-specific conditions.

Heterogeneity also concerns value. Subjects can evaluate the same outcome through different normative, cultural, professional, ecological, or experiential frameworks. A land-use change may appear as increased asset value to one actor, loss of

livelihood to another, ecological degradation to a third, and disruption of cultural continuity to a fourth. Economic analysis can sometimes translate these differences into a common measure for a specific decision. GRE does not assume in advance that every relevant value admits such conversion without remainder.

Subjects also differ in their capacity to make their valuations institutionally consequential. Some can purchase expertise, influence standards, control platforms, set contractual terms, or withdraw resources. Others possess weak bargaining power or limited representational access. Heterogeneity therefore interacts with asymmetry. A plural economy does not merely contain different preferences; it contains differently empowered subjects whose ability to stabilize their preferred classifications, metrics, and conversion rules can vary substantially.

Artificial and organizational subjects add further dimensions of heterogeneity. A corporation can persist for durations and command resources unavailable to an individual. An automated system can process information at a speed and scale that differs from human cognition. A public institution can exercise authority through rules rather than exchange. A household coordinates care and consumption through relations that are only partially contractual. Treating these subjects as analytically identical would conceal the mechanisms through which they act.

GRE's response is methodological pluralism at the level of subject modeling. Some questions can use utility functions, representative agents, or homogeneous populations. Others require types, distributions, networks, institutional categories, narratives, or qualitative reconstruction. The choice should follow the mechanism and scale of interest. Heterogeneity becomes analytically important when differences among subjects alter generation, propagation, conversion, bargaining, recognition, or exposure to risk.

This perspective also protects against interpreting difference as deficiency. A subject whose capacities do not match the requirements of a particular market or institution may still possess substantial capabilities that the institution does not recognize or reward. Economic subjecthood is therefore partly relational to the evaluative and infrastructural environment. The same person or organization can appear highly capable in one configuration and weakly capable in another. GRE analyzes that relational fit rather than converting every difference into a single hierarchy of subject quality.

3.8.6 Capability Asymmetry and Ontological Distinction

Economic subjects can differ enormously in capability. A multinational firm and an individual consumer do not command comparable resources. A state and a household occupy different institutional positions. A specialized artificial system can outperform a human participant on a bounded computational task while lacking many features that organize human economic life. GRE therefore separates capability comparison from ontological classification and from normative status.

Capability is multidimensional. It can concern computation, memory, prediction, physical action, social coordination, capital access, legal authority, mobility, learning, creativity, endurance, attention, bargaining, or the capacity to absorb loss. A subject can be strong on one dimension and weak on another. Aggregate labels such as "more

capable" therefore require explicit specification of the relevant capability domain and the task or environment in which it is measured.

The distinction becomes especially important in human–artificial comparison. Superior performance by an artificial system on prediction, optimization, search, coding, or information processing demonstrates a capability difference in the specified domain. It does not by itself establish equivalence in embodiment, vulnerability, experience, social membership, moral standing, legal personality, or other ontological and normative dimensions. Conversely, inferior productive performance by a human subject does not imply diminished moral status or a weaker claim to social participation. Productive capability and normative worth belong to different analytical registers.

GRE therefore resists deriving subject status directly from productivity. Economies routinely assign value to capacities that are historically contingent: strength in one technological regime, literacy in another, credentialed expertise in another, computational skill in another. Technological change can rapidly alter which capacities command market value. If recognition or participation were tied directly to currently scarce productive capabilities, changes in technology could destabilize subject status in ethically and politically consequential ways. GRE treats that possibility as an object of economic analysis rather than as a normative conclusion supplied by productivity itself.

Capability asymmetry also generates power when it affects the terms under which others can participate. A platform with superior information and scale can shape market access. A creditor with greater liquidity can impose conditions on a constrained borrower. An organization equipped with advanced artificial systems can negotiate, monitor, or produce at a level unavailable to smaller actors. The relevant issue is the conversion of capability difference into durable relational advantage. Not every asymmetry becomes power, and the mechanism of conversion requires specification.

Institutional design can amplify or moderate capability asymmetry. Standards, interoperability, public infrastructure, collective bargaining, competition rules, education, access to compute, liability arrangements, and rights of appeal can change how capability differences affect participation. GRE's interest lies in the resulting generative structure: which subjects gain new capacities, which become dependent, which forms of value are captured, and whether the asymmetry reproduces itself through control over the conditions of future generation.

The separation among capability, ontology, and normativity thus performs several analytical functions. It permits precise comparison where comparison is meaningful. It prevents performance metrics from silently becoming theories of personhood. It allows economic analysis to study artificial subjects without assuming human equivalence. It also preserves a space in which questions of justice, rights, dignity, or welfare can be evaluated through appropriate normative arguments rather than inferred from market productivity.

3.8.7 Subjective Participation beyond Productive Necessity

Technological development raises a further question for the constitution of the economic subject: how is participation organized when a subject's contribution is no longer required for a particular productive task? Automation has long displaced and transformed tasks, while new technologies have also created new occupations, complementary roles, and forms of demand. GRE does not assume a predetermined endpoint of this process. It identifies a structural problem that becomes more visible as productive capability can be supplied by machines or highly concentrated organizations: economic participation and social subjecthood may become less tightly coupled to productive necessity.

Historically, many economic institutions connect income, recognition, schedule, social interaction, insurance, status, training, and future opportunity to employment or productive contribution. When a task disappears, the loss can therefore extend beyond wages. A subject can lose routines, networks, bargaining position, identity, institutional recognition, and pathways for capability development. Analyses that record only the change in output or income can miss this wider transformation of subject position.

GRE uses the idea of *subjective participation* to name participation through which a person or collective can remain an active locus of choice, recognition, relation, contribution, and value formation within economic life. Productive work can be one important form of such participation, but the category is broader. Care, learning, civic contribution, cultural production, scientific inquiry, community activity, consumption, stewardship, and relational maintenance can all organize economically consequential participation even when their market valuation is limited or indirect.

The economic question is therefore partly institutional. If productive necessity declines for some subjects, which mechanisms connect them to resources, capabilities, recognition, and opportunities for meaningful participation? Several institutional arrangements are conceivable, and GRE need not select among them at the level of disciplinary constitution. The research programme can instead examine how different arrangements affect autonomy, dependence, value generation, social recognition, bargaining power, capability development, and the distribution of future possibilities.

This problem also applies within organizations. An employee whose routine tasks are automated can become more capable when artificial tools release time for judgment, learning, care, design, or coordination. The same technological change can instead narrow the employee's role to monitoring a system controlled elsewhere. The distinction depends on ownership, training, discretion, workflow design, evaluation, and bargaining relations. Automation therefore transforms subjecthood through the surrounding institutional field rather than through task substitution alone.

Artificial systems intensify the question because they can participate in economic processes without requiring the same conditions for welfare, livelihood, social membership, or embodied reproduction as human subjects. A production system organized solely around output can therefore allocate increasingly large shares of economically consequential activity to artificial or organizational subjects while human participation becomes administratively residual. Whether and how institutions re-

spond is a normative and political question; the economic analysis concerns the relations through which such a configuration affects value, demand, bargaining, recognition, capability, and social reproduction.

GRE thus separates the right to analyze productive contribution from the broader question of subject participation. It does not assume that economic inclusion must be earned through scarcity of labor, nor does it presume a specific institutional alternative. It asks how systems generate or foreclose forms of participation when technological and organizational change modifies the economic necessity of particular human capacities. The answer will depend on the orientation of generation, the subject of the following section.

3.8.8 Subject Formation as an Economic Process

The preceding subsections imply a final constitutional claim: subject formation is itself an economic process. Economic relations do more than coordinate already formed subjects. They participate in producing the capacities, identities, expectations, dependencies, temporal horizons, and recognized positions through which subjects subsequently act. GRE therefore includes subject formation within its field of inquiry whenever economic mechanisms materially contribute to that formation.

Labor markets provide a clear illustration. Education and credentialing prepare subjects for occupational categories; hiring procedures classify them; employment develops some skills while allowing others to decay; organizational hierarchies distribute authority; compensation affects outside options; performance metrics orient attention; career ladders shape expectations about the future. The resulting worker is neither created wholly by the labor market nor independent of it. Subject formation occurs through the interaction of economic, educational, familial, legal, cultural, technological, and biological processes.

Credit relations can similarly generate debtor subject positions. Access to credit expands purchasing or investment capacity while repayment schedules reorganize future income. Credit histories affect later access. Default categories alter institutional treatment. Financial literacy, risk tolerance, and expectations can change through repeated borrowing. The economic subject that returns to a credit market is therefore historically modified by previous participation.

Platforms generate other subject forms through accounts, metrics, rankings, recommendation systems, monetization rules, and categories of permissible participation. A person can become a seller, creator, driver, host, advertiser, moderator, or rated customer through platform-specific infrastructures. These positions can create capabilities and income while also subjecting participants to new dependencies, forms of visibility, and evaluative systems. Artificial systems can likewise acquire operational subject positions through permissions, interfaces, memory, delegated objectives, and persistent identifiers.

Property institutions contribute to subject formation by stabilizing relations of control, responsibility, inheritance, exclusion, and expectation. Welfare institutions constitute beneficiary categories. Tax systems recognize households, firms, dependents, and taxable events. Corporate law stabilizes organizations that can persist beyond individual members. Monetary institutions constitute account holders and counter-

parties. Economic subjecthood therefore emerges repeatedly through institutional architectures that define who can do what, with which resources, under which records and obligations.

Subject formation also has recursive effects. Once a subject position is stabilized, subjects can act to preserve, reinterpret, contest, or transform the relations that formed them. Workers organize; firms lobby; consumers coordinate; professional groups set standards; communities create institutions; platform participants develop practices that alter platform design. Subject formation is therefore compatible with reflexivity. Generated subjects can become generators of subsequent institutional change.

This recursive structure connects subject analysis to GRE's broader concern with transformation of generative conditions. An economic system can generate subjects whose capacities and orientations reinforce the system. It can also generate subjects capable of questioning, modifying, or leaving it. Educational investment can create workers suited to an existing industrial structure while also producing knowledge that enables new industries. Financial systems can stabilize prevailing ownership while funding innovations that disrupt incumbent firms. Organizational routines can reproduce hierarchy while creating expertise that later supports institutional reform. The direction of subject formation is therefore neither mechanically reproductive nor inherently emancipatory.

For empirical work, treating subject formation as an economic process requires evidence appropriate to the mechanism. Administrative records can reveal changing classifications and access. Longitudinal data can track capability or income trajectories. Organizational records can show role transformation. Interviews and ethnography can recover changes in interpretation, identity, and perceived possibility. Experiments can identify bounded responses to institutional arrangements. Computational methods can trace large-scale patterns of classification or interaction. GRE does not privilege one method; it requires the method to match the dimension of subject formation being claimed.

The economic subject can now be located within the constitutional architecture of Chapter 3. GRE treats subjects as relatively stabilized participants whose capacities, recognition, persistence, and orientations are relationally conditioned and historically transformable. Human, organizational, and artificial subjects can all enter economic analysis while remaining ontologically and normatively distinct. Capability asymmetry can shape power without determining moral status. Participation can remain economically important even when particular productive contributions lose scarcity. Subject formation itself can be generated through economic relations and can recursively transform those relations in return.

This account also identifies the next constitutional problem. If economic relations help generate subjects, capacities, attention, and future possibilities, the direction of that generation cannot be treated as analytically empty. Economic systems select, reward, amplify, suppress, and stabilize different possibilities. Section 76 therefore turns from the constitution of subjects to the orientation of generation: the processes through which attention, curiosity, aesthetic judgment, epistemic priorities, institutional selection, and heterogeneous value structures influence what becomes economically generative.

3.9 GRE and the Orientation of Generation

Generative Relational Economics treats economic generation as more than the production of additional outputs from given inputs. Economic relations can enlarge, redirect, stabilize, or close future possibilities; they can generate capacities, questions, representations, institutions, expectations, forms of value, and modes of participation. Once generation is understood in this wider sense, a further analytical problem becomes unavoidable: generative processes are oriented. Among many possible objects of attention, questions, investments, designs, interpretations, and institutional trajectories, some become salient and others remain peripheral. The role of this section is to make that directional dimension explicit within the constitution of GRE. Its objective is to identify several mechanisms through which orientation is formed and economically consequential without reducing orientation to a single preference ordering or normative criterion. The discussion proceeds through attention and salience, curiosity and question formation, aesthetic judgment, epistemic orientation, institutional selection, and heterogeneous value structures before locating orientation itself as an economic and political problem. The method remains constitutive rather than exhaustive: these mechanisms identify admissible objects of GRE inquiry and can be combined differently across empirical domains.

Orientation occupies a position between possibility and realized generation. A field can contain several technically feasible innovations, several plausible interpretations of evidence, several ways of organizing care, several institutional reforms, or several investments capable of producing future value. Generativity alone does not determine which possibility receives resources, recognition, attention, or continued development. Selection occurs through subjects, organizations, infrastructures, norms, evaluative conventions, histories, and unequal capacities to make one possibility visible or actionable. GRE therefore asks not only what a relation can generate, but how its generative direction becomes selected, reinforced, contested, or revised.

This problem is distinct from saying that every economic process possesses a conscious purpose. Orientation can arise without centralized intention. Search rankings alter attention; funding rules privilege some questions; professional conventions stabilize standards of relevance; prices redirect investment; built environments make some actions easier than others; inherited categories determine what can be recorded; and repeated interaction can make one trajectory increasingly probable. Orientation can therefore be intentional, institutional, distributed, emergent, or mixed. What matters for GRE is the mechanism through which a space of possibilities becomes unevenly weighted and how that weighting changes subsequent generation.

3.9.1 Direction within Generative Processes

Generation becomes analytically directional whenever several possible continuations are available and the realized process favors some over others. A research group can investigate several questions but allocates effort to a subset. A firm can deploy capital across several technologies but selects particular projects. A city can support several mobility arrangements but builds infrastructure that makes some

trajectories easier to reproduce. A household can convert additional income into consumption, education, savings, care, mobility, or debt reduction. In each case, resources enter a relational configuration whose later consequences depend partly on how possibilities are selected.

Direction should be distinguished from destination. A destination specifies an endpoint toward which activity is explicitly organized. Direction can be weaker and more distributed. It can consist in a persistent bias toward particular questions, objects, timescales, values, or forms of recognition even when no actor has specified a final state. An institution that rewards measurable short-term outputs may orient inquiry toward easily countable achievements without formally prohibiting long-horizon research. A credit system can orient firms toward revenue models compatible with repayment schedules without prescribing a specific product. A platform can orient cultural production through visibility metrics even when creators retain formal freedom over content. GRE is interested in these directional effects because they alter the future distribution of generative opportunity.

Orientation should also be distinguished from deterministic selection. A strong directional field can coexist with novelty, resistance, and contingency. Subjects can reinterpret incentives, institutions can be repurposed, and unexpected relations can open alternatives. The analytical claim is therefore probabilistic and structural: some configurations make particular generative pathways easier to enter, sustain, fund, legitimate, or recognize than others. The strength of orientation is an empirical question that can vary across scales and historical periods.

The concept also permits several levels of analysis. At the level of a subject, orientation can concern attention, aspiration, perceived possibility, or evaluative judgment. At the organizational level, it can concern strategy, metrics, hiring, budgeting, and project selection. At the institutional level, it can concern law, professional standards, eligibility rules, and classification systems. At the infrastructural level, it can concern access, interoperability, search, transportation, or computation. At the cultural level, it can concern what appears admirable, credible, urgent, or worth pursuing. These levels can reinforce or conflict with one another.

Direction becomes especially consequential when orientation feeds back into the conditions of future choice. A selected research programme develops specialized instruments and expertise, making adjacent questions easier to investigate. An industry cluster attracts suppliers and workers, increasing the relative feasibility of further investment in the same domain. A classification adopted for administrative convenience can accumulate datasets organized around its categories, making alternative classifications harder to operationalize. What begins as selection among possibilities can therefore become a transformation of the possibility structure itself.

GRE treats this recursive effect as one reason to study orientation separately from immediate allocation. Allocation determines where resources initially go. Orientation concerns the relational processes that make some uses, interpretations, and continuations more likely to become generative. Their interaction can produce path dependence without requiring that the path was planned in advance. Orientation is thus a bridge between local selection and historical transformation.

3.9.2 Attention and Salience

Attention is a scarce and selective condition of economic participation. Subjects, organizations, and institutions encounter more signals, opportunities, demands, and possible actions than they can process with equal intensity. What enters attention can therefore influence what becomes available for evaluation and generation. GRE treats attention not simply as an internal cognitive resource but as relationally organized through environments, interfaces, institutions, social expectations, and distributions of visibility.

Salience is one mechanism through which this organization occurs. An object can become salient because it is perceptually striking, institutionally emphasized, repeatedly measured, socially endorsed, economically rewarded, emotionally charged, or strategically amplified. Salience need not indicate importance in any independent normative or causal sense. A highly visible indicator can dominate decision making while a less visible condition exerts larger long-term effects. Conversely, a previously neglected relation can become salient when a crisis, measurement innovation, public controversy, or new interpretive framework makes it perceptible as an economic problem.

The economic consequences of salience are therefore twofold. First, salience affects allocation of attention in the present. A firm monitors some indicators more closely than others; an investor notices some opportunities; a public agency prioritizes some risks; a consumer sees some products; a researcher encounters some literatures. Second, repeated attention can alter the object itself. Metrics invite optimization, visibility attracts resources, and recognized problems acquire organizations, professions, and infrastructures devoted to them. Attention can consequently become generative rather than merely observational.

Digital mediation intensifies this issue because ranking, recommendation, notification, and search systems actively order visibility. Their orientation effects may arise from commercial objectives, relevance models, engagement metrics, moderation rules, personalization, or technical constraints. The resulting distribution of attention can affect demand, reputation, cultural production, political communication, and the formation of economic subjects. GRE need not assume that a platform fully controls these outcomes. It can instead ask which mechanisms structure exposure, how users respond, and how visibility feeds back into production and value.

Attention also interacts with inequality. Subjects differ in their capacity to command attention and in their ability to protect their own attention from external capture. Advertising budgets, institutional prestige, network centrality, media access, and control over interfaces can increase one actor's capacity to make objects salient to others. At the same time, workers, consumers, citizens, and researchers can face environments saturated with demands on attention. The distribution of attention therefore has both productive and power dimensions.

A GRE analysis should avoid equating attention with endorsement. A subject may attend to an object because it is threatening, unavoidable, controversial, or institutionally mandatory. Nor should measured engagement be treated as a complete representation of attention. Observable clicks, purchases, dwell time, or citations are partial indicators conditioned by the platform or institution through which they are

recorded. The relation between salience, attention, interpretation, and later action requires empirical specification.

Attention becomes a problem of orientation when it changes which possibilities can enter generative processes. What remains persistently unseen may receive neither investment nor institutional articulation. What becomes hyper-salient can attract disproportionate resources and narrow alternative exploration. GRE therefore studies the production and distribution of salience as part of the economic organization of possibility.

3.9.3 Curiosity and Question Formation

Curiosity introduces a different form of orientation. Attention identifies what enters a field of concern; curiosity can transform an encountered difference, anomaly, absence, or possibility into an object of inquiry. This transformation matters economically because new questions can redirect research, entrepreneurial activity, public investment, education, and institutional experimentation before the value of an answer is known.

Question formation is generative in a stronger sense than information acquisition. A subject seeking a known datum operates within a pre-specified problem. A newly formulated question can reorganize the problem-space itself by distinguishing previously conflated phenomena, proposing a new comparison, or making an unrecognized relation investigable. The economic consequences can be substantial. Scientific questions create research programmes; engineering questions motivate design trajectories; policy questions define measurable problems; entrepreneurial questions organize searches for unmet needs or new combinations.

Curiosity should not be romanticized as an unconstrained internal virtue. Opportunities for curiosity are institutionally distributed. Time, income security, educational access, research infrastructure, mentorship, mobility, archival access, computational resources, and tolerance for failure all affect who can pursue uncertain questions. A person may possess strong curiosity while lacking the relational conditions required to sustain inquiry. Conversely, organizations can create protected spaces in which exploratory questions become economically viable despite uncertain short-term returns.

Question formation is also socially mediated. A discipline defines which questions appear legitimate, mature, trivial, or impossible. A market communicates demand signals that make some problems commercially visible. Public institutions define categories of need. Communities preserve practical knowledge that can make different questions salient from those generated in professional research settings. Interdisciplinary contact can expose assumptions that remain invisible within a single field. Curiosity therefore emerges within histories of classification, authority, and encounter.

The economic orientation of curiosity becomes visible in the distribution of exploratory resources. Research grants, venture finance, procurement programmes, universities, laboratories, foundations, public challenges, and organizational slack all influence which uncertain inquiries can be sustained long enough to generate results. These mechanisms differ from ordinary exchange because expected value may be difficult to estimate ex ante. Selection often relies on judgments concerning

plausibility, novelty, promise, social relevance, or strategic fit rather than on known outputs.

GRE can therefore analyze curiosity as a relational capacity with downstream economic effects. It can ask how an environment makes questions possible, how inquiry becomes sustained, how failed questions still generate capabilities or networks, and how exploratory activity alters the future set of feasible projects. It can also examine exclusion: whose questions receive recognition, which experiences become researchable problems, and which uncertainties remain institutionally invisible.

This perspective does not imply that more curiosity is always better. Unbounded exploration can consume resources, produce distraction, or impose risks on others. Some domains require reliability, maintenance, and disciplined exploitation of established knowledge. GRE's task is not to assign curiosity an intrinsic positive value, but to make visible the conditions under which question formation becomes economically generative and the trade-offs through which exploratory orientation is governed.

3.9.4 Aesthetic Judgment

Economic generation often proceeds under incomplete evidence. Researchers choose among conjectures before proof is available. Designers compare forms before market response is known. Investors assess emerging projects with limited histories. Engineers select architectures before every downstream consequence can be calculated. Public institutions imagine futures for which no complete dataset exists. In such settings, judgment frequently includes an aesthetic dimension: a sense that a problem, pattern, design, explanation, or possibility is elegant, coherent, beautiful, compelling, fertile, proportionate, or otherwise worthy of continued attention.

GRE treats aesthetic judgment as a possible orientation mechanism rather than as a universal or infallible faculty. The term refers here to evaluative responses that help rank possibilities when propositional evidence does not fully determine selection. Such judgments can concern mathematical elegance, conceptual simplicity, visual form, narrative coherence, spatial atmosphere, craftsmanship, symbolic resonance, or the perceived fertility of a question. Their content varies across practices and communities.

Aesthetic judgment can become economically consequential because it directs scarce exploratory resources. Scientists choose which problems feel deep or promising. Architects and planners create environments that shape movement and encounter. Consumers attach value to form and atmosphere. Organizations cultivate identities through design. Investors may respond to narrative and presentation alongside formal projections. Cultural industries depend directly on aesthetic differentiation. In each case, aesthetic orientation participates in the generation of value without being reducible to price.

The relational character of aesthetic judgment is important. Judgments are neither simply arbitrary private tastes nor automatically universal properties of objects. They are formed through histories of training, exposure, comparison, convention, embodiment, and social interaction. What appears elegant to a mathematician, trustworthy to a patient, refined to a consumer, or harmonious to a community can de-

pend on learned repertoires and material environments. Institutions can therefore cultivate, standardize, or marginalize aesthetic criteria.

This relationality creates both generative possibility and power. Shared aesthetic repertoires can coordinate collaboration and make complex quality judgments possible without complete formalization. They can also become exclusionary when dominant groups define legitimate taste, professional style, or intellectual beauty. A funding committee's sense of what constitutes an "interesting" question, for example, may reproduce disciplinary histories that favor some objects and methods. Aesthetic judgment can thus influence resource allocation even when it is not formally acknowledged.

GRE should keep aesthetic judgment distinct from truth, welfare, and justice. An elegant theory can be empirically wrong. A beautiful design can be inaccessible or harmful. A compelling narrative can conceal exploitation. A technically awkward solution can nevertheless generate substantial social value. The analytical significance of aesthetic judgment lies in its role in orientation under uncertainty, not in a presumption that aesthetic approval validates the selected object.

Aesthetic orientation also interacts with serendipity. Encounters that were not sought for instrumental reasons can become generative when a subject experiences them as salient, intriguing, beautiful, strange, or worth pursuing. The generative consequence depends on both encounter and judgment. An environment rich in variation does not guarantee innovation; subjects and institutions must still recognize some differences as invitations to inquiry or creation. This suggests an economic problem of field design: how can environments sustain heterogeneous encounters and exploratory judgment without attempting to pre-engineer the exact novelty that should emerge?

Within GRE, aesthetic judgment therefore belongs to the analysis of orientation because it can influence which possibilities receive further attention, articulation, resources, and institutional support. Its mechanisms require contextual investigation, and its normative status remains open to separate evaluation.

3.9.5 Epistemic Orientation

Economic generation is also directed by epistemic orientation: the standards, classifications, methods, evidential expectations, and interpretive habits through which subjects and institutions decide what can be known, what counts as relevant evidence, and which uncertainties deserve investigation. Epistemic orientation does not merely affect description after economic processes occur. It can shape which processes become actionable and therefore which futures are generated.

Measurement provides a direct example. Once an organization adopts a metric, activity can reorganize around what the metric makes visible. Data collection creates categories, time series, benchmarks, and comparison groups. These representations can improve coordination and accountability, but they also privilege some dimensions over others. A phenomenon that cannot be recorded within the existing schema can remain difficult to govern even when participants experience it as important. Epistemic orientation therefore influences institutional capacity through the design of observability.

Methods likewise orient inquiry. Randomized experiments, econometric identification, ethnography, archival reconstruction, simulation, network analysis, participatory research, and legal interpretation provide access to different dimensions of a problem. Their strengths are domain-specific. When one method becomes institutionally dominant, questions that fit its evidential architecture can become easier to legitimate and fund. GRE's methodological pluralism is partly a response to this orientation effect: the research problem should guide method selection rather than allowing an inherited method to define the only admissible problem.

Classification is another generative mechanism. Administrative categories determine eligibility, statistics, taxation, regulation, and rights. Market classifications affect comparability and exchange. Scientific classifications shape research populations. Professional categories define expertise. Once stabilized, classifications can influence behavior and identity, making the represented distinctions increasingly consequential. Epistemic orientation therefore links representation to ontology without collapsing the two: categories can help generate social effects even though the category remains analytically distinct from the object it represents.

Epistemic orientation has a temporal dimension. Institutions inherit archives, standards, vocabularies, and datasets from earlier periods. These resources make some historical comparisons possible while leaving other experiences poorly recorded. New questions are therefore conditioned by the epistemic infrastructure accumulated in the past. At the same time, present recording decisions shape what future investigators will be able to reconstruct. The organization of knowledge becomes part of intertemporal economic capacity.

Disagreement over epistemic orientation can be productive. Competing models, disciplinary perspectives, and interpretive frameworks can reveal different aspects of a system. GRE does not require premature convergence on a single representation. It asks whether the plurality of representations is explicit, whether their assumptions and domains of validity are understood, and whether institutions preserve the capacity to revise their epistemic orientation when anomalies or changing conditions make existing categories inadequate.

This emphasis also limits the role of formal precision. A precisely estimated quantity can answer a poorly oriented question, while a qualitative observation can reveal a relation that has not yet been formalized. GRE values formal and computational methods where they perform genuine analytical work, but epistemic orientation precedes technique in the sense that the researcher must first decide what distinctions, scales, and forms of evidence are relevant to the inquiry.

3.9.6 Institutional Selection of What Is Generated

Orientation becomes institutional when durable rules, organizations, infrastructures, and evaluative procedures repeatedly privilege some generative pathways over others. Institutions do not need to specify the content of future outcomes in order to shape them. By controlling eligibility, resources, recognition, standards, timing, and access, they can alter which possibilities survive long enough to become self-sustaining.

Funding systems provide an obvious case. Research grants, venture investment,

bank credit, public procurement, philanthropy, and internal organizational budgets each use different selection criteria. Those criteria can favor measurable returns, strategic importance, novelty, reliability, social need, collateral, prior reputation, or compatibility with existing infrastructure. A funding architecture therefore orients generation before the downstream value of a project is known. Its effects accumulate when successful projects create expertise, reputation, and networks that improve their access to future resources.

Legal and regulatory institutions also orient generation. Intellectual-property rules affect incentives and diffusion. Liability rules influence experimentation. Licensing can protect safety while raising entry barriers. Competition policy changes the conditions under which scale can consolidate. Data governance shapes access to informational resources. Labor and social-protection institutions influence the risks subjects can bear when changing occupations or starting new projects. In each case, legal structure changes the feasible and attractive trajectories available to economic actors.

Educational institutions orient generation by shaping capabilities, vocabularies, disciplinary boundaries, and aspirations. Curriculum determines which problems become familiar. Credentials affect access to professions and organizations. Mentorship can make previously invisible pathways imaginable. Evaluation systems influence whether students optimize for standardized performance, exploration, collaboration, or independent inquiry. Education therefore participates in economic generation long before its effects appear as wages or productivity.

Markets themselves are institutional selection environments. Prices, demand, competition, and profitability orient resources toward some activities and away from others. GRE retains this insight while asking how market selection interacts with other orientation mechanisms. Markets depend on property rules, infrastructures, classifications, information, financing, and distributions of purchasing power. A profitable opportunity can reflect genuine social demand, concentrated wealth, regulatory design, network effects, or externalized costs. Market orientation is therefore economically powerful without being normatively self-interpreting.

Platforms and algorithmic systems add another layer by combining infrastructure, ranking, rule enforcement, and data collection. Their selection mechanisms can shape which sellers are visible, which workers receive tasks, which content gains distribution, and which behaviors become economically rewarded. Because participants often adapt to these selection systems, the platform's orientation can become recursive: metrics influence behavior, behavior supplies new data, and new data update the mechanism that structures visibility or access.

Institutional orientation also creates lock-in and complementarity. Once organizations invest in a technology, standard, profession, or accounting category, adjacent investments may become more valuable. Alternative pathways then face higher switching costs even if they are technically feasible. The resulting persistence can be efficient when coordination benefits are large, but it can also preserve arrangements whose original justification has weakened. GRE therefore asks how institutional selection creates future dependency and what forms of optionality remain available.

The analytical objective is not to identify a single institution responsible for ori-

entation. Selection is often distributed across finance, law, culture, infrastructure, expertise, and public authority. A GRE inquiry traces how these mechanisms combine and where control over selection becomes concentrated, contested, or open to revision.

3.9.7 Plural Orientations under Heterogeneous Values

Economic systems contain subjects and communities whose orientations differ. They may disagree about desirable outcomes, relevant time horizons, legitimate evidence, acceptable risk, ecological obligations, cultural continuity, forms of recognition, or the value of particular capabilities. GRE treats this heterogeneity as a constitutive feature of orientation rather than assuming that all relevant directions can be represented by one shared scalar objective.

Plural orientation creates coordination problems. A project that expands aggregate income can weaken a local form of life. A conservation policy can protect ecological conditions while constraining livelihoods unless transition mechanisms are provided. A technological system can increase convenience for users while intensifying surveillance or labor precarity. A research programme can generate broadly useful knowledge while concentrating intellectual property. These tensions cannot always be resolved by discovering a hidden common metric.

Value conversion can help decision making when the conversion rule is explicit and appropriate. Monetary valuation, cost-effectiveness, multi-criteria analysis, voting, deliberation, legal balancing, and negotiated compromise are among the mechanisms institutions use to compare heterogeneous claims. GRE does not reject such conversions. It asks what is gained and lost through them, whose valuations enter the procedure, and whether the conversion becomes mistaken for an ontological equivalence among the values involved.

Plural orientation also means that generativity itself can be evaluated differently. One group may value rapid innovation; another may value reliability and continuity. One institution may prioritize employment; another ecological regeneration; another strategic autonomy; another freedom of inquiry. A relation can therefore be highly generative according to one orientation while appearing destructive according to another. The disagreement concerns both produced outcomes and the standards through which generation is interpreted.

Institutions can respond to plural orientation through several architectures. They can aggregate preferences into a single decision, allocate separate domains of authority, preserve local autonomy, establish rights that constrain aggregation, create deliberative procedures, or maintain experimental diversity across jurisdictions and organizations. Each architecture has generative consequences. Centralization can coordinate large-scale investment but narrow local variation. Decentralization can preserve experimentation but weaken collective capacity. Rights can protect vulnerable subjects while limiting some forms of optimization. GRE treats these trade-offs as empirical and normative objects rather than deriving a universal institutional design.

The distribution of voice matters because heterogeneous values do not enter decision processes with equal force. Wealth, legal status, expertise, organizational ca-

pacity, time, language, and control over infrastructure can affect which orientations become institutionally consequential. A formally plural process can therefore reproduce asymmetry if some actors possess much greater ability to define agendas, supply evidence, or sustain participation. Analysis of orientation must consequently include the conditions of representation and participation.

Plurality also has an epistemic benefit. Different orientations can reveal consequences that a dominant framework misses. Workers, users, local communities, engineers, ecologists, regulators, and investors can perceive different dimensions of the same system. Maintaining structured disagreement can therefore increase the system's capacity to detect emerging harms or opportunities. Diversity of orientation is not automatically valuable, but under some conditions it functions as a distributed sensing and exploration mechanism.

For GRE, the constitutional implication is that economic orientation should remain representationally plural unless a specific analytical or decision context justifies aggregation. Heterogeneous values are not noise to be removed before economic reasoning begins. They are part of the relational field through which generation is directed and evaluated.

3.9.8 Orientation as an Economic and Political Problem

Orientation becomes an economic problem because it influences the allocation and generation of scarce capacities across time. Attention, research effort, capital, infrastructure, education, organizational commitment, and institutional legitimacy cannot be devoted equally to every possibility. Selection therefore shapes which capabilities accumulate, which industries form, which questions receive answers, which risks become visible, and which subjects gain access to future opportunities. Orientation is economically consequential even when no market transaction directly prices it.

It becomes a political problem when the authority to orient generation is unevenly distributed or collectively contested. Governments set research priorities and infrastructure plans. Firms select technologies and business models. Platforms organize visibility. Financial institutions influence investment trajectories. Professional bodies define standards. Universities establish curricula and disciplines. Communities defend or transform local practices. Individuals exercise agency within these fields but do not enter them with equal resources. Orientation is therefore partly a question of who can shape the conditions under which future possibilities become more or less available.

This form of power is upstream from many observable outcomes. Control over a final allocation matters, but control over the categories, infrastructures, questions, and selection procedures through which future allocations will be made can have longer-lived effects. A subject that determines what can be measured, funded, connected, certified, or searched can influence generation without dictating every downstream action. GRE can analyze this as power over generative conditions while still requiring concrete mechanisms rather than inferring power from asymmetry alone.

The political character of orientation also appears in conflicts over temporality. Short electoral cycles, quarterly reporting, long infrastructure lifetimes, ecological regeneration, intergenerational obligations, and scientific research operate on dif-

ferent temporal horizons. Institutions that privilege one horizon can redirect generation away from possibilities whose value emerges later. The question is not simply whether actors discount the future, but how organizational and institutional arrangements determine whose future, which risks, and which forms of value remain actionable in the present.

A generative orientation can also produce foreclosure. Investment in one infrastructure can make alternatives expensive. A dominant technical standard can exclude incompatible innovations. A classification can make some identities administratively invisible. A business model can generate dependency that reduces exit options. Foreclosure is therefore the counterpart of orientation: selecting and reinforcing one trajectory changes the feasibility of others. GRE evaluates orientation partly by tracing these changes in future option sets rather than only immediate outputs.

This does not imply that preserving every option is desirable. Coordination, commitment, specialization, and institution building often require closing alternatives. A society cannot maintain every infrastructure standard simultaneously, and an organization cannot pursue every project. The analytical question concerns the terms under which closure occurs, its reversibility, who bears the resulting constraints, and whether institutions retain capacities for revision when conditions change.

Orientation also connects economic analysis to governance. A governance system can attempt to specify desired outcomes directly, or it can shape fields in which desirable forms of generation are more likely to emerge. The latter approach may involve public infrastructure, open standards, rights, research capacity, plural participation, safety constraints, or mechanisms for feedback and revision. Such field-oriented governance does not eliminate political choice; it relocates part of that choice to the design of enabling and constraining conditions.

The constitutional position of GRE is therefore neither that generation should be maximized nor that orientation should be centralized. GRE makes orientation visible as an object of economic inquiry. It asks how attention, curiosity, aesthetic judgment, epistemic practices, institutions, and heterogeneous values combine to direct generative processes; how orientation distributes future capacities and risks; how power enters selection; and how orientations themselves change through history.

This completes the present chapter's account of one major dimension of GRE's problem-space. Economic generation is mediated by subjects, but subjects themselves are formed through relations; generation is directional, but direction arises through multiple cognitive, institutional, symbolic, and political mechanisms. The next constitutional task is methodological. The following section therefore distinguishes the principal modes through which GRE can describe, explain, reconstruct, compare, interpret, formalize, evaluate, and intervene in the economic processes identified here.

3.10 Modes of GRE Inquiry

Generative Relational Economics requires methodological breadth because its objects are heterogeneous and its questions concern several different kinds of claim. A study may need to describe a relational configuration, explain how it is reproduced, recon-

struct how it emerged historically, compare it with alternative configurations, interpret the meanings through which subjects act, identify causal effects, formalize a mechanism, simulate possible trajectories, evaluate consequences normatively, or design an intervention. These tasks are related, but they are not interchangeable. The role of this section is to distinguish the principal modes through which GRE can conduct inquiry while preserving their mutual compatibility. Its objective is methodological clarification rather than the prescription of a single research design. The discussion proceeds from descriptive and explanatory inquiry through historical, comparative, interpretive, causal, formal, computational, normative, and intervention-oriented modes. Across them, the governing principle is that each mode must make explicit what kind of claim it is entitled to support, which evidence or representation bears that claim, and where its warrant ends.

The distinction among modes concerns the epistemic work being performed rather than a rigid classification of disciplines or techniques. An interview can contribute to descriptive, interpretive, historical, causal, or normative inquiry depending on how it is used. A regression can support description, comparison, or causal inference under different designs. Archival material can reconstruct a historical sequence while also revealing institutional meanings and mechanisms. A simulation can clarify the consequences of specified assumptions without establishing that the modeled mechanism exists empirically. GRE therefore classifies inquiry by the relation between question, evidence, representation, and warranted conclusion rather than by the surface form of the method alone.

The modes also differ from the objects and scales identified earlier in this chapter. The same object can be approached through several modes. A platform can be described as an organization and infrastructure, interpreted through the classifications embedded in its interface, studied causally through changes in ranking rules, reconstructed historically through its institutional development, represented formally as a multilayer network, evaluated normatively through the distribution of generated capacities and harms, and examined interventionally through alternative governance designs. Methodological plurality becomes useful precisely because the object does not determine a unique mode of inquiry.

GRE does not require every project to use every mode. A narrowly designed causal study can be valuable if its boundaries are clear. A historical reconstruction can illuminate the emergence of a generative structure without formalization. An interpretive study can reveal categories that would otherwise be mismeasured. A formal model can clarify possible mechanisms before adequate data exist. The methodological demand is therefore fit rather than comprehensiveness: the mode or combination of modes should match the question and should remain corrigible by evidence or arguments arising from other modes when their domains overlap.

3.10.1 Descriptive Inquiry

Descriptive inquiry establishes what is present, how it is distributed, how it is related, and how it changes over a specified observational domain. In GRE, description can concern entities, subjects, relations, resources, capacities, forms of value, constraints, institutional rules, symbolic representations, trajectories, or fields. Its importance

is easily underestimated because description is sometimes treated as a preliminary stage before "real" explanation. Yet a relational research programme depends heavily on careful description: a mistaken boundary, omitted relation, inappropriate unit, or unstable category can distort every later explanatory or normative claim.

A GRE description is therefore more than an inventory of isolated attributes. It can map relational incidence: who is connected to whom, through which mechanism, under what terms, and with what asymmetries. It can characterize distributions of access, exposure, recognition, risk, or capability. It can identify temporal patterns such as persistence, turnover, accumulation, or decay. It can distinguish administrative recipients from affected subjects and can trace where value, constraints, or opportunities appear outside the nominal boundary of a programme or transaction. Description thereby makes the relational field empirically available before deeper attribution is attempted.

The construction of descriptive categories requires explicit judgment. Terms such as worker, household, platform, community, firm, beneficiary, asset, skill, trust, or harm are not self-interpreting. Their operationalization can depend on legal definitions, institutional records, self-identification, measurement conventions, or analytical reconstruction. GRE therefore treats descriptive categories as representations whose adequacy must be justified relative to the question and scale. A category can be useful without being ontologically final, and a stable administrative classification can remain inadequate for a relational question if it suppresses relevant interactions or affected subjects.

Description also has a temporal dimension. Cross-sectional description captures a configuration at a moment or interval, while longitudinal description tracks changes in states, relations, or distributions. The latter becomes especially important when generation concerns future capacities. A programme that appears distributively modest at one date may substantially change later educational, technological, organizational, or relational possibilities. Conversely, an apparent short-term gain may dissipate or convert into dependence. Descriptive inquiry can reveal these trajectories without yet claiming a mechanism for them.

Rich description can combine quantitative and qualitative evidence. Administrative records may establish scale and distribution; interviews may reveal unrecorded relations; ethnographic observation may show how formal rules are enacted; network data may identify patterns of connectivity; documents may clarify institutional categories; spatial data may reveal infrastructural concentration. GRE has no reason to privilege one evidence type in advance. The relevant standard is whether the descriptive representation captures the features required by the question while making omissions and uncertainty visible.

Descriptive adequacy also depends on boundaries. A study of a firm's wage policy can stop at employees, extend to households, include subcontractors, or incorporate local labor markets and public services. Each boundary produces a different descriptive object. GRE does not assume that the widest boundary is always best; wider boundaries increase complexity and can reduce tractability. The researcher instead states why a boundary is appropriate and tests whether excluded relations materially alter the description.

The output of descriptive inquiry is therefore a warranted account of configuration rather than a claim about why the configuration exists. It establishes patterns that explanatory, historical, causal, interpretive, or normative inquiry may subsequently address. In GRE, this mode is foundational because relational and generative claims become meaningful only after the relevant configurations, transitions, and affected subjects have been specified with sufficient empirical discipline.

3.10.2 Explanatory Inquiry

Explanatory inquiry asks how and why an observed configuration, transition, or regularity occurs. GRE gives particular attention to mechanisms through which relations produce, reproduce, transform, amplify, or constrain later possibilities. Explanation can therefore address immediate effects, recursive feedback, institutional reproduction, conversion among forms of value, subject formation, cross-scale propagation, or changes in the conditions under which subsequent generation occurs.

Explanation requires more than naming a correlation or attaching a familiar concept to an outcome. To say that an outcome results from power, incentives, norms, networks, institutions, culture, or path dependence is incomplete unless the operative process is specified sufficiently to connect conditions to consequences. A GRE explanation should identify the relevant actors or configurations, the relations through which effects travel, the enabling and constraining conditions, the temporal sequence where it matters, and the observations that would distinguish the proposed mechanism from plausible alternatives.

Mechanistic explanation can operate at different levels. A change in organizational behavior may be explained through individual incentives, professional norms, governance rules, technological affordances, inter-organizational dependence, or combinations among them. These explanations need not compete if they address different parts of the process. GRE is particularly interested in explanations that connect levels without treating one as automatically fundamental. A legal rule can alter organizational incentives; organizational practices can reshape individual capabilities; repeated individual actions can stabilize a convention; a convention can later become codified. The explanatory task is to show how these relations connect rather than to reduce them to a single privileged scale.

Generative explanation extends the temporal horizon beyond the immediate outcome. A scholarship programme may explain increased enrollment through reduced cost, but GRE may also ask how participation generates networks, expectations, credentials, institutional capacities, or new constraints that alter later educational and labor-market trajectories. This does not mean every explanation must trace indefinitely downstream. It means that when later capacities are central to the research question, the explanatory account should not stop at the first measurable output merely because it is administratively convenient.

Explanatory inquiry can draw on several other modes. Historical evidence can reveal how a mechanism became possible. Interpretive evidence can show how subjects understand and respond to classifications. Causal designs can estimate whether an intervention changes an outcome. Formal models can clarify whether a proposed mechanism is internally coherent. Comparative cases can test whether the explana-

tion travels across configurations. Computational models can explore implications that are difficult to derive analytically. Explanation is therefore often integrative, but the contributions of these components should remain distinguishable.

The standard of explanatory sufficiency depends on the claim. A local explanation of a policy effect requires less than a theory of institutional transformation. Claims about altered generative conditions require evidence that the later opportunity structure, rule environment, capacities, or relations changed in a way relevant to subsequent processes. Claims about transformation of the effective rule of change require still stronger evidence that the mechanism governing later transitions itself changed. GRE therefore scales explanatory ambition to evidential support.

Explanatory inquiry is central to GRE because the framework is concerned with more than relational association. It seeks to understand how relations become consequential through identifiable processes. At the same time, explanation remains compatible with ontological suspension: a useful mechanism model can explain an empirical pattern without establishing that its analytical categories constitute the ultimate ontology of the economic system.

3.10.3 Historical Inquiry

Historical inquiry reconstructs how economic configurations, categories, subjects, institutions, and generative conditions emerge and transform through time. Its role in GRE is constitutive rather than supplementary. If entities and relations can be historically generated, then their present form cannot always be understood by treating them as fixed inputs to analysis. Historical inquiry asks how the objects that later appear stable became available, how alternative possibilities were closed or retained, and how prior trajectories condition present generative capacity.

A historical GRE study can begin with an institution, technology, classification, market, profession, infrastructure, or relation and reconstruct the sequences through which it acquired its current form. The relevant history may include legislation, organizational decisions, conflict, technical development, demographic change, cultural interpretation, investment, crises, accidents, or encounters with other systems. The aim is not to produce chronology for its own sake. The analytical objective is to identify transformations that changed what later actors could perceive, do, coordinate, own, exchange, contest, or generate.

Historical inquiry is especially important for categories that appear natural after stabilization. The distinction between employee and contractor, the legal form of a corporation, a standardized credential, a property right, a data category, a currency regime, or a professional jurisdiction can become embedded in administrative systems and everyday expectations. Once stabilized, these categories structure evidence and action. Historical reconstruction can reveal their contingency, the relations that produced them, and the alternatives that were once viable. Such reconstruction supports ontological suspension by showing that analytical objects may have histories of constitution.

Temporal ordering can also bear explanatory weight. The same set of conditions can produce different outcomes when encountered in different sequences. Early infrastructure can create increasing returns; a legal designation can precede and en-

able market formation; a crisis can accelerate an institution that had previously remained marginal; a technical standard can become difficult to displace after complementary investments accumulate. Historical inquiry can therefore identify path-dependent mechanisms while avoiding the loose use of "history matters" as an explanation.

GRE also treats methods and evaluative categories as historical. What counts as reliable evidence, recognized value, legitimate participation, acceptable risk, or relevant harm can change. A historical study may therefore examine not only the object of evaluation but the evolution of the evaluative and epistemic apparatus itself. This becomes particularly important when contemporary assessment applies categories that did not exist, had different meanings, or excluded relevant subjects in earlier periods.

Historical evidence is heterogeneous. Archives, legal documents, organizational records, correspondence, material artifacts, statistical series, oral histories, media, technical standards, and retrospective testimony can each illuminate different aspects of a process. Their survival is itself selective. GRE therefore treats the archive as part of the historical relational field: who could record, whose records were preserved, which categories were administratively legible, and which forms of experience remained unrecorded can shape what later researchers are able to reconstruct.

Historical inquiry does not imply that every present problem requires a complete genealogy. The relevant temporal horizon depends on the process. Some mechanisms can be understood through recent organizational history; others depend on decades of institutional accumulation or longer histories of law, infrastructure, or social classification. The methodological requirement is to extend the historical frame far enough that the object and its operative conditions are not mistakenly treated as timeless when their formation is relevant to the explanation.

3.10.4 Comparative Inquiry

Comparative inquiry examines similarities and differences across cases, configurations, periods, scales, or institutional arrangements. In GRE, comparison is valuable because relational and generative mechanisms are often conditional. A relation that generates capability in one institutional environment may generate dependence in another; a governance arrangement that supports participation at one scale may produce exclusion at another; the same technology can reorganize value differently under different property, labor, or regulatory structures.

Comparison can therefore reveal which features are specific to a configuration and which travel across contexts. Cases may be organizations, regions, legal systems, historical episodes, technologies, communities, markets, or interventions. A comparison can hold some features relatively stable while examining variation in others, or it can compare broader configurations whose differences are themselves analytically meaningful. GRE does not require all comparisons to approximate experiments. Configurational comparison can be valuable when the research question concerns how combinations of relations produce different generative trajectories.

The major methodological problem is commensurability. Cases become comparable only through selected dimensions, and the choice of dimensions can obscure

differences in meaning or institutional constitution. "Employment," "household income," "community participation," or "innovation" may be measured similarly across jurisdictions while referring to materially different social arrangements. Comparative inquiry must therefore justify both the common dimension and the retained differences. Translation among categories can be part of the research rather than a preliminary technical step.

Comparison across time presents a related problem. A variable can retain its label while the institutional relations that constitute it change. Longitudinal comparisons of occupations, assets, industries, educational attainment, or household forms may therefore require attention to changing definitions and social significance. GRE treats historical comparability as an empirical and interpretive achievement, not an automatic consequence of having a numerical series.

Comparative inquiry is also useful for mechanism assessment. If a proposed explanation depends on a particular relation, cases in which that relation differs can help evaluate the claim. A platform governance mechanism can be compared across ownership models; a welfare intervention across administrative designs; a cooperative across legal environments; a knowledge commons across licensing regimes. The objective is not necessarily to identify a single universally best arrangement. Comparison can instead map how different relational configurations generate different distributions of capacity, value, risk, or closure.

Negative and deviant cases can be especially informative. A case in which an expected self-reinforcing process fails may reveal a missing enabling condition. A community that resists a dominant institutional trajectory can disclose alternative relations that preserve options. A technological diffusion that remains limited despite strong incentives may reveal interpretive, infrastructural, or legal constraints. GRE can use such cases to refine mechanisms rather than treating them as noise around an average effect.

Comparative inquiry thus provides a disciplined way to study plurality. It can test portability without assuming invariance, and it can illuminate alternative economic arrangements without reducing them to a single ranking dimension. Its contribution is strongest when the basis of comparison, the boundaries of each case, and the limits of generalization are stated explicitly.

3.10.5 Interpretive Inquiry

Interpretive inquiry examines the meanings, classifications, narratives, symbols, expectations, and practical understandings through which economic subjects perceive and act within relational configurations. GRE requires this mode because many economic objects are symbolically mediated. Prices, contracts, credentials, reputations, categories, metrics, risk scores, organizational roles, and legal statuses acquire consequences partly through shared or contested interpretations.

Interpretation enters economic processes in several ways. Subjects respond to what they believe a rule requires, what they expect others to do, what a category signifies, or what an action communicates. An institutional classification can alter behavior because it changes eligibility or sanctions, but also because subjects understand themselves and others through it. A market signal can influence investment be-

cause actors interpret its informational content. A policy can fail because its official category does not correspond to the categories through which affected communities organize practice. Meaning is therefore neither an ornamental layer nor a universal substitute for material explanation. It is one mechanism through which relations become actionable.

Interpretive inquiry can focus on language, documents, interviews, practices, rituals, interfaces, images, classifications, or institutional procedures. The researcher asks how a representation is produced, which distinctions it makes salient, how subjects use or contest it, and what practical consequences follow. Interpretive evidence can reveal why formally identical incentives generate different responses, why some risks remain unrecognized, or why an institutional reform changes subject positions even when resource distributions move little.

GRE distinguishes the meaning attributed by subjects from the analyst's representation. Researchers can misdescribe a relation if they impose categories that erase locally consequential distinctions. Conversely, subjects' interpretations do not exhaust causal explanation. An institution can have effects that participants neither intend nor perceive. Interpretive inquiry therefore contributes one layer of evidence within a plural methodology: it reconstructs situated meaning while remaining open to material, institutional, statistical, and historical evidence about effects beyond conscious understanding.

Symbolic mediation becomes particularly important under conditions of representational abundance. Rankings, dashboards, automated classifications, recommendation systems, financial models, and AI-generated representations can shape what becomes visible and credible. Interpretive inquiry can examine how these representations acquire authority and how subjects orient action around them. It can also ask how categories designed for one purpose migrate into other domains and begin to organize allocation, recognition, or exclusion.

Interpretive disagreement is itself an economic phenomenon. Different actors may attach incompatible meanings to the same resource, relation, technology, or institutional change. A redevelopment project can signify investment to one group and displacement to another; data sharing can signify innovation, surveillance, or public infrastructure depending on the relation. GRE does not require these meanings to be collapsed into a single utility metric before analysis begins. Their coexistence can shape conflict, coalition, legitimacy, and future generative possibilities.

Interpretive inquiry thus expands what counts as economically relevant evidence while remaining disciplined by context and consequence. Its aim is not to replace causal or material analysis with discourse, but to identify when meaning and representation form part of the mechanism through which economic relations are generated, sustained, or transformed.

3.10.6 Causal Inquiry

Causal inquiry asks whether and through what conditions a change in one factor contributes to a change in another. GRE requires causal discipline because relational language can otherwise encourage unwarranted attribution. The presence of a relation, asymmetry, institution, or field does not by itself establish that it caused an

observed outcome. Causal inquiry therefore provides tools for distinguishing association, sequence, mechanism, and intervention-relevant effect.

Causal questions can be narrow or generative. A narrow question may ask whether a transfer increases school attendance. A broader question may ask whether the transfer changes household bargaining, peer networks, expectations, credential accumulation, or later labor-market options. These questions operate on different outcomes and time horizons, and they may require different designs. GRE's contribution is not to replace established causal inference but to broaden the set of causally relevant downstream and relational outcomes when theory gives reason to expect them.

Counterfactual reasoning remains central. To claim that an intervention caused an outcome requires some account of what would have occurred under a relevant alternative. Randomization, natural experiments, quasi-experimental designs, matching, synthetic controls, longitudinal models, process tracing, comparative case analysis, and mechanistic evidence can support counterfactual claims under different assumptions. GRE is methodologically plural about these tools but not indifferent to identification. The choice of design must match the causal claim.

Relational settings create additional challenges. Interference can violate assumptions that one unit's treatment does not affect another. Network spillovers can make the administrative recipient a poor unit for causal analysis. Institutional reforms can change the categories through which outcomes are measured. Feedback can make causes and effects mutually reinforcing across time. Selection into relationships can confound observed associations. GRE therefore treats relational structure as part of causal design rather than as a reason to abandon causal inference.

Causal attribution can also be distributed. A harmful outcome may depend on a sequence of financing rules, organizational incentives, technical standards, local decisions, and infrastructural constraints. No single element is sufficient on its own, yet the configuration can reliably generate the outcome. GRE can analyze such conjunctural causation while distinguishing it from claims that every contributing condition bears equal explanatory or normative weight.

Generative causal inquiry may ask whether an intervention changes later capacities to produce further effects. This creates nested causal questions. A training programme can directly change skill, which changes network access, which changes employment opportunities, which changes household investment. The causal chain can branch and feed back. Researchers need not estimate every link simultaneously, but they should distinguish measured effects from hypothesized downstream mechanisms and avoid presenting an observed endpoint as evidence for the entire generative story.

Causal inquiry therefore disciplines GRE's ambition. It permits strong claims where design and evidence support them and encourages restraint where mechanisms remain plausible but unverified. Relational complexity expands the causal questions worth asking; it does not lower the evidential burden for answering them.

3.10.7 Formal Inquiry

Formal inquiry constructs explicit representations of economic structures or processes in mathematical, logical, graphical, or computationally specified form. Its role in GRE is clarification. Formalization can make assumptions visible, expose inconsistencies, distinguish mechanisms that natural language leaves conflated, derive consequences, and reveal which empirical observations would discriminate among alternative accounts.

The appropriate formalism depends on the problem. Dynamical systems can represent trajectories, stability, and regime change. Networks and hypergraphs can represent relational topology and higher-order interaction. Multilayer structures can distinguish relation types. Optimization and game-theoretic models can clarify strategic constraints and incentive compatibility. Probabilistic models can represent uncertainty and conditional dependence. Field-like representations can describe distributed conditions when locality or spatial organization matters. Logical or categorical formalisms can clarify compositional structure. GRE does not designate one of these as its universal mathematics.

Formal inquiry begins by specifying what the symbols represent. A node may stand for a person, organization, legal entity, document, or technical component; an edge may encode communication, ownership, exchange, dependency, recognition, or another relation. A state variable can summarize a capacity, stock, classification, or measured condition. The model becomes meaningful only through the mapping between formal object and empirical interpretation. Two models with identical mathematics can therefore represent substantively different economic mechanisms.

Formalization also requires ontological restraint. A network representation does not prove that the economy is fundamentally a network, and a state-space model does not establish that the selected variables constitute a complete economic state. The formal representation is an analytical instrument whose adequacy depends on the question, assumptions, and empirical correspondence. GRE's ontological suspension is compatible with strong formal work precisely because it separates representational usefulness from metaphysical commitment.

One important use of formal inquiry is to distinguish levels of transformation. A model can represent change in state under fixed rules, changes in parameters, changes in topology, or transformations in the effective rule itself. These are different formal problems. GRE's concern with changing generative conditions becomes clearer when the model states which elements are permitted to vary and which remain fixed. A formalism that endogenizes network ties while fixing node identities captures one form of relational change but leaves other forms outside the model.

Formal inquiry can also produce impossibility or boundary results. Under specified assumptions, certain combinations of objectives may be incompatible; some allocation rules may generate unavoidable trade-offs; some dynamics may be unstable; some information may be insufficient for identification. Such results can be valuable even when the assumptions are idealized because they clarify where a proposed intervention requires additional structure or information.

The evidential status of a formal result must nevertheless remain explicit. A theorem establishes a consequence of assumptions. A numerical model shows behavior

of a specified representation. Neither alone establishes that the assumptions hold empirically. Formal inquiry becomes empirically explanatory when the mapping, assumptions, and relevant predictions or mechanisms are supported by evidence. GRE therefore treats formalization as one rigorous mode among several, especially powerful when combined with descriptive, historical, causal, or interpretive work.

3.10.8 Computational Inquiry

Computational inquiry uses algorithmic procedures to analyze data, simulate specified systems, explore high-dimensional models, search large possibility spaces, or construct representations that would be difficult to handle analytically. It overlaps with formal inquiry but is not identical to it. A formal model can be studied without computation, while computational analysis can involve empirical pattern detection whose theoretical structure remains comparatively weak. GRE distinguishes these uses so that computational power is not mistaken for explanatory completeness.

Simulation is one major application. Agent-based models can explore how heterogeneous local rules generate aggregate patterns; network simulations can study diffusion, contagion, coordination, or rewiring; dynamical models can examine sensitivity and regime change; Monte Carlo methods can characterize uncertainty; optimization algorithms can explore feasible designs under constraints. Simulation is particularly useful when feedback, heterogeneity, or combinatorial complexity makes closed-form analysis difficult.

The epistemic status of simulation remains conditional. A simulated trajectory is evidence about the behavior of the model under specified assumptions. It becomes evidence about a target economic system only through an additional argument that the model represents relevant features adequately. Calibration, validation, sensitivity analysis, out-of-sample comparison, qualitative mechanism matching, and robustness checks can strengthen this bridge. The visual plausibility of a simulated pattern is insufficient on its own.

Computational inquiry also includes data-intensive empirical methods. Machine learning can classify, predict, embed, cluster, or detect patterns in large datasets. Natural-language processing can analyze documents and discourse. Network algorithms can identify structural positions or communities. Spatial computation can reveal geographical concentration and accessibility. These methods can extend observational capacity, but the resulting representations inherit the categories, sampling processes, missingness, labels, and objectives of the data-generating system.

For GRE, computational representation can itself become an object of inquiry. A credit score, recommendation model, allocation algorithm, or generative AI system does not merely describe an economic field; once used operationally, it can alter access, visibility, bargaining power, subject classification, and future data. The computational model can therefore enter the generative relation it represents. Researchers may need to study both model performance and the feedback through which deployment changes the target system.

Computation can further support exploratory work under ontological uncertainty. Researchers can test several network boundaries, alternative state representations, or competing mechanisms and examine which are robust to changes in specification.

Such exploration is valuable if it is reported transparently and distinguished from confirmatory inference. Computational flexibility increases the importance of documenting choices because many plausible pipelines can yield different apparent structures.

GRE therefore welcomes computational inquiry without treating computation as a substitute for theory, meaning, causality, or normative judgment. Its contribution lies in extending what can be represented and explored while maintaining explicit links among algorithm, data, modeled object, and warranted conclusion.

3.10.9 Normative Inquiry

Normative inquiry evaluates economic arrangements, relations, processes, or interventions according to articulated standards of value, justice, participation, capability, harm, responsibility, freedom, sustainability, or other justified criteria. GRE requires this mode because generativity is not intrinsically beneficial. A relation can generate wealth and dependency, knowledge and exclusion, capability and ecological damage, trust and vulnerability, innovation and concentration. Description of generation therefore cannot settle whether the generated configuration is desirable.

Normative inquiry begins by making the evaluative standard visible. A study may evaluate distribution, procedure, recognition, participation, capability, rights, ecological integrity, intergenerational effects, or the preservation of future options. These standards can converge in some cases and conflict in others. GRE does not resolve such conflict by assuming that all values can be converted into a common metric. Monetary valuation, utility, capability, rights, and relational goods can each illuminate different dimensions while leaving remainders that resist equivalence.

The distinction between generated value and generated harm is central. An intervention that expands productive capacity can simultaneously concentrate decision authority. Infrastructure can increase mobility while displacing communities. A platform can create new forms of participation while producing surveillance or dependency. Normative inquiry therefore follows the distribution and conversion of effects across subjects, scales, and time rather than assigning the entire process a single positive or negative label from one immediate outcome.

Participation matters both instrumentally and intrinsically. Subjects affected by an intervention may hold knowledge unavailable to designers, making participation epistemically valuable. Participation can also constitute recognition and agency rather than merely improve technical outcomes. Yet participation itself varies in form and power. Consultation, veto authority, co-design, ownership, and self-governance are not equivalent. GRE can therefore examine the relational structure of participation rather than treating its nominal presence as sufficient.

Normative inquiry also addresses capability and future generativity. An arrangement can be evaluated partly by how it changes subjects' capacities to act, learn, cooperate, exit, contest, or generate further value. This future-oriented criterion does not imply that more capability is always better or that every option must be preserved. Some capabilities are harmful, and institutional commitments often require selective closure. The normative problem concerns which capacities are expanded or foreclosed, for whom, under what justification, and with what possibilities for revision.

Evaluation must remain historically and contextually responsive. Normative concepts can have general aspirations while their application depends on institutions, technologies, ecological conditions, and available alternatives. Standards themselves can also be criticized and revised through new knowledge or previously excluded perspectives. GRE therefore treats normative inquiry as reasoned and contestable rather than as a final scoring procedure appended after positive analysis.

The mode remains analytically distinct from empirical explanation even when the two interact. Evidence can show who is harmed, which capacities change, or how participation is distributed. It cannot by itself determine how conflicting claims should be weighted. Conversely, normative arguments that ignore empirical mechanisms can recommend interventions that reproduce the very harms they seek to address. GRE joins the modes through mutual constraint while preserving the distinction between what occurs and how it ought to be evaluated.

3.10.10 Intervention-Oriented Inquiry

Intervention-oriented inquiry asks how knowledge can inform deliberate attempts to alter a relational configuration, its generative conditions, or the processes through which future outcomes are produced. It is distinct from normative inquiry because deciding that a condition is undesirable does not establish how it can be changed. It is also distinct from causal inquiry because estimating the effect of one intervention does not by itself provide a complete strategy for governance under changing conditions.

A GRE intervention begins with diagnosis. The researcher or practitioner identifies the relevant relations, subjects, constraints, capacities, value flows, representations, and scales. The intervention target may be an allocation, a rule, an infrastructure, a relation among organizations, an information environment, a participation mechanism, or a field condition that makes certain actions easier or harder. This breadth allows GRE to consider interventions that modify generative conditions rather than only redistribute final outputs.

Intervention design then requires an explicit theory of change. Which relation is expected to change? Through what mechanism? Which subjects can respond? Which enabling conditions are required? What downstream pathways are anticipated? Which unintended effects are plausible? At what time horizon should evaluation occur? These questions prevent “relational intervention” from becoming a vague label for any complex policy.

Field-oriented intervention is one important possibility. Instead of specifying a single terminal outcome, governance can alter conditions under which desirable forms of generation become more feasible. Open standards can lower barriers to entry; public infrastructure can expand capability; rights can protect participation; information systems can make harms visible; funding structures can diversify inquiry; modular regulation can preserve reversibility. Such approaches remain interventions with distributive and political consequences even when they do not centrally prescribe final behavior.

Intervention-oriented inquiry also requires feedback. Economic systems respond to policy, and subjects can adapt strategically or creatively. An initially effective rule

can become ineffective after behavior changes. A subsidy can create dependence; a measurement target can be gamed; a new right can generate institutional innovation; an infrastructure can enable uses that designers did not anticipate. GRE therefore treats monitoring and revision as part of intervention rather than as post hoc maintenance.

Reversibility and repair deserve explicit attention. Some interventions are easy to modify, while others create sunk costs, legal entitlements, ecological damage, technical lock-in, or institutional dependencies. An intervention that transforms generative conditions can make later reversal difficult even if the original allocation was modest. Design can therefore consider exit, rollback, sunset, compensation, remediation, and mechanisms for affected subjects to challenge or revise the arrangement.

Intervention-oriented inquiry is necessarily ethical and political. Choosing what to change, whose capacities to expand, which risks to accept, and which alternatives to close involves normative judgment and distributions of authority. Technical sophistication cannot remove these questions. What GRE can contribute is a disciplined account of how proposed interventions enter relational fields, how their effects propagate beyond immediate recipients, how they alter future capacities and constraints, and how governance can remain responsive to evidence and contestation.

The ten modes distinguished in this section are therefore complementary ways of making GRE's research programme operational. Descriptive inquiry establishes configurations; explanatory inquiry identifies mechanisms; historical inquiry reconstructs formation; comparative inquiry tests variation and plurality; interpretive inquiry recovers meaning and symbolic mediation; causal inquiry disciplines attribution; formal inquiry clarifies explicit structures; computational inquiry extends representation and exploration; normative inquiry evaluates consequences and arrangements; and intervention-oriented inquiry connects analysis to deliberate change. Their combination is problem-dependent rather than fixed.

Methodological plurality, however, requires epistemic discipline. Combining modes does not automatically produce stronger knowledge if their assumptions, evidential statuses, and inferential limits remain implicit. The next constitutional task is therefore to state the commitments that govern how GRE moves among these modes: ontological suspension, partial observation, distinction between relation and representation, explicit boundary and scale selection, mechanism-sensitive attribution, historical dependence, methodological pluralism, revisability, and epistemic humility.

3.11 Epistemic Commitments of GRE

The methodological plurality established in the preceding section creates a further constitutional requirement. If Generative Relational Economics permits descriptive, historical, interpretive, causal, formal, computational, normative, and intervention-oriented inquiry, it also requires standards governing how claims move across those modes and how uncertainty is represented. Methodological plurality without epistemic discipline can produce a collection of incompatible assertions whose evidential status remains unclear. The role of this section is therefore to state the principal

epistemic commitments that constrain GRE inquiry across methods and domains. Its objective is neither to supply a complete philosophy of science nor to impose a single theory of knowledge. It instead specifies a working discipline for research conducted under relational complexity, historical change, partial observability, heterogeneous forms of evidence, and revisable analytical categories.

The commitments are organized around nine requirements: ontological suspension, acknowledgment of partial observation, separation of relation from representation, explicit boundary and scale selection, mechanism before unwarranted attribution, historical and contextual dependence, methodological pluralism, revisability of analytical categories, and epistemic humility. They are mutually reinforcing. Ontological suspension restrains the conversion of useful models into premature metaphysical claims. Partial observation prevents the observed record from being equated with the whole relational configuration. Distinguishing relation from representation keeps measurements, categories, graphs, narratives, and models analytically separate from the processes they represent. Explicit boundary and scale selection makes exclusions visible. Mechanism disciplines attribution. Historical dependence limits the portability of claims across contexts and periods. Methodological pluralism allows different forms of evidence to correct one another. Revisability makes the analytical vocabulary responsive to changing objects and evidence. Epistemic humility calibrates the strength of conclusions to the scope of their warrant.

These commitments do not require a researcher to remain permanently agnostic about every substantive question. GRE can make strong empirical or theoretical claims when evidence, design, and argument justify them. The commitments instead determine what must be shown before such strength is warranted. A causal estimate obtained from a credible design can support a bounded causal claim. A historically reconstructed mechanism can support an explanation when the documentary and comparative record is sufficiently strong. A formal theorem can establish consequences within a defined model. A normative argument can defend criteria under stated premises. Epistemic restraint does not weaken inquiry; it clarifies where the force of a conclusion comes from and which transformations of the claim would exceed the evidence that supports it.

The same discipline is particularly important because GRE studies processes that may alter the categories through which they are observed. A platform can reorganize what counts as work, a legal reform can alter the recognized economic subject, an accounting standard can change what becomes economically visible, an artificial system can redistribute capacities among human and organizational actors, and a governance intervention can transform the relations that later measurements attempt to describe. In such settings, the research object and the research representation can co-evolve. GRE therefore requires epistemic commitments that are compatible with historical transformation rather than assuming a permanently fixed ontology, vocabulary, or observation regime.

3.11.1 Ontological Suspension

Ontological suspension is the first epistemic commitment because GRE deliberately works with heterogeneous representations of economic reality. An inquiry may describe persons, organizations, institutions, flows, relations, fields, trajectories, networks, states, constraints, events, capacities, or symbolic objects. Each representation can disclose features that another suppresses. GRE therefore withholds claims about the ultimate ontological status of these objects unless the local inquiry requires such a claim and adequate argument is available.

Ontological suspension does not imply that nothing exists independently of description, nor does it reduce inquiry to arbitrary perspectivism. It is a methodological restraint concerning the relation between analytical usefulness and metaphysical conclusion. Treating a firm as an entity can be economically useful because the firm has relatively stable legal, organizational, accounting, and decision-making properties. Treating the same firm as a nexus of contracts, a field of authority, a network of relations, a bundle of productive capacities, or a historical process can also be useful for other questions. The availability of several productive representations does not by itself decide which description identifies the firm's final or most fundamental mode of being.

This suspension is especially important when scientific formalisms are transferred into economic analysis. A state space can organize possible configurations without proving that the economy literally consists of points in a pre-given mathematical space. A network model can represent relations without proving that node and edge ontology is fundamental. A field representation can model distributed conditions without establishing a physical field ontology for social life. An agent-based model can operationalize actors without settling the philosophical status of agency. GRE treats such formalisms as analytical constructions whose adequacy depends on the question, assumptions, empirical correspondence, and explanatory gain.

The commitment also protects inquiry against premature reduction. Economic value need not be reduced to price because price is measurable. Institutional recognition need not be reduced to individual preference because choice data are available. Collective capacities need not be reduced to the sum of personal attributes when organizational relations contribute to what can be done. Conversely, relational language does not license the reduction of entities to relations in every context. Relational constitution and relative entityhood can coexist at different scales and for different purposes.

Ontological suspension therefore supports a layered practice of commitment. GRE can commit locally to an operational ontology for a study: it may define firms, households, algorithms, jurisdictions, or communities as analytical units and proceed rigorously within that specification. The suspension concerns the elevation of that local choice into a universal claim. A representation is adequate when it supports warranted inquiry into the relevant mechanism or phenomenon; it becomes ontologically overextended when its convenience is treated as proof that excluded dimensions are unreal or insignificant.

This commitment also preserves the possibility of theoretical correction. New evidence can reveal that an apparently stable entity is internally heterogeneous, that a

presumed relation is mediated by an unobserved institution, or that a category formerly treated as natural is historically contingent. GRE should permit the analytical ontology to change with the inquiry rather than defend the initial representation merely because it was useful at an earlier stage. Ontological suspension is thus not indecision. It is a discipline of keeping the strength of ontological claims proportionate to the work they actually perform.

3.11.2 Partial Observation

GRE assumes that economic observation is structurally partial. Researchers encounter traces, measurements, classifications, documents, transactions, interviews, images, records, behavioral outputs, and other manifestations of processes rather than an exhaustive presentation of the processes themselves. This partiality is not a temporary defect that disappears once sufficiently large datasets are obtained. Even abundant observation remains conditioned by what can be recorded, which categories are used, which events become legible, which populations are included, and which temporal or relational scales are accessible.

Partial observation has several forms. Some variables are simply unobserved. Others are observed through proxies whose validity depends on context. Some relations leave weak administrative traces. Informal activity may be systematically missing from official records. Household labor can remain economically consequential while being absent from market transactions. Platform data can be highly granular while revealing little about off-platform constraints. Historical archives can preserve institutional voices more consistently than marginalized ones. A sensor system can continuously observe behavior while remaining unable to identify meaning or motive. The volume of evidence therefore does not determine its completeness.

The relational character of GRE makes this issue especially consequential. Observing an individual without observing relevant relations can produce a misleading description of capacity, constraint, or choice. A worker's income does not fully disclose bargaining power, household obligations, visa dependence, care responsibilities, access to infrastructure, or exposure to algorithmic evaluation. A firm's balance sheet can omit the public infrastructures, ecological dependencies, cultural resources, or community relations that condition production. A policy's administrative beneficiary list can omit subjects affected through prices, labor markets, household relations, ecological effects, or institutional precedents.

Partial observation also has a temporal dimension. Data may capture a process after important generative events have already occurred. Current inequality can reflect earlier institutional selections that are no longer directly visible. An observed preference can be the result of prior adaptation, exclusion, learning, or habituation. A stable relation may have emerged from a sequence of contingencies that cross-sectional evidence cannot recover. GRE therefore distinguishes observing a current configuration from knowing the history that generated it.

The commitment to partial observation changes how evidence is reported. Missingness, measurement error, selection, proxy construction, archival survival, model dependence, and unobserved mediation should be treated as substantive features of the epistemic situation rather than technical footnotes. A study need not solve every

limitation, but it should identify those that materially affect interpretation. When evidence supports only a restricted claim, the claim should remain restricted.

Partiality also motivates triangulation without turning triangulation into automatic confirmation. Different evidence sources can compensate for different blind spots. Administrative data may establish distributional patterns; interviews can identify mechanisms or meanings absent from records; archival sources can reconstruct institutional change; ethnography can reveal enactment; experiments can isolate effects under constrained conditions; computational traces can show large-scale patterns. Agreement among these sources can strengthen confidence, while disagreement can reveal that they are observing different layers of the process.

GRE therefore treats observability as part of the economic and institutional environment. What becomes observable can itself be shaped by law, technology, organizational incentives, classification systems, and power. Some actors can make their activities legible while others remain invisible; some institutions can require reporting; some platforms can monopolize data; some harms appear only after measurement categories are created. Observation is consequently both an epistemic relation and, in many settings, an object of economic analysis.

3.11.3 Distinction between Relation and Representation

GRE distinguishes the relations under study from the representations through which those relations become analytically accessible. A representation can be a variable, category, graph, matrix, equation, narrative, map, model, legal classification, accounting entry, database schema, or visual diagram. Each representation selects and organizes features of a target domain. None should be treated as identical to the relation merely because it is useful for describing it.

This distinction is fundamental to relational inquiry because representations can create an appearance of precision that exceeds their empirical warrant. A network edge can encode communication, ownership, authority, trust, exchange, co-membership, or inferred association. Two edges of identical graphical form can represent substantively different relations. A weight attached to an edge may record frequency, monetary value, probability, distance, or a model-derived score. The mathematical object is therefore interpretable only through the measurement and theoretical decisions that produced it.

The same issue appears in categorical and institutional representations. A legal category can stabilize a relation for governance without exhausting its social meaning. An accounting classification can make a form of value visible while excluding others. A survey category can facilitate comparison while compressing heterogeneous experiences. An algorithmic score can summarize observed correlates while becoming institutionally consequential through decisions made on its basis. Representation can therefore both describe relations and participate in their transformation.

GRE consequently requires researchers to specify the mapping between representation and target. If “trust” is represented by repeated cooperation, the inferential gap should be stated. If “power” is represented by network centrality, the mechanism connecting centrality to power must be argued rather than assumed. If a latent variable is used to summarize capability, the construction and interpretation of that

variable should remain visible. If text embeddings represent semantic similarity, similarity in the model space should not automatically be equated with shared meaning among subjects.

This distinction also protects formal analysis from reification. A model can derive properties of a representation with complete mathematical rigor while leaving open whether the represented mechanism is empirically operative. Computational sophistication cannot bridge that gap by itself. A simulation result is a consequence of a model and its parameterization. It becomes evidence about an empirical target only through validation, calibration, comparison, and argument connecting the representation to observed processes.

Representations can nevertheless become economically real in a second sense: actors may respond to them. Credit scores, rankings, performance indicators, ratings, risk categories, forecasts, and accounting metrics can alter behavior and resource allocation. The fact that a representation becomes causally consequential does not erase the distinction between representation and relation; it creates an additional relation in which the representation enters the system it describes. GRE should then study both its descriptive adequacy and its performative effects.

Maintaining this distinction enables stronger rather than weaker modeling. It allows researchers to use abstraction aggressively while keeping track of what has been abstracted. A representation can be deliberately narrow if the local question is narrow. The epistemic requirement is transparency concerning what the representation contains, what it excludes, how it was constructed, and which claims can legitimately be inferred from it.

3.11.4 Explicit Boundary and Scale Selection

Every GRE inquiry selects a boundary and scale. The selection determines which entities, relations, periods, jurisdictions, infrastructures, ecological conditions, and forms of value enter the analysis. Because GRE often studies effects that propagate beyond administrative recipients or immediate transactions, boundary selection is an epistemic decision with direct consequences for what can be observed and explained.

A boundary is never justified merely by being available in the data. Firm-level data encourage a firm boundary; household surveys encourage a household boundary; national statistics encourage a national boundary. These sources can be appropriate, but the research question may require a different relational domain. A wage change can affect households, local demand, public revenue, migration, or subcontracting. A technological intervention can change organizational workflows, professional identities, educational demand, and infrastructural dependence. An ecological extraction can produce effects beyond the jurisdiction in which economic value is recorded. The boundary should therefore be selected in relation to the mechanism under investigation.

Scale selection poses a related problem. The individual, organization, community, institution, ecosystem, and transnational system are not simply nested containers with fixed causal priority. A process that appears exogenous at one scale can become endogenous at another. An organizational rule can constrain an individual while being generated by industry regulation, professional norms, or platform infrastructure.

A national policy can appear autonomous until cross-border capital, legal regimes, or supply chains are included. GRE requires the researcher to state which scale is analytically primary and which cross-scale effects are being omitted or modeled.

Explicit selection does not require maximal expansion. The widest possible system boundary is rarely the most useful. Expanding a model can reduce identification, tractability, interpretability, or evidential quality. A bounded inquiry can be superior when the excluded relations are unlikely to alter the conclusion materially. GRE therefore favors justified boundaries rather than maximal boundaries. The researcher should explain why the chosen domain is sufficient for the claim and identify plausible pathways through which excluded relations could matter.

Temporal boundaries require equal attention. A programme evaluated after six months may appear successful while longer-term dependency, capability formation, institutional learning, or ecological cost remains unobserved. Conversely, a long historical window can obscure short-run mechanisms by aggregating distinct institutional regimes. The relevant temporal scale depends on the generation process being studied. Some effects are immediate; others emerge through accumulation, threshold crossing, learning, reproduction, or delayed conversion.

Boundary and scale choices can themselves be politically consequential. Administrative categories define who counts as a beneficiary, employee, resident, household member, owner, victim, or stakeholder. Jurisdictional boundaries determine which costs enter public accounting. Corporate boundaries can externalize labor or ecological relations into subcontracting and supply chains. GRE therefore examines not only the researcher's boundary but also the boundaries through which economic actors and institutions organize responsibility and visibility.

The epistemic commitment is straightforward: boundary and scale should be stated, defended, and revisable. Where conclusions are sensitive to alternative boundaries, that sensitivity is part of the result. A claim that survives reasonable changes in scale has different epistemic status from one that depends on a narrow administrative frame. GRE treats this sensitivity as informative rather than embarrassing because it reveals where economic descriptions are relationally contingent.

3.11.5 Mechanism before Unwarranted Attribution

GRE is interested in generation, propagation, conversion, subject formation, power, orientation, and structural transformation. These concepts can become excessively expansive if they are used to attribute every downstream difference to an initial relation. The fifth epistemic commitment therefore requires mechanism before unwarranted attribution. A relational association or temporal sequence becomes a generative claim only when the study provides a defensible account of how the earlier configuration contributed to the later one.

Mechanism can take different forms. It may involve incentives, authority, learning, information, legal recognition, technological affordances, resource transfer, network diffusion, social interpretation, institutional reproduction, ecological feedback, or strategic adaptation. The relevant mechanism can be probabilistic rather than deterministic and can operate jointly with other causes. GRE does not require a single universal mechanism of generation. It requires the mechanism invoked in a partic-

ular explanation to be specified sufficiently that evidence could distinguish it from plausible alternatives.

This standard is especially important for relational language. A relation between two actors does not automatically explain an outcome merely because the actors are connected. Network position, for example, can matter through access to information, bargaining leverage, reputational visibility, control of brokerage, exposure to contagion, or institutional authority. Different mechanisms can produce similar network patterns. A claim about the economic significance of structure therefore requires more than descriptive topology.

The same discipline applies to power. Persistent asymmetry is relevant to power, but asymmetry alone does not establish the mechanism through which one actor constrains another's options, shapes rules, controls resources, determines classifications, or alters future generative conditions. GRE should identify how asymmetry becomes actionable. Ownership rights, legal authority, infrastructure dependence, agenda control, data access, financial leverage, or control over recognition may provide such mechanisms. Where the pathway remains uncertain, the claim should be framed as a hypothesis rather than a conclusion.

Mechanism also disciplines claims about value conversion. If educational participation is said to generate social capital, which interactions produce continuing relations? If trust is said to generate economic cooperation, what institutional or experiential processes stabilize expectations? If cultural recognition is said to improve economic capability, through which access, motivation, legitimacy, or network pathways does the conversion occur? Naming the initial and final categories is insufficient; the transformation between them is the object that requires explanation.

This commitment does not imply that every GRE study must identify a complete micro-mechanism. Some phenomena are best explained at organizational, institutional, or ecological scales. A legal rule can have a causal effect without being reduced to individual psychology. A market design can alter incentives without reconstructing every subjective deliberation. Mechanistic adequacy is scale-relative. The requirement is that the explanatory link be more specific than a retrospective association and that the proposed pathway fit the level at which the claim is made.

Mechanism before attribution also protects normative analysis. Harm should not be assigned to a particular actor or intervention merely because the harm occurred within a broader relational system. Responsibility can be distributed, mediated, historically inherited, or structurally reproduced. Normative attribution may therefore require a separate analysis of control, foreseeability, benefit, capacity, institutional role, and available alternatives. GRE's relational orientation expands the field of possible responsibility while simultaneously requiring greater care in attributing it.

3.11.6 Historical and Contextual Dependence

GRE treats economic categories, mechanisms, and regularities as potentially dependent on historical and institutional context. This commitment follows from the earlier chapters' emphasis on changing productive relations, subject forms, technologies, norms, legal categories, and value structures. A relation that operates in one institutional environment may change meaning or effect in another. Historical and

contextual dependence therefore constrains generalization without eliminating the possibility of general knowledge.

Context dependence can enter through mechanisms. Credit can expand productive capacity in one institutional setting and reinforce dependence in another. Informal networks can provide resilience where formal systems are weak while reproducing exclusion where membership is restrictive. Algorithmic evaluation can reduce some forms of discretion while creating new informational asymmetries and dependencies. A cooperative structure can enable collective control under supportive legal and financial conditions yet remain marginal under a regime that withholds access to capital or procurement. The nominal form of a relation therefore does not uniquely determine its generative effects.

Historical dependence also affects categories. The economic meaning of "worker," "firm," "household," "property," "skill," "platform," or "currency" is shaped by institutional arrangements that change over time. A category can retain its name while the relations that constitute it transform. GRE should therefore avoid treating administrative continuity as proof of substantive continuity. Historical reconstruction can be necessary even when contemporary data appear precise.

The commitment does not require every proposition to be historically unique. Recurrent mechanisms can be identified across cases, and comparative analysis can reveal robust patterns. The epistemic task is to specify the domain of portability. A mechanism may generalize across institutional settings under identifiable conditions; a formal model may describe a family of processes; a causal effect may transport when relevant effect modifiers are sufficiently similar. GRE therefore distinguishes universalizing language from conditional generalization.

Context dependence also concerns meaning. Economic actors interpret rules, resources, risks, and opportunities through historically situated symbolic and normative frameworks. The same monetary transfer can signify compensation, obligation, charity, recognition, debt, or entitlement in different settings, with different relational consequences. Interpretive evidence can therefore be necessary when the mechanism depends on how actors understand the relation.

The historical commitment extends to the researcher's categories and methods. Measures calibrated in one period can lose validity as institutions change. A proxy for employment stability can fail when contractual forms transform. A model of media attention can become obsolete after a platform redesign. A measure of technological capability can change meaning as complementary infrastructures diffuse. GRE should treat measurement regimes as historically situated rather than assume that a stable variable label guarantees stable construct validity.

This commitment encourages temporal comparison and repeated evaluation. A finding can be valid for the period studied and later require revision because the object changed. Such revision does not necessarily invalidate the earlier research; it can reveal the historical conditions under which the earlier claim held. GRE therefore regards the temporal domain of a claim as part of its specification.

3.11.7 Methodological Pluralism

Methodological pluralism is an epistemic commitment because no single method has privileged access to every aspect of a generative relational process. Quantitative estimation, qualitative interpretation, historical reconstruction, formal modeling, computational simulation, comparative analysis, experiments, ethnography, archival work, network analysis, and participatory methods each make some features more visible and others less so. GRE therefore treats methods as differentiated instruments of inquiry whose adequacy depends on the claim being made.

Pluralism differs from methodological eclecticism without standards. The presence of several methods does not strengthen a study automatically. Each method must contribute an identifiable epistemic function. A qualitative study can identify mechanisms and meanings that guide quantitative measurement. A quantitative design can estimate the distribution or magnitude of an effect suggested by qualitative evidence. Historical analysis can reveal institutional transitions that make a cross-sectional association intelligible. Formal modeling can clarify whether a proposed mechanism is internally coherent. Simulation can explore trajectories under specified assumptions. Their combination is valuable when the outputs constrain or inform one another.

Pluralism also means that methodological disagreement can be productive. If administrative data indicate improved employment while interviews reveal increased insecurity, the discrepancy may reflect different populations, time horizons, definitions, or dimensions of the outcome. GRE should investigate the divergence rather than force immediate convergence. Different methods can reveal multiple aspects of a heterogeneous value structure or relational configuration.

No hierarchy follows automatically from formal precision. Mathematical and computational methods can make assumptions explicit, derive implications, and handle complexity that prose alone cannot. Their precision concerns the representation once specified. Empirical relevance still depends on the quality of the mapping between model and target. Conversely, qualitative richness does not eliminate the need for disciplined inference. Interpretive accounts require transparent evidence, plausible alternatives, and attention to scope. Historical narratives require source criticism. Normative arguments require defensible premises. Methodological pluralism therefore expands the repertoire of rigor rather than relaxing it.

The commitment also preserves compatibility with established economics. GRE does not require replacing econometrics, experiments, equilibrium analysis, mechanism design, industrial organization, public economics, labor economics, or other established approaches when they answer the relevant question well. A GRE inquiry can incorporate these methods and add relational or generative analysis where it materially changes explanation. Pluralism includes the possibility that the best answer to a bounded question is supplied by an existing method without specifically GRE additions.

Pluralism has institutional implications for research design. Data infrastructures, publication norms, disciplinary training, and funding systems often privilege some evidence types over others. A research programme that studies heterogeneous relational processes must resist converting institutional convenience into epistemic hi-

erarchy. This does not mean every project must be interdisciplinary. It means that exclusions among methods should be justified by the question rather than inherited uncritically from disciplinary boundaries.

The strongest form of methodological pluralism in GRE is mutual corrigibility. Formal models can expose ambiguity in conceptual claims. Historical evidence can show that apparently universal categories are contingent. Qualitative evidence can reveal omitted mechanisms. Causal designs can challenge compelling narratives. Computational models can test whether proposed local rules produce the claimed system-level pattern. Normative analysis can reveal that an empirically efficient intervention depends on contested evaluative premises. Methods become part of a common research programme when they can correct one another without being forced into a single epistemology.

3.11.8 Revisability of Analytical Categories

GRE treats its analytical categories as revisable. Relation, subject, value, capacity, institution, field, constraint, trajectory, generativity, and power are working concepts whose definitions should become more precise through research. The commitment to revisability follows from ontological suspension and historical dependence: if the objects of inquiry can change and if different representations disclose different aspects of them, then the vocabulary of the research programme cannot be permanently fixed at its founding stage.

Revisability does not imply conceptual looseness. A study should define its categories precisely enough to support inference. The revision occurs when evidence, theoretical contradiction, cross-case comparison, or improved formalization shows that the existing category fails. The relevant distinction is between local precision and global finality. GRE can use a precise operational definition while remaining open to revising that definition in later research.

Category revision can take several forms. A category can be subdivided when previously hidden heterogeneity becomes important. Several categories can be combined when distinctions prove analytically unproductive. Boundaries can change when new relations become visible. A category can move from exogenous condition to endogenous object of inquiry. A variable treated as an attribute can be reconceptualized as relationally generated. A representation can be abandoned if it systematically misclassifies the phenomenon.

Economic subjecthood provides one example. A research programme built exclusively around human individuals would be strained by organizations, automated systems, collective entities, or hybrid arrangements that make economically consequential selections. Expanding the category of operational economic subject can improve analysis, but that revision need not erase distinctions concerning consciousness, personhood, legal standing, or moral status. Revisability allows the category to change while preserving distinctions that remain normatively or empirically necessary.

Value provides another example. Price can remain a central economic representation of value without exhausting the relevant evaluative or relational phenomena. Research can discover forms of value whose realization depends on access, recognition, participation, ecological capacity, institutional continuity, or future capability.

Revising the analytical vocabulary to capture these forms does not require treating them as commensurable or collapsing them into a single metric.

Revisability also applies to GRE itself. Concepts introduced in this book are provisional elements of a research programme rather than protected doctrine. Later empirical work may show that some distinctions are unproductive, that other concepts are missing, or that the framework overstates the usefulness of generative analysis in particular domains. A research programme becomes cumulative not by preserving every founding category but by creating procedures through which categories can be criticized, compared, refined, and replaced.

This commitment places a burden on documentation. When categories change across studies or over time, researchers should record how definitions differ and why. Conceptual drift can otherwise appear as empirical change. GRE therefore favors transparent conceptual provenance: the history of a category's operationalization is part of the knowledge needed to compare results.

3.11.9 Epistemic Humility

Epistemic humility is the concluding commitment because it governs the relation among all the preceding ones. It requires the strength, scope, and precision of a claim to remain proportionate to the evidence and argument that support it. Humility does not require weak conclusions where strong conclusions are justified. It requires researchers to distinguish what has been observed from what has been inferred, what has been modeled from what has been validated, what is locally supported from what is generalized, and what is normatively defended from what is empirically established.

In relational economic inquiry, overstatement can arise easily because the studied systems are interconnected. Once a downstream effect is observed, it is tempting to narrate a complete chain of generation. Once a network pattern appears, it is tempting to attribute power or influence. Once a simulation reproduces a stylized fact, it is tempting to treat the mechanism as confirmed. Once an intervention succeeds locally, it is tempting to generalize it across contexts. Epistemic humility interrupts these moves by requiring an explicit account of the inferential bridge.

Humility also concerns uncertainty that cannot be reduced to a probability estimate. Researchers can face model uncertainty, category uncertainty, boundary uncertainty, interpretive disagreement, historical incompleteness, unknown unknowns, or normative pluralism. Quantification is valuable when a defensible probability model exists, but not every epistemic limitation is probabilistic. GRE therefore permits qualitative statements of uncertainty where numerical precision would be misleading.

The commitment is especially important for intervention. Application-dominant praxis often requires action before knowledge is complete. Epistemic humility does not imply inaction under uncertainty. It changes how intervention is designed: assumptions are made explicit, monitoring is built in, reversible steps are preferred where feasible, affected subjects retain opportunities for contestation, and the intervention is treated as a source of new evidence rather than the execution of a final truth. Learning and governance become coupled.

Humility also requires attention to the distribution of epistemic authority. Researchers, administrators, firms, communities, workers, users, and affected populations can possess different forms of knowledge. Expertise can be real without being total. Local experience can identify mechanisms invisible to aggregate data while remaining limited in scope. Institutional actors can possess operational information while having incentives to frame it selectively. GRE therefore treats disagreement among knowledge holders as an object for analysis rather than assuming that one standpoint has automatic priority across all questions.

This commitment extends to artificial and computational systems. Large models, automated inference, and high-dimensional data can increase the scale and speed of analysis, but they do not eliminate uncertainty concerning data generation, representation, causal identification, normative criteria, or institutional effects. Computational confidence can be numerically precise while remaining epistemically narrow. GRE should therefore distinguish predictive performance from explanatory adequacy, statistical calibration from normative legitimacy, and representational capacity from knowledge of the target process.

Epistemic humility finally concerns the research programme's own historical position. GRE is being constituted under particular contemporary conditions: changing productive relations, computational abundance, new forms of artificial capability, ecological constraints, institutional complexity, and increasing visibility of relational and generative processes. These conditions make the programme plausible and potentially useful; they do not guarantee its enduring adequacy. Future economic forms may require different concepts. Existing theories may explain domains where GRE adds little. Evidence may contradict central hypotheses. The programme should be organized so that such correction is possible without treating revision as failure.

Taken together, the commitments of this section define a disciplined epistemic posture for Generative Relational Economics. GRE can make strong claims, employ sophisticated formalisms, combine diverse evidence, and participate in intervention, but it should do so while suspending unnecessary ontological conclusions, acknowledging partial observation, separating relations from their representations, making boundaries and scales explicit, demanding mechanisms for attribution, locating claims historically, preserving methodological pluralism, revising categories when required, and calibrating confidence to warrant. These commitments prepare the transition from inquiry to praxis. The following section turns to how GRE moves from explanation and evaluation toward relational diagnosis, generative diagnosis, and intervention under conditions where knowledge remains necessarily incomplete.

3.12 Praxis in Generative Relational Economics

The preceding sections established the objects, scales, questions, analytical perspective, modes of inquiry, and epistemic commitments of Generative Relational Economics. Those elements define how GRE can study economic relations, but a research programme concerned with generative conditions also requires an account of how inquiry can enter practice. The role of this section is to specify a preliminary praxis architecture for GRE: a disciplined way of moving from explanation toward interven-

tion while preserving the epistemic restraints developed above. Its objective is not to provide a universal policy cycle or a general theory of governance. It identifies a recurrent sequence of practical operations through which relational and generative knowledge can inform action under conditions of incomplete knowledge, heterogeneous values, changing environments, and effects that propagate beyond the administratively designated recipient.

GRE praxis begins from a distinction between understanding a system and acting within it. Explanation can identify mechanisms, constraints, distributions, histories, and relational structures, yet intervention changes the very configuration that explanation describes. An intervention can redistribute resources, alter expectations, create or dissolve relations, redefine institutional categories, shift bargaining positions, generate new dependencies, reorganize attention, and modify later capacities for action. Praxis therefore cannot be represented as the simple application of a finished model to a passive target. It is an entry into an evolving relational domain in which the intervention, the affected subjects, the environment, and the relevant knowledge can all change through their interaction.

For that reason, the praxis architecture developed here is iterative. It moves through relational diagnosis, generative diagnosis, identification of constraints and enabling conditions, intervention design, allocation understood as relational intervention, tracing of downstream effects, feedback and revision, adaptive governance, and, where required, withdrawal, reversal, or repair. These operations can overlap, recur, or be entered from different points. They are not a mandatory sequence imposed on every practical problem. Their function is to prevent a narrow intervention logic in which resources are allocated, an immediate output is measured, and wider changes are treated as externalities unless they happen to fit the original administrative frame.

The praxis perspective also preserves the distinction between research-dominant and application-dominant activity. Research-dominant praxis principally seeks improved understanding, even when research design itself changes the studied field. Application-dominant praxis principally seeks to alter an economic or institutional situation under practical constraints. The difference concerns orientation rather than an absolute separation between knowledge and action. Research can generate interventions, and interventions can generate knowledge. GRE therefore treats praxis as a domain in which explanation, evaluation, experimentation, governance, and learning become coupled while remaining analytically distinguishable.

A further constraint is normative. Generativity is not itself a sufficient criterion of success. An intervention can generate economic activity while deepening dependence, produce capabilities for one group while foreclosing possibilities for another, increase circulation while accelerating extraction, or create institutional stability by suppressing exit and contestation. Section 3.12 therefore develops the architecture of intervention without resolving the normative standards by which generated consequences should be judged. Those standards are taken up in the following section. Here the central concern is more basic: how GRE can intervene without treating either the target of intervention or the intervention's own consequences as fixed in advance.

3.12.1 From Explanation to Intervention

The movement from explanation to intervention is a change in epistemic and practical burden. Explanatory inquiry asks what relations, mechanisms, histories, and conditions contributed to an observed pattern. Intervention asks what may happen if some part of that configuration is deliberately altered. The second question contains the first but adds counterfactual, organizational, ethical, and temporal demands. A mechanism that explains a past outcome may not remain invariant after actors learn about the intervention, institutions adapt, or the distribution of resources changes. GRE therefore resists the assumption that an explanatory model can be converted directly into a policy instrument without re-examining the relations through which the intervention will operate.

A practical intervention enters a field already structured by prior relations. Subsidizing a household, financing a firm, redesigning a public service, opening access to data, changing a legal entitlement, or introducing an artificial system does more than modify one variable. It can alter who interacts with whom, which claims become enforceable, which actions become feasible, whose knowledge becomes authoritative, and which future trajectories become easier to sustain. The intervention should therefore be represented not only by its administrative action but also by the relational changes through which its consequences may be mediated.

This perspective changes the meaning of implementation. Implementation is often treated as the stage in which a previously selected intervention is executed with fidelity. GRE instead treats implementation as an epistemically productive period in which assumptions about relations, mechanisms, and capacities encounter an evolving empirical configuration. Deviations from the original design can indicate administrative failure, but they can also reveal that the initial model omitted relevant actors, constraints, interpretations, or feedback mechanisms. Praxis requires distinguishing avoidable execution error from informative evidence that the intervention theory requires revision.

The transition from explanation to intervention also introduces strategic interaction. Subjects can anticipate policy, resist classification, exploit new opportunities, reorganize coalitions, change reporting behavior, or redirect resources. Organizations can internalize an intervention into routines that differ from its stated purpose. Platforms can redesign interfaces in response to regulation. Beneficiaries can combine an allocation with household, community, or informal resources in ways that produce unanticipated effects. These responses are part of the relational system rather than noise surrounding an otherwise fixed treatment.

GRE therefore favors interventions whose theory of change states at least four elements. First, it identifies the relevant relations through which the intervention is expected to operate. Second, it specifies the generative claim: what capacities, structures, opportunities, constraints, or forms of value are expected to emerge or transform. Third, it states the anticipated temporal and scalar pathways through which effects may propagate. Fourth, it identifies observations that would count against the intervention theory. The resulting design remains provisional, but its provisionality is disciplined rather than vague.

Intervention under uncertainty does not imply paralysis. Many economic and gov-

ernance problems require action before the relational system is fully known. The practical question is how to make action compatible with learning. GRE therefore gives special weight to staged implementation, monitoring, contestability, modularity, reversible components, and explicit review points where feasible. These features do not eliminate uncertainty. They reduce the cost of discovering that the intervention has altered the field in ways the initial explanation did not anticipate.

3.12.2 Relational Diagnosis

Relational diagnosis identifies the configuration within which the practical problem is constituted. Its purpose is not to produce an exhaustive map of all social relations. It asks which relations are materially relevant to the problem, how they are organized, which boundaries have been selected, and where the apparent administrative object depends on actors or conditions outside that boundary. Diagnosis therefore precedes intervention design because the same nominal problem can require different action when its relational constitution differs.

A relational diagnosis begins by identifying the subjects, organizations, institutions, infrastructures, symbolic systems, and ecological conditions that participate in the relevant economic situation. It then asks how access, authority, recognition, information, resources, obligations, and opportunities are distributed among them. The resulting map may be qualitative, quantitative, historical, network-based, institutional, or mixed. Its adequacy depends on whether it reveals relations that are necessary to understand the practical problem rather than on whether it maximizes representational complexity.

Consider a programme intended to improve employment access. An administrative diagnosis might begin with unemployed individuals and available jobs. A relational diagnosis can reveal additional mechanisms: transportation, childcare, credential recognition, social networks, disability access, hiring intermediaries, platform ranking, visa status, household obligations, employer risk practices, or regional housing costs. These are not automatically the correct variables in every case. Their relevance depends on whether they mediate the conversion of an employment opportunity into an actual capability to obtain and sustain work.

Relational diagnosis also identifies asymmetry. The relevant question is not only who possesses more resources, but which actors can define categories, set terms of exchange, control infrastructures, impose switching costs, delay decisions, externalize risk, or withdraw without comparable loss. Two actors may exchange voluntarily while facing highly unequal exit conditions. A platform and a small supplier may both be organizations, yet their capacity to redesign the interaction can differ drastically. Diagnosing these asymmetries matters because an intervention that treats formally similar actors as substantively equivalent can reproduce the mechanism that generated the problem.

The diagnosis should also be historical. Present relations can depend on prior institutional settlements, accumulated debts, inherited infrastructures, past exclusions, or sequences of investment that make current alternatives unequally costly. A cross-sectional map can show who is connected to whom while missing why the relation has its present form or why some apparently available alternatives are prac-

tically inaccessible. Historical reconstruction helps distinguish a relation that is contingent and readily modifiable from one stabilized by layered commitments and path-dependent investments.

The output of relational diagnosis is therefore a bounded working representation of the practical field. It should make its exclusions visible. No map captures every relation, and an attempt to include everything can make intervention impossible. GRE instead requires an explicit statement of which relations are treated as inside the diagnostic boundary, which are treated as environmental conditions, and which remain uncertain. The map is revisable as intervention reveals previously hidden dependencies.

3.12.3 Generative Diagnosis

Relational diagnosis identifies the configuration; generative diagnosis asks what that configuration tends to produce. The distinction matters because the same relational structure can be significant for different reasons depending on the processes it sustains. A credit relation can generate productive capacity, dependency, reputational effects, data, bargaining power, future borrowing opportunities, or combinations of these. A school can distribute instruction while also generating networks, credentials, expectations, classifications, and future access. A platform can facilitate exchange while generating information asymmetries, behavioral dependence, market visibility, or new organizational capabilities.

Generative diagnosis therefore focuses on transformations rather than only states. It asks what changes because a relation persists, intensifies, weakens, or is removed. The relevant outcomes can include resources, capacities, identities, institutional routines, legal positions, expectations, symbolic categories, ecological conditions, or the ability to enter later relations. This focus is particularly important when immediate outputs are poor proxies for longer-horizon consequences. A grant may be fully disbursed while failing to produce the organizational capacity it was intended to support. A training programme may improve measured skills while weakening participation because the credential is not institutionally recognized. A subsidy may increase adoption while entrenching dependence on a proprietary infrastructure.

The generative diagnosis should distinguish several pathways. Some effects arise directly from the intervention target. Others are mediated through relations with third parties. Some emerge from feedback: an initial change alters behavior, which changes the environment faced by later participants. Some effects accumulate only after repeated interactions. Others occur through symbolic or classificatory change, where being recognized as eligible, risky, employable, innovative, or compliant modifies later treatment by institutions.

Generative diagnosis also asks what is reproduced. A relational configuration may produce no dramatic new outcome while continually regenerating a distribution of advantage, vulnerability, or access. Stable inequality can be generative in this sense because institutions repeatedly convert initial asymmetries into later opportunities. Conversely, a relation can sustain capabilities that would deteriorate if the relation disappeared. Maintenance, reproduction, and repair are therefore forms of generation when they preserve conditions that require continuing relational work.

A further question concerns foreclosure. Generation can expand possibilities for some actors while reducing the future option set for others or for the same actors at a later time. Infrastructure investment can enable activity while creating technological lock-in. Debt can finance capacity while narrowing future discretion. Standardization can reduce coordination costs while suppressing alternative forms of practice. Generative diagnosis therefore traces both enabling and constraining transformations without assuming that generation is uniformly expansive.

The practical output of generative diagnosis is a set of plausible mechanism pathways linking the relational configuration to changes that matter for the intervention. These pathways can be compared, tested, revised, or ranked by evidential support. GRE does not require every pathway to be fully identified before action. It requires the intervention to state what it expects to generate and why, so that later observations can update rather than merely decorate the original theory.

3.12.4 Identification of Constraints and Enabling Conditions

Diagnosis becomes actionable when it identifies conditions that limit or enable transformation. GRE uses constraint in a broad but disciplined sense: a constraint changes the set, cost, probability, or viability of available transformations without necessarily making an action logically impossible. Enabling conditions operate in the opposite direction by making some transformations more feasible, durable, or accessible. The same condition can constrain one pathway while enabling another.

Constraints can be material, institutional, relational, informational, temporal, symbolic, ecological, or cognitive. A lack of capital is a material constraint, but the ability to use capital may depend on licenses, trusted partners, language access, data, infrastructure, or the timing of payments. A legal entitlement can exist while remaining practically inaccessible because procedural complexity, documentation requirements, or fear of institutional contact limits its use. An organization can possess technical capacity while lacking the authority to deploy it. A community can possess knowledge while lacking channels through which institutions recognize that knowledge as actionable.

The distinction between constraint and symptom is central. Low participation can be treated as a behavioral problem and addressed through incentives, yet the underlying constraint may be timing, distrust, inaccessible procedures, reputational risk, or exclusion from the networks through which information circulates. Raising an incentive can improve participation while leaving the deeper constraint unchanged, or it can worsen inequality if only already advantaged actors can respond. Constraint identification therefore asks which conditions actually regulate the transformation pathway relevant to the intervention.

Enabling conditions deserve equal analytical attention. Praxis often becomes overly problem-centered and maps only deficits. Existing trust relations, local organizations, informal knowledge, public infrastructure, legal protections, professional norms, ecological capacities, and mutual-aid practices can already support generation. An intervention that ignores these conditions can displace them with a formal system that appears more legible while being less generatively capable. GRE therefore asks which existing relations should be preserved, strengthened, connected, or

left undisturbed.

Constraints and enabling conditions are also scale-relative. A national regulation can constrain an organization while enabling fairer competition across a sector. A household norm can constrain an individual's labor-market participation while enabling care provision that sustains other members. A standardized protocol can constrain local discretion while enabling interoperability. Praxis requires representing these tensions rather than declaring a condition simply enabling or constraining in the abstract.

The identification process should therefore produce intervention points rather than a flat inventory. Some constraints are proximal and modifiable; others are structural conditions that cannot be changed within the intervention horizon. Some enabling conditions can be activated with modest resources; others require institutional reform. Distinguishing these categories helps prevent designs that target visible but weakly generative variables while leaving the mechanisms of exclusion or capacity formation intact.

3.12.5 Intervention Design

Intervention design translates diagnosis into a provisional configuration of actions, resources, institutions, and learning procedures. GRE does not require a distinctive policy instrument. Taxes, transfers, public investment, regulation, organizational redesign, information provision, infrastructure, standards, cooperative arrangements, educational programmes, platform rules, procurement, or combinations of these can all be compatible with GRE. What distinguishes the praxis perspective is how the intervention is specified: in relation to mechanisms, downstream generation, scale, feedback, and revisability.

A GRE intervention should first identify its operative target. The target can be a resource constraint, a relation, a conversion mechanism, an institutional rule, a boundary, a feedback loop, an information structure, or an enabling condition. Target clarity matters because interventions with the same administrative recipient can act through different mechanisms. A cash transfer and a childcare service may both support household economic participation, but they alter different constraints and relational structures. Their effects should not be inferred from the shared identity of the recipient.

Second, intervention design should distinguish the intended immediate change from the intended generative effect. Providing equipment is an immediate allocation. Developing a durable productive capacity may be the generative objective. Changing a regulation is an immediate institutional act. Increasing entry, reducing dependency, or enabling new organizational forms may be the intended downstream effect. This distinction makes it possible to observe successful implementation together with failed generation, or imperfect implementation together with unexpected generative benefits.

Third, design should state relevant temporal horizons. Some interventions seek rapid stabilization; others seek capacity formation whose effects appear slowly. A short evaluation window can misclassify a long-horizon intervention as ineffective or reward interventions that produce immediate outputs by drawing down future re-

sources. GRE therefore encourages explicit differentiation among immediate, intermediate, and longer-horizon effects without assuming that longer is always better.

Fourth, intervention design should anticipate heterogeneity. Subjects differ in resources, vulnerabilities, interpretation, institutional status, and ability to convert an allocation into later capacity. Uniform provision can therefore generate unequal outcomes. The design question is not necessarily to individualize every intervention, which can become administratively costly or intrusive. It is to identify forms of heterogeneity that are mechanism-relevant and to determine whether adaptive, tiered, or plural pathways are needed.

Fifth, design should include learning architecture. Monitoring variables, qualitative feedback, review intervals, stop conditions, and procedures for incorporating affected participants should be established before implementation where possible. This prevents evaluation from becoming an after-the-fact search for favorable indicators. It also recognizes that some of the most important effects may be discovered only after the intervention enters the field.

Intervention design in GRE is therefore closer to constructing a revisable relational hypothesis than to selecting a fixed treatment. The design states what is being changed, through which relations, toward which generative effects, under which assumptions, across which scales and time horizons, and with what procedures for detecting error. The resulting intervention can still be administratively simple. Analytical sophistication does not require operational complexity when the mechanism is clear.

3.12.6 Allocation as Relational Intervention

Allocation is a central economic operation, but GRE treats allocation as the beginning of a relational process rather than its endpoint. Money, time, attention, infrastructure, rights, data access, institutional recognition, expertise, or productive assets enter existing relations when allocated. Their consequences depend on conversion conditions, obligations, expectations, complementary resources, and the position of the recipient within wider structures.

This perspective changes the unit of practical analysis. A transfer to an individual may affect a household, landlord, creditor, employer, local market, or platform through expenditure, bargaining, debt repayment, mobility, or information. Funding an organization can change its internal authority, external partnerships, reputational standing, and future ability to attract resources. Granting data access can create research capacity while redistributing informational advantage. Allocation therefore changes relations even when the formal instrument is directed to a discrete recipient.

Relational allocation does not mean that every allocation must be socially conditioned or collectively administered. Direct individual transfers can be valuable precisely because they reduce dependence on gatekeepers. The analytical point is that the intervention should ask what relations the allocation enters or transforms. An unconditional transfer can weaken a coercive relation by increasing exit capacity. A conditional transfer can create a new monitoring relation. A loan can expand productive capacity while strengthening a creditor's claims. The relational effects depend on design and context rather than on the category of instrument alone.

Allocation also has temporal structure. Resources can be consumed, invested, circulated, pooled, converted, or used to maintain existing capacities. Timing can determine which pathway becomes viable. A delayed payment can destroy a fragile organization even if the total allocation is adequate. A predictable stream can generate planning capacity beyond its nominal monetary value. A one-time grant can enable experimentation but fail to sustain maintenance. GRE therefore treats schedule, predictability, reversibility, and duration as properties of the allocation relation.

The recipient itself may be generated through allocation. Programmes define eligibility categories, create beneficiary identities, establish reporting obligations, and sometimes produce organizations capable of receiving funds. Public procurement can constitute firms as qualified suppliers. Credit scoring can define economically consequential categories of risk. Allocation systems therefore participate in the production of subjects and classifications, not merely in the distribution of pre-existing resources among them.

For praxis, the implication is that allocation should be evaluated through both direct transfer and relational transformation. The relevant questions include what capacity the resource creates, what dependencies accompany it, what complementary conditions are required, which actors gain authority, how value is recirculated or extracted, and what happens when the allocation stops. These questions extend ordinary allocation analysis rather than replacing it.

3.12.7 Tracing Downstream Effects

Once an intervention enters a relational field, praxis requires tracing effects beyond its immediate output. Downstream tracing follows the propagation, conversion, recirculation, dissipation, extraction, and stabilization of changes generated by the intervention. The purpose is not to attribute every later event to the intervention. It is to identify plausible pathways through which initially local changes become economically consequential elsewhere or later.

Downstream effects can be direct, mediated, recursive, or displaced. A subsidy can increase demand directly, alter supplier investment through expectation, change local prices through market response, and affect future policy through political interpretation. A new infrastructure can reduce transport costs, reorganize land values, change settlement patterns, and later alter fiscal capacity. A platform rule can affect user behavior, which changes the data used by the platform, which then changes ranking or recommendation, producing a recursive effect.

Tracing requires temporal discipline. Early indicators can differ from later effects because actors adapt and complementary investments emerge. Some harms are delayed. Some benefits require repeated interaction before they become visible. GRE therefore distinguishes outcome timing from causal distance. An effect that occurs quickly can still be relationally distant if it is mediated through several actors, while a delayed effect can arise from a simple accumulation mechanism.

Tracing also requires counterfactual restraint. Observing a later change in a connected actor does not prove that the intervention generated it. Evidence can come from experimental or quasi-experimental designs, process tracing, comparative cases, administrative sequences, qualitative testimony, network change, simulation,

or combinations of these. The method should match the claim. The broader the asserted downstream attribution, the greater the burden of distinguishing intervention effects from concurrent change.

Some downstream effects concern value conversion rather than magnitude. An allocation can be converted into political influence, social recognition, technical capacity, ecological pressure, or future access. These forms may not be commensurable with the original resource. Tracing therefore cannot always be reduced to adding monetary benefits and costs. GRE can use monetary valuation where appropriate while preserving additional dimensions when conversion into a scalar measure would erase mechanism-relevant differences.

The practical function of downstream tracing is to maintain contact between intervention and evolving reality. It provides evidence for revision, identifies beneficiaries or harmed parties omitted from the original frame, and detects when an intervention's generative pathway has changed. It also prevents a programme from declaring success solely because the administratively proximate output was delivered as planned.

3.12.8 Feedback and Revision

Feedback converts intervention into learning when observations are allowed to alter the intervention theory and design. GRE distinguishes feedback from mere monitoring. Monitoring records whether specified indicators change. Feedback becomes analytically consequential when those observations can revise assumptions about relations, mechanisms, boundaries, timing, subject heterogeneity, or normative effects.

A useful feedback architecture separates implementation evidence from generative evidence. Implementation evidence asks whether the intervention occurred as intended: funds reached recipients, infrastructure was built, a rule was applied, or a service became available. Generative evidence asks whether the intended transformations followed and what additional transformations occurred. Maintaining this distinction prevents implementation fidelity from being mistaken for substantive success.

Revision can occur at several levels. Parameters can be adjusted while the intervention theory remains intact. Delivery can change because conversion conditions differ across groups. The relational target can change when a hidden intermediary becomes visible. The generative objective itself can be revised when the original aim proves infeasible, harmful, or normatively contested. In more substantial cases, the intervention can reveal that the original problem representation was wrong and requires reconstruction.

Feedback should include affected subjects where their experience provides access to mechanisms or harms not visible in aggregate indicators. Participation is not automatically epistemically superior; local actors can disagree, possess partial information, or face incentives that shape reporting. Their knowledge nevertheless belongs to the evidential field. A feedback system that listens only to administrative data can systematically miss changes in trust, dignity, informal burden, strategic adaptation, or hidden exclusion.

Revision also requires institutional capacity. An organization can collect excellent evidence yet be unable to change because budgets, legal mandates, procurement contracts, professional incentives, or political commitments lock the intervention into its original form. GRE therefore treats the ability to revise as part of intervention design. Review authority, modular contracts, contingency funds, sunset clauses, and explicit decision rules can create practical room for learning, where appropriate.

Feedback is thus not a final stage after implementation. It is a continuing relation between action and evidence. Praxis becomes adaptive when the intervention is organized so that new information can change subsequent action without abandoning accountability or making goals infinitely movable.

3.12.9 Adaptive Governance

Adaptive governance is the institutionalization of revision under changing conditions. It becomes relevant when the intervention affects a system whose relations, actors, or environment evolve on a time scale comparable to the governance process. In such settings, a one-time optimal design can become obsolete even if it was well justified when adopted. GRE therefore treats governance as an ongoing arrangement for observing, deciding, revising, coordinating, and contesting changes in a relational field.

Adaptation does not mean continuous discretionary change. Constant revision can destroy predictability, undermine investment, and make rights dependent on administrative mood. Stable rules can themselves be enabling conditions. Adaptive governance therefore requires deciding which elements should remain stable and which should be revisable. Constitutional protections, procedural rights, or long-horizon commitments may provide a stable frame within which parameters, implementation mechanisms, or experimental components can change.

The architecture of adaptation should match the distribution of knowledge and consequence. Centralized revision can coordinate across regions and prevent local capture, while decentralized adaptation can respond to context and reveal heterogeneous mechanisms. Multi-level governance can combine these functions when authority, information, and accountability are allocated explicitly. GRE does not presume decentralization to be intrinsically more relational or generative. The relevant question is which governance structure can perceive and respond to the mechanisms that matter while preserving legitimate constraints on power.

Adaptive governance also involves threshold decisions. Some observed variation is noise; some indicates a changing mechanism. Revising too quickly can chase temporary fluctuations, while revising too slowly can entrench harm. Governance therefore needs criteria for escalation, experimentation, suspension, and review. These criteria can be quantitative, qualitative, procedural, or mixed depending on the domain.

Learning across cases is another component. Local adaptation can generate knowledge that becomes useful elsewhere, but portability requires comparison of mechanisms and boundary conditions. A successful intervention in one institutional environment may fail where trust, infrastructure, legal authority, or subject composition differs. Adaptive governance therefore builds cumulative knowledge by documenting not only whether an intervention worked, but under which relational conditions

and through which pathway.

At its strongest, adaptive governance alters its own learning capacities. Monitoring systems improve, categories are revised, participation channels change, and institutional memory accumulates. Governance thereby becomes a generative process whose output includes future ability to govern. This recursive feature is central to GRE praxis: the intervention should be evaluated partly by whether it leaves the system more capable of perceiving, contesting, and responding to later problems.

3.12.10 Withdrawal, Reversal, and Repair

A praxis architecture is incomplete if it specifies how to begin and revise interventions but not how to stop them. Withdrawal, reversal, and repair are distinct practical operations. Withdrawal ends or reduces an intervention. Reversal seeks to restore a prior condition or undo a change where feasible. Repair addresses harms, dependencies, damaged relations, or lost capacities that persist after withdrawal. GRE treats these operations as part of intervention design rather than exceptional responses to obvious failure.

Withdrawal can be required for several reasons. An intervention may fail to generate its intended effect, produce unacceptable harm, become obsolete as conditions change, or create costs that exceed its continuing value. It can also succeed so thoroughly that the intervention is no longer required. A temporary guarantee, emergency subsidy, or transitional institution should not become permanent merely because its removal was never designed.

Stopping an intervention can itself be generatively consequential. Organizations may have invested around a subsidy, households may depend on a service, communities may have reorganized around infrastructure, or markets may have adapted to a regulatory regime. Abrupt withdrawal can therefore destroy capacities that the intervention helped create. Exit design should consider notice, transition periods, transfer of responsibilities, preservation of useful infrastructure, and the distribution of adjustment costs.

Reversal is more demanding because relational change is often path dependent. Restoring a prior rule does not necessarily restore the prior system. Actors have learned, investments have shifted, expectations have changed, and some capacities may have disappeared. A policy reversal can therefore create a third configuration rather than return to the first. GRE treats reversibility as a graded property: some components can be reversed mechanically, others only approximately, and some transformations are effectively irreversible within the relevant horizon.

Repair addresses the residual consequences of intervention. It can involve compensation, restoration of access, institutional reform, rebuilding trust, data deletion or correction, ecological remediation, debt restructuring, reinstatement of rights, or support for capacities weakened by the intervention. Repair is not equivalent to monetary compensation because the harmed object may be relational, institutional, ecological, symbolic, or temporal. A payment can acknowledge loss while leaving the mechanism that produced the loss intact.

The possibility of repair also changes how interventions should be designed. Sys-

tems that preserve audit trails, appeals, modularity, data provenance, and institutional responsibility are easier to correct. Interventions that diffuse responsibility across opaque chains can make harm difficult to attribute and repair. GRE therefore treats repairability as a practical design consideration alongside effectiveness and adaptability.

Withdrawal, reversal, and repair complete the preliminary praxis cycle developed in this section. GRE moves from explanation toward intervention by diagnosing the relational field, identifying what the field generates, locating constraints and enabling conditions, designing a provisional intervention, treating allocation as a relational act, tracing downstream effects, learning through feedback, adapting governance, and retaining the capacity to stop or repair what has been created. The sequence remains heuristic rather than universal. Its purpose is to organize intervention under incomplete knowledge without reducing practice to either static optimization or unconstrained experimentation.

This praxis architecture also clarifies why evaluation cannot be postponed to a single terminal outcome. Each stage creates questions about value, harm, participation, capability, dependency, future possibility, and domination. An intervention may be operationally adaptive while normatively unacceptable, or normatively attractive in intention while generatively destructive in practice. The following section therefore turns from the architecture of action to the standards by which generated consequences can be evaluated under plural and sometimes incommensurable values.

3.13 Evaluation and Normative Orientation

Generative Relational Economics requires a normative vocabulary because the processes it studies can enlarge possibility, redistribute capacity, stabilize cooperation, create dependency, intensify domination, or foreclose alternative futures. The role of this section is to specify the evaluative dimensions through which such consequences can be examined without converting generativity itself into a moral criterion. Its objective is to distinguish descriptive claims about what an economic relation generates from normative judgments about whether the generated configuration should be sustained, revised, constrained, or repaired. The discussion proceeds through ten connected dimensions: the normative status of generativity; generated value and harm; participation; capability; relational quality; future possibility; dependency and domination; generative foreclosure; plural and incommensurable values; and the division of labor between GRE and GREthic. The method is constitutive and normative. It does not attempt to derive one complete moral theory from GRE. It identifies evaluative objects and inferential disciplines that allow GRE to remain normatively explicit while preserving plurality among competing theories of justice and ethical judgment.

The need for this distinction follows directly from the analytical architecture developed above. A relation can be highly generative in the descriptive sense because it produces new organizations, knowledge, technologies, markets, habits, classifications, capabilities, and forms of value. The same relation can distribute those consequences asymmetrically, externalize harms, narrow exit options, or reorganize the

field so that some future possibilities become inaccessible. An intervention can therefore succeed according to one generative objective while producing losses elsewhere in the relational domain. GRE evaluation must trace both kinds of consequence rather than allowing the presence of generation to function as evidence of desirability.

Normative evaluation also requires attention to temporal depth. Immediate welfare gains can be accompanied by long-run dependency. Short-term loss can sometimes create later capability. A stable relation can protect vulnerable participants while also becoming difficult to contest. An institution can increase aggregate opportunity while decreasing the range of trajectories available to a particular group. GRE therefore treats present outcome, relational position, future capacity, and transformation of possibility as analytically separable evaluative objects. Their relative importance cannot be fixed once for every inquiry.

Evaluation is also complicated by heterogeneous value. Economic decisions can affect income, security, care, recognition, ecological integrity, autonomy, knowledge, belonging, trust, aesthetic experience, institutional legitimacy, and many other forms of value whose relations are only partially commensurable. Monetary valuation can be useful within a defined problem while leaving significant evaluative remainders. GRE consequently distinguishes commensuration as an analytical or institutional operation from the stronger claim that the values being compared possess a common natural metric.

The resulting normative stance is neither value-neutrality nor normative closure. GRE accepts that economic inquiry frequently contains evaluative choices in the selection of outcomes, boundaries, scales, and affected subjects. It therefore seeks to make those choices explicit and contestable. At the same time, GRE does not treat its own analytical categories as sufficient to decide every ethical conflict. Participation, capability, relational quality, future possibility, dependency, domination, and foreclosure provide a multidimensional evaluative field. Normative judgment still requires specification of who is affected, which values are at stake, how conflicts among values are handled, and which ethical or political principles justify intervention.

This distinction creates an interface with GREthic. GRE supplies economic analysis of generative structures, distributions, dependencies, conversion pathways, and changes in future possibility. GREthic addresses the broader ethical problem of how such findings should enter judgment, justification, institutional design, and the evolution of normative criteria. Their relation is therefore collaborative without being identical. The present section establishes that interface while keeping GRE's disciplinary center within economics.

3.13.1 Normative Status of Generativity

Generativity describes a capacity of a relation, process, institution, or configuration to produce further states, capacities, relations, values, or possibilities. That descriptive property has no fixed normative sign. Productive networks, monopolistic infrastructures, extractive regimes, scientific communities, predatory markets, mutual-aid institutions, and systems of surveillance can all generate durable consequences. The fact that a configuration generates more than its immediate output identifies an important economic property; it does not establish that the resulting trajectory should

be preferred.

This distinction is foundational because GRE gives generativity an unusually prominent analytical role. Without an explicit normative separation, the vocabulary of generation could encourage a subtle bias toward expansion, novelty, proliferation, or self-reproduction. Economic history supplies many cases in which highly generative arrangements produced wealth together with coercion, ecological depletion, exclusion, or durable hierarchy. A relation can reproduce itself efficiently because the costs of exit are high. An institution can generate rapid innovation because risks are shifted toward actors with weak bargaining power. A platform can generate dense interaction while concentrating control over the infrastructure through which that interaction occurs. Descriptive generativity therefore requires an additional evaluative step.

The relevant question is not whether generation occurs, but what is generated, for whom, through which relations, under which constraints, and with what effects on later possibility. These questions prevent GRE from treating generativity as a scalar objective that can be maximized independently of content. More generation can be desirable in one dimension and damaging in another. A research system can generate knowledge while degrading working conditions. A credit system can generate entrepreneurial capacity while expanding vulnerability to debt. A welfare programme can generate security while also creating administrative classifications that constrain mobility. Evaluation therefore concerns the structure and distribution of generation.

Normative analysis must also distinguish generativity from regeneration. A system can generate novelty while eroding the material or social conditions required for continuation. Another system can maintain those conditions without producing substantial novelty. A third can restore damaged capacities while limiting some current activities. These trajectories involve different evaluative questions. GRE therefore avoids equating novelty, persistence, resilience, growth, and regeneration with one another. Each describes a different relation between current activity and future conditions.

A similar distinction applies to self-reinforcement. Some beneficial institutions require positive feedback to remain viable. Some harmful institutions also acquire self-reproducing capacities. The presence of a stable attractor-like pattern, increasing returns, or institutional persistence does not imply normative legitimacy. Evaluation must examine whether the mechanisms of reproduction preserve contestability, participation, and the possibility of revision or whether they make domination and exclusion increasingly difficult to reverse.

The normative status of generativity is consequently conditional and relational. GRE can identify generative mechanisms and compare their consequences without assigning a universal value to generation itself. Normative evaluation begins when the analysis asks how generated consequences affect subjects, relations, capacities, values, dependencies, and future possibility. The remaining subsections specify those dimensions in greater detail.

3.13.2 Generated Value and Generated Harm

Generated value and generated harm are parallel analytical objects. Both can emerge downstream from an economic relation, both can propagate beyond the administrative recipient, and both can change form as they circulate. The evaluative task is therefore broader than measuring the immediate benefit and subtracting a directly observed cost. GRE asks how value and harm are produced, distributed, converted, accumulated, displaced, and transmitted across scales and time.

Generated value can include income, capability, knowledge, security, trust, coordination, infrastructure, recognition, institutional capacity, ecological restoration, or access to future opportunities. Some forms of value are directly appropriable by a subject; others exist only through a relation or shared condition. A public standard, a trusted institution, a functioning ecosystem, or a community of practice can generate benefits whose value cannot be represented adequately as the possession of one individual. GRE therefore evaluates value at the level at which it is generated and realized.

Generated harm has equally varied forms. An intervention can increase surveillance, dependency, stigma, ecological burden, exclusion, precarity, misinformation, or concentration of bargaining power even when the designated recipient receives a material benefit. Harm can also be displaced. A low consumer price can be sustained through labor conditions elsewhere in the supply chain. Local ecological improvement can depend on transferring waste or extraction to another region. An automated system can reduce transaction costs while increasing the exposure of a minority of users to unreviewable classification errors. Evaluation must therefore examine relational incidence rather than only administrative incidence.

Value and harm can coexist within the same generative pathway. Education can expand capability while imposing debt. Infrastructure can improve access while displacing residents. Intellectual-property protection can support some forms of investment while constraining downstream experimentation. Social protection can reduce insecurity while creating reporting burdens or intrusive eligibility regimes. Such configurations should not be forced into a premature net-value judgment when the affected values are heterogeneous and differently distributed.

Temporal ordering further complicates evaluation. Harm can be immediate while value is delayed, or the reverse. Some effects are reversible; others create durable path dependence. A temporary subsidy may generate a lasting market or a lasting dependency. A short-lived exclusion can alter educational or professional trajectories for decades. GRE therefore records persistence and reversibility as part of the evaluative description rather than treating all consequences as contemporaneous flows.

This framework also makes attribution important. A downstream harm may be associated with an intervention without being generated by the mechanism under study. Conversely, a benefit may be credited to an intervention even though it depends mainly on pre-existing relations or complementary institutions. Normative evaluation should therefore inherit the epistemic discipline of Section 3.11: claims about generated value and harm require a stated mechanism, boundary, scale, and degree of evidential confidence.

3.13.3 Participation

Participation concerns the capacity of affected subjects to enter, influence, contest, benefit from, and withdraw from the relations through which economic life is organized. It is an evaluative object because economic systems do more than distribute resources. They distribute positions from which subjects can speak, act, create, coordinate, challenge classifications, and contribute to future generation. A configuration can therefore increase material output while narrowing meaningful participation.

Participation has several dimensions. Access concerns whether a subject can enter a relevant institution, market, infrastructure, profession, community, or decision process. Voice concerns whether the subject can make claims that receive institutional attention. Influence concerns whether participation can alter decisions rather than merely register preference. Recognition concerns whether the subject is legible within the categories through which resources and rights are allocated. Contestability concerns whether classifications, decisions, or rules can be challenged. Exit concerns whether participation remains voluntary in a meaningful sense or is sustained by dependence and prohibitive switching costs.

These dimensions need not move together. A platform can provide wide access while retaining centralized control over ranking and rule change. A formal consultation process can permit voice while leaving participants with little influence. A labor market can allow nominal exit from an employer while economic insecurity makes exit practically costly. A public service can grant rights in principle while administrative categories render some users difficult to recognize. GRE therefore avoids reducing participation to formal inclusion.

Participation also has a generative dimension. Being able to participate can develop knowledge, confidence, social ties, institutional literacy, bargaining capacity, and new forms of collective organization. Exclusion can have the opposite effect by reducing opportunities to acquire the capacities later required for participation. Present access can therefore shape future access. Evaluation should examine whether an arrangement generates broader capacities for participation or produces cumulative disadvantages that narrow future entry.

The economic significance of participation becomes especially visible under conditions of technological abundance. If productive tasks can increasingly be performed by artificial or highly automated systems, a framework that ties economic participation exclusively to productive necessity can leave human subjects with reduced access to income, institutions, social recognition, or meaningful collective activity. GRE does not presume a particular technological outcome, but it treats the institutional organization of participation as a distinct problem from the allocation of productive tasks.

Participation should not be romanticized. More participation can impose time costs, reproduce inequalities in voice, or shift responsibility onto subjects with limited resources. Some technical decisions require specialized knowledge; some participants may prefer delegation. The normative question therefore concerns the quality and consequences of participation, including who bears its burdens, what forms of representation are available, and whether nonparticipation is compatible with protection from arbitrary decisions.

3.13.4 Capability

Capability concerns the effective ability of subjects to pursue relevant actions and ways of living within their actual relational and institutional conditions. For GRE, capability is an especially important evaluative object because economic relations can generate or destroy the conditions through which resources become usable. An allocation that appears equal at the level of resources can produce unequal capability when subjects face different conversion conditions.

Capability therefore extends evaluation beyond possession. Access to money, information, technology, or legal rights matters only partly through the quantity received. Its practical significance depends on health, time, knowledge, infrastructure, social recognition, legal status, language, care obligations, physical accessibility, institutional trust, and many other conversion conditions. GRE can analyze these conditions as part of the relational field through which a resource becomes an effective opportunity.

Capabilities can also be cumulative. Education can increase the ability to learn further skills. Secure housing can improve the ability to sustain employment or study. Access to digital infrastructure can expand the capacity to participate in markets, administration, and knowledge production. Conversely, repeated exclusion can reduce the capacities needed to take advantage of later opportunities. Evaluation should therefore trace capability trajectories rather than treating capability as a static stock.

The generative perspective adds a second question: who controls the conditions under which capability can be exercised? A subject may possess technical competence while depending on a platform, license, visa, credential, payment network, data infrastructure, or institutional recognition. Capability is then relationally enabled. If access to the enabling condition can be withdrawn unilaterally, the subject's practical freedom may be more fragile than a simple skill inventory suggests.

Capability evaluation must also preserve normative pluralism. GRE does not need to specify one universal list of valuable capabilities in order to treat capability formation as economically significant. Different inquiries can justify different evaluative sets depending on the affected population, institutional context, and normative framework. The important discipline is to state which capabilities are being evaluated, why they matter, and how their measurement relates to the actual opportunities of subjects.

The distinction between capability and performance is equally important. A subject can possess a genuine opportunity without exercising it. Economic evaluation should not automatically infer deprivation from nonuse or success from observed functioning. Choices can reflect preference, but they can also reflect adaptation to constraint, uncertainty, social expectation, or limited information. GRE therefore treats capability as an evaluative lens that requires contextual interpretation rather than direct inference from observed behavior alone.

3.13.5 Relational Quality

Relational quality concerns the properties of the relations through which economic activity is organized. It directs evaluation toward features that can disappear when

analysis looks only at individual outcomes. Two arrangements can deliver similar material distributions while differing substantially in reciprocity, transparency, recognition, reliability, contestability, vulnerability to arbitrary power, or the burdens required to sustain cooperation.

Relational quality is deliberately a plural category. A high-quality relation in one context can emphasize trust and continuity; another can require independence and easy exit; a third can require procedural transparency or protection from discrimination. GRE therefore does not assume that one relational form is universally superior. It asks which properties are normatively relevant to the local relation and how those properties affect both current experience and later generative possibility.

Trust provides one example. Trust can reduce transaction costs, support cooperation, and enable forms of joint action that formal contracting cannot fully specify. Yet trust can also create vulnerability when one party controls information or enforcement. Dense trust within a group can coexist with exclusion of outsiders. Evaluation therefore concerns the conditions under which trust is generated, whether reliance is reciprocated, and what protections exist when trust is breached.

Recognition provides another example. Economic relations can treat subjects as interchangeable units or as participants whose claims and histories matter. Recognition can affect bargaining, access, dignity, willingness to cooperate, and institutional legitimacy. At the same time, institutional recognition often depends on categories that simplify complex identities. A recognition regime can include some subjects by making others invisible. Relational quality therefore includes the revisability of the categories through which recognition is granted.

Contestability is especially important in relations involving asymmetry. A subject may accept unequal expertise, authority, or capability when decisions remain reviewable and reasons can be challenged. The same asymmetry can become more problematic when rules are opaque, appeals are impossible, or dependence makes disagreement costly. GRE therefore treats relational quality as connected to the governance of asymmetry rather than to equality in every dimension.

Relational quality also has generative consequences. Relations characterized by reliability and fair contestation can support investment, experimentation, and long-term cooperation. Relations characterized by arbitrary sanction or unstable recognition can encourage defensive behavior, information withholding, and short planning horizons. Evaluation should consequently examine both the intrinsic and generative significance of relational quality without assuming that its value can be reduced to later efficiency gains.

3.13.6 Future Possibility

Future possibility concerns the range and quality of trajectories that remain realistically available after an economic relation or intervention has taken effect. It is central to GRE because present arrangements continually reshape the conditions of later action. Evaluation therefore extends beyond current welfare to ask whether subjects and institutions retain meaningful capacity to revise, learn, exit, recombine resources, or pursue alternative forms of life and organization.

Future possibility differs from abstract logical possibility. An option can exist formally while remaining practically inaccessible because of cost, law, infrastructure, knowledge, social position, or path dependence. GRE is concerned with feasible and relationally supported possibility. The relevant question is whether subjects possess the conditions required to convert an apparent option into a credible trajectory.

Economic development can expand future possibility by generating infrastructure, education, savings, institutional competence, public knowledge, and trusted coordination. It can also narrow possibility through debt lock-in, ecological depletion, monopoly, rigid standards, irreversible investment, or loss of local capability. The same intervention can expand options for one group while constraining another. Evaluation must therefore be distributional and multiscale.

Optionality also interacts with commitment. Some valuable projects require long-term coordination, sunk investment, and stable expectations. Preserving every option can prevent the formation of institutions whose value depends on continuity. GRE therefore does not treat maximal reversibility as a universal goal. It asks whether commitments are justified, whether affected subjects understand the resulting constraints, whether revision remains possible under changing conditions, and whether the burdens of irreversibility are distributed fairly.

The temporal horizon of evaluation matters. A policy that preserves short-run choice can undermine long-run ecological or fiscal possibility. A restrictive rule can reduce present options while protecting conditions needed for future generations. GRE therefore requires explicit time horizons and rejects the assumption that present preference alone exhausts normative relevance. Intergenerational effects become part of economic evaluation when current activity alters the capability and action space available later.

Future possibility also provides a bridge between economic and political evaluation. Control over infrastructure, standards, data, property, legal categories, or knowledge systems can determine which later projects become feasible. Power can therefore operate by structuring possibility before any specific decision is made. Evaluation of future possibility helps identify such upstream effects and prepares the analysis of power in the following section.

3.13.7 Dependency and Domination

Dependency is a pervasive feature of economic life. Individuals depend on households, organizations, infrastructures, ecological systems, legal institutions, markets, and other persons. Firms depend on suppliers, finance, standards, workers, customers, and public order. Dependency therefore cannot serve as a simple indicator of injustice. The evaluative problem concerns the structure of dependence: how essential the relation is, whether alternatives exist, how burdens and benefits are distributed, and whether one party can exercise discretionary power over another's conditions of action.

Some dependencies are reciprocal and mutually enabling. Specialization creates interdependence because actors can achieve more through coordinated reliance than through autarky. Care relations can involve deep dependence while also generating security, capability, and belonging. Public infrastructure creates dependence

on collective institutions that may be normatively desirable. GRE therefore distinguishes dependency from domination rather than treating self-sufficiency as the default ideal.

Domination becomes relevant when dependency is combined with power that is difficult to contest, exit, or subject to accountable rules. A worker can depend on an employer, a seller on a platform, a tenant on a landlord, or a state on a creditor. Whether the relation becomes dominating depends on the available alternatives, procedural protections, transparency, collective organization, legal constraints, and the ability to challenge arbitrary decisions. The analysis therefore concerns relational structure rather than the mere presence of unequal capability.

Generative mechanisms can deepen dependency over time. A platform can become more indispensable as participants invest in platform-specific reputation or data. A lender can acquire increasing influence when refinancing becomes necessary. A technology ecosystem can create switching costs through proprietary standards and complementary investments. Such processes transform an initially optional relation into one that shapes the subject's future possibilities. GRE evaluates the trajectory of dependency, not only its initial contractual form.

Dependency can also be hidden by administrative boundaries. An organization may appear autonomous while relying on unpaid care, public infrastructure, ecological services, or precarious subcontracting. A wealthy region can reduce local dependence by externalizing extraction elsewhere. Evaluation should therefore trace dependency across scales and identify whose capacities sustain the apparent independence of others.

The normative task is consequently to distinguish enabling interdependence from dependency that concentrates arbitrary power or systematically transfers risk. This distinction is contextual and requires attention to alternatives, voice, exit, reciprocity, and governance. GRE can map these conditions economically while leaving broader ethical judgment open to explicit normative argument.

3.13.8 Generative Foreclosure

Generative foreclosure occurs when a present economic relation, intervention, or institutional arrangement reduces the capacity to generate relevant future alternatives. Foreclosure is stronger than an ordinary opportunity cost. Every choice excludes some alternatives because resources and time are finite. Generative foreclosure concerns changes to the conditions of future generation themselves: the loss of capabilities, relations, infrastructures, ecological conditions, institutional pluralism, or epistemic resources required to create or recognize later options.

A technological standard can produce generative foreclosure when complementary investment makes alternative architectures prohibitively costly. Concentrated ownership of research infrastructure can narrow which questions can be investigated. Educational exclusion can reduce not only present opportunity but also the later capacity to formulate and pursue new projects. Ecological degradation can remove future productive and cultural possibilities that current actors cannot fully specify. In each case, the loss concerns the generative field rather than one foregone transaction.

Foreclosure can be intentional or emergent. A dominant actor may deliberately raise barriers to entry. An institution may unintentionally create lock-in through cumulative coordination. A society may deplete a resource without any actor intending to eliminate later possibilities. Normative evaluation therefore cannot rely only on motive. It must examine the mechanisms through which possibility is narrowed and the distribution of the resulting loss.

The concept also requires restraint. Stable institutions necessarily reduce some degrees of freedom by creating rules, commitments, standards, and expectations. Such constraint can itself enable generation by lowering uncertainty and coordinating investment. GRE therefore distinguishes productive structuring from foreclosure by asking whether the constraint preserves meaningful routes for learning, contestation, recombination, and revision relative to the values at stake.

Irreversibility is an important but incomplete indicator. Some irreversible changes are desirable; some reversible systems can still reproduce severe domination. The evaluative question concerns which future capabilities and relations are lost, who bears the loss, whether the loss was foreseeable, whether affected subjects had meaningful participation, and whether compensating generative capacities are created elsewhere. Foreclosure is thus a relational and normative concept rather than a synonym for permanence.

Generative foreclosure gives GRE a way to evaluate economic processes whose most important harms are difficult to observe in present output measures. The absence of a future innovation, institution, community, ecological state, or life trajectory cannot be measured in the same way as an existing commodity. Evaluation therefore requires counterfactual and historical reasoning, explicit uncertainty, and humility concerning possibilities that current categories may fail to represent.

3.13.9 Plural and Incommensurable Values

GRE assumes that economic evaluation can involve several forms of value whose relations are partial, contested, or context-dependent. Income, security, autonomy, care, recognition, ecological integrity, knowledge, cultural continuity, trust, and future possibility can matter simultaneously without reducing naturally to one metric. The presence of plural value therefore creates a problem of judgment rather than a technical defect awaiting universal conversion.

Commensuration can still be useful. Budgets require numerical comparison; cost-effectiveness analysis can clarify trade-offs within a defined objective; markets generate prices that coordinate many transactions; legal and administrative systems require thresholds and categories. GRE treats these operations as institutionally situated forms of comparison. The existence of a price or index demonstrates that a conversion rule has been established for a purpose. It does not prove that every ethically relevant dimension has been captured.

Partial comparability is often sufficient for action. One option can dominate another across several relevant dimensions without requiring a common cardinal scale. Thresholds can exclude arrangements that violate minimum conditions of safety, participation, or rights. Deliberative procedures can address remaining conflicts. Scenario analysis can reveal how rankings change under different value weightings.

GRE therefore does not infer decision paralysis from incommensurability.

Plural value also changes the interpretation of conversion. An institution can transform cultural recognition into market demand, social trust into credit access, educational status into employment opportunity, or ecological resources into monetary revenue. Such conversions can create value while also degrading or crowding out the source relation. Evaluation should therefore examine who controls conversion interfaces, which values become legible after conversion, and which remainders disappear from institutional accounting.

Conflicts among values can also be distributional. A policy may maximize aggregate income while concentrating ecological harm in one community. A conservation programme may protect biodiversity while limiting livelihoods or customary access. An automated service may improve average efficiency while weakening procedural recognition for individuals who require exceptions. These conflicts cannot be resolved by naming all values equally important. Normative judgment must specify priority rules, procedural safeguards, compensation, thresholds, or other principles appropriate to the case.

GRE's contribution is to keep the value architecture visible. It can trace where values are generated, converted, captured, dissipated, or rendered institutionally invisible. It can identify the relations through which one value form gains priority over another. It can also expose where apparent commensurability depends on a contested institutional convention. The choice among competing normative resolutions remains an explicit ethical and political task.

3.13.10 Relation between GRE and GREthic

The normative dimensions developed in this section create a direct interface between GRE and GREthic. Their division of labor should remain explicit. GRE is an economic research programme concerned with relational constitution, generation, allocation, value transformation, capability, power, dependency, and changes in future possibility. GREthic addresses the broader ethical problem of how relational and generative consequences should be interpreted, justified, contested, and governed when several values, subjects, and temporal horizons are involved.

This division does not make GRE normatively empty. Economic research already contains evaluative choices in the definition of welfare, harm, efficiency, opportunity, risk, and admissible intervention. GRE adds explicit dimensions such as participation, relational quality, future possibility, dependency, domination, and foreclosure. These dimensions belong legitimately within economic evaluation because they describe economically generated conditions. The ethical question becomes more demanding when the inquiry asks how competing dimensions should be weighted, which constraints should function as side conditions, whose claims have priority, or what constitutes a just relation.

GREthic can therefore operate as a neighboring normative domain rather than as a final module appended after economic analysis. Ethical judgment can alter the research boundary, the choice of evaluative dimensions, the treatment of uncertainty, the design of participation, and the interpretation of evidence. Conversely, economic analysis can revise ethical judgment by revealing hidden dependencies,

indirect harms, conversion mechanisms, or long-run consequences that were absent from the initial normative description. The relation between GRE and GREthic is consequently iterative.

A generative ethical perspective also faces the problem of changing criteria. Institutions learn, social meanings evolve, new subjects become visible, and technologies create forms of action that earlier normative vocabularies did not anticipate. Ethical evaluation therefore cannot assume that a fixed list of criteria will remain sufficient under every historical condition. GREthic must be capable of examining how normative categories themselves emerge, stabilize, exclude, and require revision. This does not imply that every value is historically arbitrary. It means that the institutional expression and interpretation of values require continuing critical examination.

The interface is especially important for application-dominant praxis. An intervention can be technically effective and economically generative while raising unresolved questions of justice. In such cases GRE can provide the relational diagnosis, trace the effects, identify capability changes, map dependency, and evaluate future possibility. GREthic can help articulate the normative standards governing participation, acceptable asymmetry, protection from domination, treatment of irreversible harm, and procedures for revising the intervention when values conflict.

The distinction also protects disciplinary restraint. GRE need not become a complete moral philosophy in order to analyze normatively significant economic processes. GREthic need not replace economic explanation with ethical vocabulary. Their productive relation depends on maintaining both the empirical and normative burdens of argument. Ethical claims require justification; economic claims require evidence and mechanism; interventions require both.

The normative architecture established in Section 3.13 therefore completes an important part of Chapter 3's constitution of GRE. Generativity becomes an object of evaluation rather than a criterion of goodness. Generated value and harm, participation, capability, relational quality, future possibility, dependency, domination, foreclosure, and plural values provide a multidimensional field for judgment. The following section turns to one of the most consequential mechanisms through which these dimensions become unequally distributed: power and asymmetry within the GRE problem-space.

3.14 Power and Asymmetry within the GRE Problem-Space

Generative Relational Economics requires an explicit account of power because economic relations rarely begin from symmetric positions, and the consequences of those asymmetries can accumulate through the very processes that GRE studies. The role of this section is to identify the principal forms of asymmetry that can become economically consequential and to clarify the conditions under which asymmetry is converted into power. Its objective is to avoid two opposite reductions: treating every difference between subjects as domination, and treating power as a property possessed independently of the relations through which it becomes effective. The discussion proceeds through resource, capability, knowledge, institutional, vulnerability, and exit asymmetries; the conversion of asymmetry into power; the limits

of capability equalization and counter-power; and relational governance under persistent asymmetry. The method is constitutive and analytical. It establishes a vocabulary for later empirical, normative, and governance work without presuming that one scalar measure can represent every relevant form of power.

The starting point is a distinction between *asymmetry* and *power*. An asymmetry exists when subjects occupy different positions with respect to resources, capacities, information, institutional authority, vulnerability, or alternatives. Power arises when such differences become usable, durable, or institutionally supported means of shaping another subject's feasible actions, access to resources, interpretive environment, exposure to risk, or future conditions of generation. A highly capable subject can therefore remain weak in a particular relation when its capabilities are irrelevant to the terms of interaction. Conversely, a subject with modest resources can exercise substantial power when it controls a scarce interface, legal authorization, standard, platform, bottleneck, or exit option on which others depend.

Power is consequently relational, domain-specific, and temporally structured. The same pair of subjects can be asymmetric in opposite directions across different domains. A worker can possess knowledge essential to production while remaining institutionally subordinate in wage negotiation. A state can regulate a corporation domestically while depending on that corporation for infrastructure, tax revenue, or technological expertise. A user can choose among digital services while having little capacity to alter the standards through which data are collected and converted into commercial value. The relevant question for GRE is therefore not simply who has more, but how a difference is connected to a mechanism through which one subject can affect another subject's present options or future generative conditions.

This emphasis also distinguishes power from immediate coercion. Power can operate through direct commands, but it can also operate by shaping defaults, eligibility criteria, technical standards, access routes, classifications, expectations, and the cost of refusal. It can be episodic or structurally persistent. It can be consciously exercised or reproduced through institutions whose participants do not individually intend the resulting asymmetry. GRE therefore treats power as a family of relational mechanisms that affect the generation and distribution of possibility. Normative evaluation enters when those mechanisms are assessed in terms of domination, justice, harm, participation, capability, or foreclosure, but descriptive power analysis must first identify how the relation works.

3.14.1 Resource Asymmetry

Resource asymmetry concerns unequal access to economically consequential stocks or flows such as money, land, infrastructure, energy, data, equipment, labor time, organizational slack, credit, logistics, or legally protected assets. It is among the most visible forms of economic difference because many resources are already measured through accounting, ownership, or administrative systems. Yet possession alone does not determine relational power. What matters is the role that a resource plays within a specific relational configuration.

A resource becomes power-relevant when control over it changes another subject's feasible set or bargaining position. The owner of a scarce input can influence down-

stream producers when substitutes are limited and switching is costly. A lender can impose conditions when borrowers face liquidity constraints and alternative finance is unavailable. A landlord's control over housing can become consequential when residence is tied to employment, schooling, legal status, or local social networks. A platform's control over computational infrastructure can matter when users, firms, or public institutions depend on that infrastructure for participation in other economic processes. The same nominal resource can therefore carry very different power consequences depending on substitutability, timing, dependence, and institutional context.

Resource asymmetry also has a generative dimension. Resources can be consumed, but they can also be converted into capacities for producing later resources. Capital can finance research, data collection, legal representation, lobbying, recruitment, or acquisition. Infrastructure can make future coordination cheaper. Land ownership can generate collateral. A large user base can generate additional data and network effects. Resource inequality can therefore reproduce or amplify itself when existing holdings enable access to mechanisms that generate further advantage.

GRE analysis should distinguish this recursive possibility from simple accumulation. A subject can possess more resources without gaining additional structural leverage if the relevant relation remains competitive and alternatives remain accessible. Conversely, a relatively small resource difference can become decisive when it controls a bottleneck or threshold. The analytical task is thus to identify the conversion mechanism: which resource matters, to which relation, over what time horizon, through which institutional or technical structure, and with what downstream effects on future capacity.

This distinction also matters for policy. Redistribution of money can reduce one resource asymmetry while leaving infrastructural, legal, informational, or organizational asymmetries intact. Access subsidies can improve current consumption without altering control over the mechanisms that generate future options. Resource equalization is therefore one possible intervention among several. GRE asks whether the relevant inequality lies in holdings, access, conversion capacity, rule-making position, or the structure through which resources become generative.

3.14.2 Capability Asymmetry

Capability asymmetry concerns differences in what subjects are able to do within a defined economic relation. Capabilities may include technical competence, organizational coordination, computational capacity, mobility, learning, bargaining skill, physical endurance, social connectivity, legal competence, linguistic access, or the ability to mobilize resources under time pressure. Capability differs from resource possession because two subjects with formally similar resources can have very different capacities to convert them into effective action.

This distinction is central in contemporary economies where productive capability can differ sharply across persons, organizations, and artificial systems. A large model can process information at scales unavailable to an individual worker. A multinational firm can coordinate legal, financial, and logistical operations across jurisdictions that a small supplier cannot match. An experienced organization can exploit

a regulatory opportunity that a newly formed association does not yet understand. These differences can affect bargaining positions, speed, error tolerance, and the range of feasible strategies.

Capability asymmetry becomes power-relevant when it changes the terms under which other subjects must participate. Superior prediction can support price discrimination. Superior legal capacity can make contractual complexity costly for weaker parties to contest. Superior computational capacity can enable rapid experimentation over markets, attention, or product design. Superior logistical coordination can make a supplier difficult to replace. In each case the capability matters because it is connected to a relation through which the more capable subject can shape conditions faced by others.

At the same time, capability differences do not by themselves establish domination, moral superiority, or ontological hierarchy. Specialized capabilities are common in cooperative systems. A surgeon and patient, pilot and passenger, engineer and user, or teacher and student occupy asymmetric capability relations that can be socially valuable when authority, accountability, consent, and institutional safeguards are appropriately organized. The relevant GRE question is whether capability asymmetry becomes a mechanism for unilateral control, extraction, dependency, or foreclosure, or whether it is embedded in reciprocal and revisable arrangements that distribute benefits and protect affected subjects.

Capability asymmetry also changes historically. Training, tools, institutional access, automation, collective organization, and technical infrastructure can expand or reduce particular capabilities. The introduction of artificial intelligence makes this especially visible because capability gaps can change quickly and unevenly across tasks. A useful GRE analysis therefore tracks the trajectory of capability differences rather than treating them as fixed attributes. It asks who gains new capabilities, who loses the economic relevance of existing ones, what new dependencies arise, and which institutions govern the conversion of capability differences into economic authority.

3.14.3 Knowledge Asymmetry

Knowledge asymmetry concerns unequal access to information, interpretive resources, expertise, explanatory models, evidence, or the capacity to recognize the significance of available information. It extends beyond the familiar problem of one party knowing more facts than another. Economic power can also arise from asymmetries in classification, prediction, interpretation, and the ability to determine which descriptions become institutionally actionable.

A seller may know more about product quality than a buyer. A financial institution may know more about pricing models and contractual risk than a client. A platform may observe aggregate behavioral patterns invisible to individual users. A government agency may hold administrative records unavailable to the public. A technical community may control specialized vocabularies required to contest a decision. These are distinct knowledge relations, and their power effects depend on how the knowledge is connected to action.

Knowledge becomes especially consequential when one subject can make decisions on the basis of information that another cannot inspect, verify, or meaningfully

interpret. The weaker subject may then depend on assurances, reputation, certification, professional norms, or institutional oversight. Such dependence is not intrinsically pathological; complex economies require extensive reliance on expertise. The power problem emerges when epistemic dependence combines with weak accountability, conflicts of interest, high switching costs, or control over the channels through which claims can be challenged.

Knowledge asymmetry also includes the power to produce or stabilize representations. Economic subjects are frequently acted upon through categories: credit scores, risk classes, performance metrics, eligibility rules, rankings, profiles, diagnoses, forecasts, and algorithmic classifications. The subject who controls the production or interpretation of a category can influence access to employment, credit, insurance, visibility, public benefits, or market participation. In such cases knowledge power does not consist only in possessing hidden information. It also consists in shaping the representational architecture through which institutions perceive other subjects.

GRE therefore distinguishes informational access, interpretive competence, model authority, and representational control. These dimensions can diverge. Data can be publicly available while computational requirements make meaningful analysis inaccessible. A model can be technically transparent while the institutional consequences of its output remain opaque. A subject can understand a classification yet lack any procedure for contesting it. Knowledge governance consequently requires more than disclosure. It may require intelligibility, auditability, contestability, alternative expertise, evidential access, and institutional routes through which interpretations can be revised.

The generative dimension of knowledge asymmetry is equally important. Knowledge can generate later knowledge, and control over data or research infrastructure can compound advantages. Organizations with larger observational fields can train better models, attract more users, and generate still more data. Institutions that define legitimate evidence can also shape which questions receive funding and which phenomena become visible. Knowledge asymmetry can therefore alter the future epistemic field itself, making it a central GRE object rather than merely a background imperfection in exchange.

3.14.4 Institutional Asymmetry

Institutional asymmetry concerns unequal positions within rule-making, authorization, recognition, enforcement, classification, and dispute-resolution structures. It is distinct from resource or capability asymmetry because an institution can grant authority to a subject whose private resources are limited. A regulator, court, standards body, professional association, university, central bank, certification agency, or platform governance unit can exercise substantial influence through the rules it is authorized to establish or interpret.

Institutional position shapes who can define admissible participation, whose claims count, which categories receive legal recognition, and which remedies are available when conflict occurs. Formal authority is one obvious form. Less visible forms include agenda-setting, control over procedure, discretionary interpretation, default-setting, accreditation, and the capacity to delay or accelerate decisions.

Timing itself can become power when one party can tolerate delay and another cannot.

Institutional asymmetry is often self-reinforcing because rules influence the resources and capabilities available to participants. Licensing can protect quality and safety while also raising entry barriers. Intellectual-property rules can reward innovation while concentrating control over subsequent use. Procurement standards can improve accountability while favoring organizations with administrative capacity to comply. Corporate governance rules can distribute formal voting rights while leaving agenda formation concentrated. Institutional analysis therefore asks not only what a rule states but how it reorganizes relational possibilities.

GRE treats institutional asymmetry as especially important because institutions mediate conversion among other forms of asymmetry. Wealth can be translated into lobbying, litigation, or organizational access. Expertise can be converted into recognized professional authority. Formal office can provide privileged information. Institutional status can determine whose vulnerability receives protection and whose losses remain externalized. Institutions are thus conversion structures through which resources, capabilities, knowledge, and recognition become power.

This does not imply that institutional asymmetry should be eliminated. Governance itself requires differentiated roles, mandates, and responsibilities. The relevant question is how authority is bounded, justified, monitored, revisable, and connected to affected subjects. An institution can exercise asymmetric authority while remaining constrained by procedure, transparency, appeal, rotation, representation, or substantive rights. GRE therefore analyzes the architecture of authority rather than treating formal symmetry as the only legitimate institutional form.

3.14.5 Vulnerability Asymmetry

Vulnerability asymmetry concerns differences in exposure to loss and differences in the capacity to absorb, recover from, or adapt to that loss. It introduces a dimension of power that is easy to miss when analysis focuses only on holdings or productive capacities. Two subjects may enter the same formal transaction while facing radically different consequences if the transaction fails.

A worker dependent on one employer can face greater loss from contract termination than the employer faces from replacing one worker. A small supplier can be more vulnerable to delayed payment than a large purchaser is to delayed delivery. A tenant can face relocation costs that exceed the landlord's costs of replacing the tenant. A household with minimal savings can be more affected by a small price shock than a wealthier household is by a larger nominal loss. These differences change bargaining relations even when contractual rights appear formally symmetric.

Vulnerability can arise from biological, social, legal, ecological, financial, or infrastructural conditions. It can also be generated by prior economic relations. Debt can increase sensitivity to income interruption. Loss of public infrastructure can increase dependence on private providers. Concentrated employment can make a region vulnerable to one firm's decisions. Data-driven personalization can expose particular groups to targeted exploitation. Vulnerability is therefore often historically produced rather than merely given.

The conversion of vulnerability into power occurs when another subject can credibly condition access to necessities, impose risks, or shift costs onto those less able to bear them. The stronger party need not intentionally threaten harm. Structural vulnerability can influence behavior because subjects anticipate the consequences of refusal. A worker may accept unfavorable terms because unemployment is costly. A state may offer concessions to a mobile investor because local employment is concentrated. A consumer may accept invasive data practices because essential services have become digitally mediated.

GRE analysis should also distinguish vulnerability from weakness in every domain. A subject can be technologically capable and financially wealthy while highly vulnerable to reputational, legal, ecological, or infrastructural disruption. Conversely, a subject with few resources can be relatively resilient when needs are modest, alternatives are available, and social support is strong. Vulnerability therefore requires explicit specification of the relevant hazard, exposure, recovery capacity, and time horizon.

This perspective has normative implications, but the descriptive analysis comes first. Governance can reduce vulnerability by creating buffers, insurance, redundancy, public options, collective support, or guaranteed access to essentials. Yet such interventions can create new dependencies if they centralize provision without contestability. The GRE question is how vulnerability is generated, distributed, converted into leverage, and transformed by the institutions intended to manage it.

3.14.6 Exit Asymmetry

Exit asymmetry concerns differences in the cost, feasibility, and consequences of leaving a relation. It is one of the clearest mechanisms through which other asymmetries become durable. A relation can appear voluntary at entry while becoming difficult to leave once investments, identities, data, legal obligations, infrastructures, social ties, or specialized capabilities accumulate around it.

Exit costs take many forms. Financial penalties and contractual restrictions are explicit examples. Others include retraining, relocation, loss of reputation, incompatibility of technical systems, loss of accumulated data, social isolation, disruption of care arrangements, immigration consequences, or forfeiture of institution-specific benefits. Exit can also be asymmetric because one party can replace the other more easily. A large platform can lose an individual user with little consequence, while the user may lose access to a network on which professional or social activity depends.

Exit asymmetry matters because it alters the practical meaning of consent. Continued participation can reflect genuine preference, but it can also reflect high switching costs, dependence, fear of retaliation, or lack of viable alternatives. GRE therefore treats observed continuation as evidence that requires interpretation rather than as automatic proof that a relation remains mutually beneficial.

The generative dimension of exit is particularly important. Participation in a relation can produce assets that are specific to that relation: reputation scores, social connections, customized tools, accumulated knowledge, eligibility, or identity. These assets can increase productivity and value while simultaneously making exit more costly. Successful cooperation can therefore deepen dependence even without inten-

tional lock-in. The governance problem is to preserve the benefits of relational investment while preventing accumulated specificity from becoming unilateral leverage.

Exit is also only one response to problematic relations. Voice, contestation, collective bargaining, institutional appeal, and internal reform can be preferable when relationships are valuable and exit would destroy jointly generated capacities. An exclusive focus on exit can therefore privilege subjects already able to move while leaving the most embedded or vulnerable participants unprotected. GRE analyzes exit together with voice, representation, repair, and alternative provision.

Exit asymmetry can be reduced through interoperability, portability, nonretaliation rules, social insurance, public alternatives, transferable credentials, data mobility, and limits on restrictive contracts. Such measures alter the relational field even if few subjects actually leave. The credible possibility of exit can change bargaining power. Exit governance is therefore about the structure of alternatives, not merely the observed frequency of departure.

3.14.7 Conversion of Asymmetry into Power

The preceding forms of asymmetry become analytically significant when they are connected to mechanisms of conversion. GRE treats conversion as the process through which a difference in resources, capability, knowledge, institutional position, vulnerability, or exit becomes effective influence over another subject's options or over the conditions from which future options are generated. This conversion is neither automatic nor uniform.

Several relational conditions commonly affect conversion. Scarcity matters because control over abundant and substitutable resources usually provides less leverage than control over bottlenecks. Dependence matters because the value of an asymmetry rises when other subjects rely on the advantaged subject for essential functions. Replaceability matters because subjects with many alternatives can resist conditions that dependent subjects must accept. Coordination matters because individually weak subjects can aggregate resources or voice. Institutional recognition matters because formal rules can authorize, limit, or redirect the use of an advantage. Information matters because leverage can depend on subjects understanding their alternatives and the likely consequences of refusal. Time matters because a party that can wait often has bargaining advantages over a party facing urgent costs.

Power conversion can also be recursive. A resource advantage can buy expertise; expertise can influence institutional design; institutional design can protect future resource accumulation. Superior knowledge can improve targeting; improved targeting can increase profit; profit can finance further data collection. Control over infrastructure can generate dependence; dependence can support contractual authority; contractual authority can increase exit costs. Such cycles matter to GRE because they transform temporary differences into persistent relational structures.

The concept of conversion also helps distinguish power from inequality. A wealthy subject can lack power over a regulator empowered to impose binding rules. A technically capable firm can remain dependent on a monopolistic supplier. A state with formal sovereignty can be constrained by financial, technological, or security dependencies. Power maps therefore need not reproduce wealth rankings. GRE analysis

should trace conversion pathways rather than infer power from one observable variable.

Power can furthermore operate through the generation of expectations. If subjects anticipate that one party can impose costs, deny access, classify them adversely, or shape future opportunities, they may alter behavior before any explicit exercise occurs. This anticipatory effect can make power difficult to observe through events alone. Stable compliance can coexist with strong asymmetry precisely because overt conflict becomes unnecessary. Empirical inquiry may therefore need to study suppressed alternatives, unrealized options, counterfactual bargaining positions, and institutionalized expectations.

The conversion perspective also clarifies why power is domain-specific. A subject can be powerful in hiring and weak in finance, powerful in data and weak in law, powerful domestically and dependent internationally. GRE should therefore resist the temptation to compress heterogeneous power relations into one universal rank. A multidimensional mapping of asymmetries, conversion mechanisms, and affected generative conditions is often more informative than a single power score.

3.14.8 Limits of Capability Equalization

Capability enhancement is one important response to asymmetry. Education, public infrastructure, assistive technology, access to finance, legal aid, data access, computational tools, collective organization, and social protection can increase the ability of weaker subjects to participate, contest, adapt, and generate alternatives. Yet capability equalization has limits as a general theory of power reduction.

First, some asymmetries arise from differentiated roles rather than remediable deficits. Regulators and regulated entities, doctors and patients, judges and litigants, infrastructure operators and users, or specialized technical teams and general publics occupy different positions because complex systems distribute functions. Governance must then organize accountability across unequal roles rather than assume that every participant should acquire identical capabilities.

Second, capability enhancement can leave institutional conversion mechanisms untouched. Training workers may improve mobility while employers retain unilateral control over scheduling, surveillance, or termination. Financial literacy can improve decisions while contractual complexity and market concentration remain. Digital skills can expand participation while platforms retain control over standards, visibility, and data. Strengthening the weaker subject can therefore be valuable without fully altering the relation that generates the asymmetry.

Third, capabilities can themselves become positional. If all participants acquire a skill that was previously scarce, the advantage associated with that skill can move elsewhere. Credential inflation provides one familiar pattern: expanding qualifications can increase absolute competence while preserving relative competition for scarce positions. In technological domains, widespread adoption of one tool can raise the baseline expected from all participants and create a new asymmetry around access to more advanced infrastructure.

Fourth, equalization can impose burdens. Requiring vulnerable subjects to be-

come expert negotiators, data analysts, legal specialists, or cybersecurity practitioners shifts responsibility onto those already facing structural disadvantage. Some protections are better provided through institutional design, fiduciary duties, public options, default rules, or limits on permissible extraction than through endless demands for individual capability upgrading.

GRE therefore treats capability equalization as one component of relational governance. The relevant question is which asymmetry should be reduced by expanding capability, which should be bounded through institutional rules, which should be made contestable through collective organization, and which should be accepted as functionally necessary but governed through accountability. The objective is not symmetry for its own sake. It is to prevent capability differences from becoming unjustified control over the conditions of participation and future generation.

3.14.9 Limits of Counter-Power

Counter-power refers to capacities that enable subjects to resist, negotiate, constrain, or redirect an existing concentration of power. Collective bargaining, competition, regulatory oversight, courts, professional associations, consumer organization, public alternatives, investigative journalism, open technical standards, mutual aid, and democratic participation can all function as forms of counter-power in different contexts. GRE treats them as relational interventions rather than as automatic restorations of balance.

Counter-power is often necessary because persistent asymmetry cannot be addressed by individual adaptation alone. Workers can negotiate more effectively through collective organization. Small firms can benefit from shared infrastructure or interoperability mandates. Consumers can rely on regulators or courts when individual monitoring is costly. Communities can build institutions that reduce dependence on a single provider. Such arrangements change the structure through which asymmetry is converted into power.

Yet counter-power has limits. It can become concentrated in its own right. A union, regulator, professional body, platform cooperative, or civic organization can develop internal hierarchies and exclusion mechanisms. Institutions created to represent weaker subjects can become difficult for those subjects to contest. Competition can constrain one monopoly while producing instability or shifting concentration to another layer of the system. Transparency can expose misconduct while advantaging actors with superior capacity to process disclosed information. Counter-power therefore requires its own governance.

Counter-power can also reproduce the ontology of the power it contests. If resistance must use the same metrics, platforms, legal categories, or technical infrastructure established by the dominant actor, alternatives may remain confined within the existing field. A community can gain representation without gaining control over the categories through which its interests are recognized. A new market entrant can challenge price while leaving data extraction practices unchanged. GRE therefore asks whether counter-power changes bargaining within a relation or transforms the generative conditions of the relation itself.

Temporal asymmetry further complicates counter-power. Concentrated actors can

sometimes act quickly while collective organizations require deliberation, consent, and coordination. Conversely, public institutions can impose durable constraints that private actors cannot easily evade. The relevant balance is therefore dynamic. Effective governance must consider response speed, persistence, institutional learning, and the capacity of power holders to adapt around controls.

The limit of counter-power does not imply resignation. It indicates that balancing strategies should be evaluated recursively. A mechanism introduced to constrain power should itself be analyzed for new dependencies, exclusions, and conversion pathways. GRE's contribution is to keep that second-order question visible: what does the counter-power generate, whose capacities does it strengthen, which relations does it stabilize, and what new asymmetries emerge from its operation?

3.14.10 Relational Governance under Persistent Asymmetry

Many economic systems will continue to contain substantial asymmetries even under ambitious reforms. Subjects differ in knowledge, scale, specialization, mobility, resources, biological needs, legal mandates, technical capabilities, and exposure to risk. Relational governance therefore cannot depend on the expectation that legitimate order will emerge only after differences have been eliminated. Its task is to organize persistent asymmetry so that necessary differentiation does not become uncontrolled domination or generative foreclosure.

A GRE governance perspective begins by specifying the relevant asymmetries and their conversion mechanisms. It asks which subjects depend on which others, what alternatives exist, which resources or capabilities function as bottlenecks, who defines the institutional categories of participation, how vulnerability is distributed, and what happens if a subject attempts to exit or contest the relation. This diagnosis identifies where safeguards are likely to matter.

Several governance principles follow from the analysis, although their concrete form remains context-dependent. Authority can be bounded by mandate and review. Essential services can be protected by continuity obligations or public alternatives. Exit can be made more credible through portability and interoperability. Knowledge asymmetry can be addressed through independent expertise, audit, contestation, and evidential access. Vulnerability can be reduced through buffers, insurance, redundancy, and guaranteed minimum capacities. Collective organization can strengthen voice. Rule-making can include affected subjects without presuming that participation alone resolves all asymmetry. Institutions can preserve appeal, revision, and sunset mechanisms so that temporary arrangements do not harden into unchallengeable structures.

Relational governance also requires attention to generative conditions. A policy can constrain abusive behavior in the present while leaving the mechanisms that reproduce future dependence untouched. Conversely, an intervention can redistribute immediate resources while weakening the organizational capacities through which a community previously governed itself. GRE therefore evaluates governance at more than one temporal layer: present protection, future capability, relational quality, structural transformation, and preservation of alternative pathways.

The concept of persistent asymmetry also changes the meaning of fairness. For-

mal equality of rules can coexist with radically unequal vulnerability or exit costs. Identical disclosure can be useless when interpretive capacities differ. Equal access to a market can mask unequal control over infrastructure. Governance may therefore require differentiated protections or obligations in order to make participation substantively contestable. Such differentiation must itself remain transparent and revisable because protective categories can reify the subjects they are intended to assist.

Power analysis should also remain separate from final normative judgment. A concentrated authority may sometimes be justified by coordination, safety, fiduciary responsibility, or public purpose. A decentralized arrangement can reproduce severe power through infrastructure, convention, or cumulative advantage. GRE therefore does not infer justice from decentralization, symmetry, or participation alone. It supplies a relational map of how influence is generated and sustained; normative evaluation then asks whether those mechanisms are justified under the relevant ethical, legal, and political standards.

This section therefore places power within the GRE problem-space as a dynamic relation among asymmetries, conversion mechanisms, dependencies, institutional structures, and future generative conditions. Resource, capability, knowledge, institutional position, vulnerability, and exit are analytically distinct sources of asymmetry. Their conversion into power depends on scarcity, substitutability, dependence, coordination, authorization, time, and the structure of alternatives. Capability equalization and counter-power can alter these relations, but each has limits and can generate new asymmetries. Relational governance must consequently remain adaptive, contestable, and attentive to second-order effects.

The analysis also prepares the next constitutive problem. Persistent asymmetry does not occur among identical subjects. Economic relations increasingly connect persons, organizations, states, artificial systems, ecological systems, and other heterogeneous participants whose capacities, temporalities, vulnerabilities, and value structures differ in kind as well as degree. The following section therefore turns from asymmetry within relations to the broader problem of heterogeneity and coexistence.

3.15 Heterogeneity and Coexistence

Generative Relational Economics requires an explicit account of heterogeneity because many economic relations connect subjects, systems, and processes that differ in ways that cannot be reduced to variation along a single scale. The role of this section is to establish coexistence across heterogeneous forms as a constitutive problem of GRE rather than as a residual complication added after a homogeneous model has been constructed. Its objective is to clarify how economic coordination, exchange, dependence, conflict, and joint generation remain possible when participants differ in subject form, intelligence, temporality, vulnerability, value structure, and degree of mutual intelligibility. The discussion proceeds from heterogeneous subjects and forms of intelligence through temporal and vulnerability differences, heterogeneous values, partial mutual intelligibility, economic relation under incomplete commen-

surability, human–AI relations, more-than-human relations, and boundary cases involving radically different subjects. The method is constitutive and analytical. It identifies conditions under which heterogeneous coexistence can be studied without presuming either complete commonality or complete incomparability.

Heterogeneity matters to GRE for a reason deeper than descriptive diversity. Difference can alter the mechanisms through which relations are formed, interpreted, stabilized, and transformed. Subjects that process information at different speeds can experience the same contract differently. Subjects with different vulnerabilities can bear the same nominal risk unequally. Subjects organized around different value structures can participate in the same economic arrangement while understanding its significance in different terms. Human and artificial systems can cooperate productively while differing sharply in embodiment, temporal horizon, memory, responsibility, and normative status. Economic coexistence therefore often depends on interfaces that enable coordination across difference rather than on the elimination of difference itself.

This perspective also changes the analytical meaning of coordination. Coordination need not imply shared ontology, identical preferences, common measures of value, or full mutual comprehension. It can arise through partial translation, rule-governed interfaces, protocols, conventions, negotiated thresholds, legal forms, institutional guarantees, or stable expectations concerning a limited domain of interaction. Such arrangements can be robust even when deeper interpretations remain divergent. They can also be fragile when the interface suppresses differences that later become economically consequential. GRE therefore asks both how heterogeneous subjects manage to relate and which differences remain unresolved beneath an apparently successful relation.

Heterogeneity should consequently be distinguished from disorder. A heterogeneous system can possess highly organized relations, and a homogeneous representation can conceal important differences. Likewise, coexistence should be distinguished from harmony. Subjects can coexist through cooperation, competition, dependency, conflict, indifference, mutual constraint, or asymmetric accommodation. The relevant GRE question is not whether heterogeneity produces agreement, but how different forms remain connected, how the relation distributes benefits and burdens, and how the terms of coexistence shape future generative possibilities.

3.15.1 Heterogeneous Subjects

The first dimension of heterogeneity concerns the kinds of subjects that participate in economic relations. Earlier sections treated economic subjecthood as relationally situated, institutionally recognized, temporally persistent, and historically transformable. The present section extends that argument by emphasizing that an economy can contain multiple subject forms at once. Individual persons, households, firms, states, cooperatives, communities, platforms, algorithmic systems, hybrid organizations, and other collective or artificial arrangements can all occupy economically consequential positions while remaining different in constitution and status.

These differences matter because the capacities through which subjects enter relations are not interchangeable. A natural person may possess legal rights, embodied

needs, lived vulnerability, memory, social identity, and moral standing that differ categorically from the capacities of a corporation or software system. A corporation can persist across changes in personnel, accumulate assets, sign contracts, and coordinate action across large spatial scales. A public institution can exercise legally authorized powers that private actors lack. An artificial system can process or generate representations at speeds and volumes unavailable to human participants while lacking many forms of embodied participation through which human economic life is organized.

GRE therefore resists the temptation to create one abstract subject model and treat every participant as a parameterized instance of it. A unified formal representation can be useful for a local task, but the analyst must identify which dimensions of subjecthood have been suppressed. Treating a household, a company, and an automated trading system as "agents" can clarify interaction structure while obscuring differences in accountability, embodiment, temporal persistence, legal rights, or the capacity to experience harm. The representational convenience of a common agent label does not establish ontological or normative equivalence.

Heterogeneous subjecthood also means that relations can be constitutive in different ways for different participants. Employment may constitute livelihood and social identity for a worker while functioning as a cost and organizational input for a firm. Credit can appear as a portfolio exposure to a lender and as a condition of continued residence or enterprise survival to a borrower. A platform can treat a user interaction as data-generating activity while the user experiences it as communication, work, entertainment, or social participation. The same relation can therefore occupy different places in the reproduction of each subject.

This asymmetry of significance is analytically important. Economic relations cannot always be understood by assigning the same type of variable to each side. The relation may link subjects whose persistence conditions are fundamentally different. One participant can exit with limited consequence while another loses access to income, identity, infrastructure, or social connection. GRE analysis should therefore specify what the relation does for each subject, which capacities it supports, which vulnerabilities it exposes, and how these differences affect bargaining, interpretation, and future generation.

Heterogeneous subjects can nevertheless form stable relations. Stability may arise through law, trust, standards, routines, contracts, technical interfaces, conventions, organizational design, or repeated adaptation. The existence of such stability shows that shared subject form is not a prerequisite for economic relation. What matters is whether the relation contains sufficiently compatible interfaces for action, interpretation, and expectation within the domain that must be coordinated.

3.15.2 Heterogeneous Forms of Intelligence

Economic analysis often speaks of information, knowledge, skill, and rationality as though intelligence were a single capacity that subjects possess in greater or lesser amounts. GRE treats intelligence more cautiously. Different subjects can exhibit different forms of problem solving, inference, adaptation, memory, perception, coordination, judgment, and representation. These forms may be partly comparable for a

defined task without being reducible to one general economic scale.

Human economic intelligence includes dimensions that are difficult to separate cleanly: practical know-how, embodied familiarity, social interpretation, linguistic competence, moral judgment, imagination, aesthetic discrimination, memory, emotional response, and the capacity to act under incomplete and ambiguous conditions. Collective subjects can display organizational intelligence that no member possesses individually, including routines, distributed expertise, institutional memory, and coordinated response. Computational systems can display high performance in search, optimization, prediction, generation, classification, or symbolic transformation while relying on infrastructures, training processes, objectives, interfaces, and external forms of validation that structure what their outputs mean and how they are used.

Task-specific comparison is therefore often more informative than a universal ranking. One system may outperform another at high-dimensional pattern recognition while performing poorly where contextual interpretation, embodied judgment, accountability, or long-horizon institutional memory is decisive. An expert organization may coordinate a complex regulatory process effectively while responding slowly to unfamiliar technological change. A local community may possess detailed ecological knowledge that is poorly represented in standardized datasets. Heterogeneous intelligence appears as differentiated capability profiles rather than as a single ladder.

This matters economically because different forms of intelligence can become complementary. A relation can generate value precisely because participants perceive or process different features of a problem. Human–machine systems can combine computational scale with human contextual judgment. Interdisciplinary teams can connect different epistemic traditions. Firms can coordinate specialized units whose local knowledge would be insufficient in isolation. Markets themselves can sometimes coordinate dispersed information without requiring any participant to possess a complete representation of the system.

Complementarity, however, does not eliminate power. The party that controls the interface among forms of intelligence can shape which outputs count, which errors are visible, which judgments are overridden, and which forms of knowledge become economically legible. Standardization can facilitate coordination while devaluing tacit or local knowledge. Automated decision systems can increase processing capacity while concentrating control over model design, data, thresholds, or appeals. The governance of heterogeneous intelligence is therefore partly a problem of interface design and partly a problem of institutional power.

GRE should accordingly distinguish capability difference from epistemic authority. Superior performance in one domain does not automatically justify decision authority in another. Prediction accuracy does not itself settle normative legitimacy. Computational scale does not settle interpretive authority. Human status does not guarantee technical competence. A mature analysis asks which form of intelligence is relevant to which claim, what evidence supports its reliability, how different forms are combined, and who controls the terms of combination.

3.15.3 Heterogeneous Temporalities

Economic subjects also inhabit different temporal structures. Temporal heterogeneity concerns differences in pace, horizon, persistence, delay, memory, reversibility, and the timing through which consequences become visible. These differences can be as consequential as differences in resources or capability because a relation that is sustainable at one temporal scale can be destructive at another.

Individuals often make decisions under lifetimes measured in decades, daily needs measured in hours, and contractual obligations measured in months or years. Firms may evaluate projects through reporting cycles, investment horizons, product lifecycles, or expectations concerning market entry and exit. Public institutions can operate through electoral, budgetary, legal, and infrastructural timescales. Financial systems can react within milliseconds while housing, education, ecological restoration, demographic change, and institutional trust can unfold over decades. Artificial systems can process and update representations rapidly while the social institutions required to evaluate, regulate, or contest their deployment move more slowly.

Temporal heterogeneity creates coordination problems. A rapidly adjusting actor can repeatedly change strategy before a slower institution completes review. Short-term financial incentives can conflict with long-term maintenance or ecological resilience. A policy may generate immediate benefits while degrading capacities that become visible only years later. Conversely, insisting on very long evaluation horizons can leave urgent present vulnerabilities insufficiently addressed. No single time horizon is automatically privileged across all economic questions.

GRE therefore treats temporal alignment as an analytical problem. Contracts, standards, insurance, reserves, review periods, waiting times, sunset clauses, intergenerational institutions, and adaptive governance can all be understood partly as devices for coordinating subjects whose consequences and capacities unfold at different rates. Such devices do more than schedule action. They distribute whose temporality receives priority. A deadline can privilege the actor able to mobilize quickly. A long approval process can protect against irreversible harm while disadvantaging subjects facing immediate need. A quarterly reporting regime can orient organizations toward measurable near-term outputs at the expense of slower generative effects.

Temporal heterogeneity also complicates attribution. A downstream effect may emerge long after the originating intervention, after intermediate relations have changed and after responsible institutions or personnel have disappeared. Conversely, a long-standing structure can condition present action without appearing in short observational windows. GRE analysis should therefore state the temporal horizon of its claims and examine whether the relevant mechanism operates faster or slower than the data used to identify it.

Coexistence across heterogeneous temporalities requires more than synchronization. Some differences should remain. Ecological regeneration cannot necessarily be accelerated to match financial expectations. Human deliberation may require time that automated processing does not. Institutional due process can be intentionally slower than market reaction. The governance question is therefore which temporal differences should be bridged, which should be protected, and how costs created by temporal mismatch are distributed.

3.15.4 Heterogeneous Vulnerabilities

Subjects differ not only in what they can do but also in what can harm them, how quickly harm occurs, how visible it is, and how readily recovery is possible. Vulnerability heterogeneity concerns these differentiated exposures and recovery conditions. It is especially important because relations that appear symmetric in formal terms can create highly asymmetric consequences when participants have different capacities to absorb loss.

The same monetary loss can be marginal for one subject and existential for another. A temporary service interruption can inconvenience a large organization while eliminating a small firm's only route to customers. Delayed payment can be a minor accounting issue for a well-capitalized buyer and a liquidity crisis for a supplier. Exposure of personal information can create embodied or social risks for an individual that have no equivalent in the experience of an automated system. Environmental degradation can affect communities whose livelihoods depend directly on local ecosystems while remaining abstract in the accounting of distant investors.

Vulnerability is therefore relational and domain-specific. A subject can be highly capable in one domain and vulnerable in another. Large firms can possess extensive resources while depending critically on specific infrastructure or regulatory permissions. States can exercise coercive authority while remaining technologically dependent. Artificial systems can be operationally powerful yet dependent on electricity, hardware, data centers, network access, maintenance, and human authorization. Vulnerability analysis should identify the failure conditions that matter for the particular relation rather than infer resilience from general size or capacity.

Recovery is as important as exposure. Two subjects exposed to the same disturbance can differ in reserves, insurance, social support, legal recourse, substitutability, repair knowledge, or access to alternative relations. These differences affect bargaining because the subject that can survive delay or failure usually possesses greater strategic freedom. Exit asymmetry, discussed in the previous section, is one expression of this wider vulnerability structure.

GRE also asks how relations generate vulnerability over time. Specialization can increase efficiency while producing dependence on narrow supply chains. Platform participation can expand market access while making future income dependent on ranking systems or account continuity. Debt can finance productive capacity while increasing sensitivity to interest rates or income interruption. An ecological intervention can raise present output while reducing resilience to later shocks. Vulnerability is therefore often produced jointly with value.

Governance under heterogeneous vulnerability should not assume that formally equal treatment produces equivalent protection. Uniform rules can distribute risk unequally when participants have different failure thresholds. At the same time, vulnerability should not be used as a permanent identity that freezes subjects into protected categories. The analytical task is to identify specific exposure, consequence, recovery capacity, and the mechanisms through which the relation modifies them.

3.15.5 Heterogeneous Value Structures

Economic coexistence frequently connects subjects that organize value differently. Value heterogeneity includes differences in what is valued, how value is recognized, which trade-offs are acceptable, what temporal horizon matters, what forms of loss are considered substitutable, and which goods are treated as inappropriate for exchange. GRE therefore treats value structure as plural rather than assuming that all relevant evaluation can be represented through a single utility, price, welfare index, or scalar measure.

Some values are readily expressed through monetary exchange because institutions already provide stable units, markets, contracts, and accounting conventions. Others are represented through rights, duties, thresholds, rankings, narratives, professional norms, ecological indicators, cultural meanings, or qualitative judgments. A community may value continuity of place in ways poorly represented by compensation for relocation. A worker may value autonomy, recognition, security, or meaningful participation alongside income. A public institution may be bound by legality and equal treatment even where another arrangement would reduce cost. Ecological relations can involve irreversibility, species loss, or system resilience that resists straightforward substitution.

Heterogeneous value structures do not imply that coordinated decision is impossible. Institutions routinely make decisions under plural values. They use budgets together with rights constraints, technical standards, minimum thresholds, deliberation, priority rules, side constraints, multicriteria evaluation, and negotiated settlements. These devices are forms of practical ordering rather than proof that all underlying values have become commensurable.

This distinction between ordering and commensurability is central. A decision can select one option without establishing a universal measure that converts every relevant value into a common unit. A legal prohibition can exclude some options before cost comparison begins. A safety threshold can structure a feasible set without pricing every possible injury. Negotiation can produce agreement acceptable to different parties for different reasons. GRE can analyze these arrangements as relational mechanisms for coordinating value heterogeneity.

Value heterogeneity also creates power questions. The institution that chooses the metric can privilege values that fit that metric. Monetary valuation can make some losses legible while rendering others peripheral. Quantitative indicators can improve transparency while narrowing attention to what is measurable. Expert vocabularies can facilitate comparison while excluding affected participants whose reasons are expressed differently. The politics of value therefore includes the design of representation and conversion rules.

GRE evaluation should preserve this plurality where it is substantively real. Scalar measures remain useful where a common measure is justified, but they should not acquire authority merely because they simplify optimization. When values are only partially commensurable, the analysis should record the remaining plurality rather than treating it as noise around a preferred metric.

3.15.6 Partial Mutual Intelligibility

Heterogeneous subjects rarely understand one another completely. Their categories, temporal horizons, sensory access, institutional roles, languages, models, and value structures can differ. Yet complete mutual understanding is not required for economic relation. Partial mutual intelligibility refers to the degree of shared interpretation sufficient for a defined form of coordination while leaving other aspects of the participants' worlds untranslated.

A buyer and seller can agree on quantity, quality, price, and delivery without sharing the same reasons for valuing the transaction. Organizations from different legal cultures can cooperate through contracts and technical standards while retaining different institutional assumptions. Humans can use computational systems whose internal representations they do not fully reconstruct, provided interfaces, validation procedures, and accountability arrangements make the relevant outputs sufficiently interpretable for the task. Scientific and local knowledge systems can sometimes coordinate around observable indicators while interpreting causal significance differently.

Partial intelligibility is therefore often produced by interfaces. A contract translates complex intentions into enforceable obligations. A standard reduces heterogeneous production processes to specified performance criteria. An API enables computational systems built on different internal architectures to exchange defined messages. A price compresses information relevant to exchange while leaving many reasons and consequences outside the transaction. A legal category makes different cases administratively comparable while suppressing detail. These interfaces enable relation precisely by limiting what must be mutually understood.

The reduction involved in an interface can be productive, but it can also generate misrecognition. When the interface omits a difference that later becomes consequential, coordination can fail. A metric can appear shared while participants interpret it differently. A model output can be operationally accepted without agreement on its epistemic status. A standardized category can group subjects whose vulnerabilities diverge sharply. The existence of a functioning interface therefore does not establish deep mutual understanding.

GRE analysis should ask what must be intelligible for the relation to function and what remains opaque. It should also ask who bears the risk created by opacity. If one party can demand explanation while the other cannot, interpretive asymmetry can become power. If a computational system influences access to credit, employment, or public services, the intelligibility required for legitimate use can be greater than the intelligibility required merely for technical operation.

Partial mutual intelligibility offers a middle position between two unrealistic assumptions: complete transparency and complete incommensurability. Economic life often proceeds through workable but incomplete translations. The quality of coexistence depends on whether these translations are sufficient for the stakes involved, revisable when they fail, and governed in ways that distribute interpretive risk fairly.

3.15.7 Economic Relations without Full Commensurability

Economic relation does not require every relevant object, value, subject, or consequence to be representable on one common scale. Exchange itself can involve commensuration for a limited purpose while broader aspects of the relation remain incommensurable. GRE therefore distinguishes local comparability from full commensurability.

A wage places a monetary value on labor time for the purpose of employment, but it does not establish that income exhausts the value of work, identity, health, autonomy, or social recognition. Insurance can assign compensation schedules to losses without implying that the compensated state is equivalent to the pre-loss state. Environmental markets can price particular emissions or ecosystem services while leaving cultural, ecological, and intergenerational values only partially represented. Cost-benefit analysis can support a decision under specified assumptions without becoming a complete theory of value.

Relations under incomplete commensurability often rely on layered decision rules. Some dimensions are priced. Others are protected through rights or prohibitions. Some are represented through minimum standards, negotiated conditions, or procedural safeguards. Others remain open to qualitative judgment. Such layered arrangements can be analytically messy, but the mess may reflect genuine plurality rather than methodological failure.

GRE can therefore study conversion without assuming equivalence. A value can be converted into another form through an institution even when the conversion is contested or incomplete. Time can be converted into wages; attention into advertising revenue; reputation into credit access; ecological damage into compensation obligations; research prestige into funding opportunity. The existence of a conversion mechanism shows that a relation connects the forms. It does not prove that the forms are intrinsically equivalent.

This distinction helps analyze exploitation and loss. When an institution repeatedly converts one form of value into another under asymmetric terms, the question is not only how much is transferred but which dimensions disappear during conversion. A platform can monetize social interaction while leaving users with limited claims on the resulting economic value. A development project can compensate property loss while failing to restore community networks. A labor contract can pay for output while externalizing health or care burdens. In each case, commensuration can enable exchange while concealing residual effects.

Coexistence under plural values therefore requires institutional creativity. Markets are one mechanism among several. Deliberation, commons governance, public provision, professional standards, rights, mutual aid, licensing, quotas, thresholds, and hybrid arrangements can coordinate heterogeneous values in different ways. GRE does not presume in advance which mechanism is appropriate. It asks how the chosen mechanism makes some values comparable, leaves others outside comparison, distributes authority over conversion, and alters future possibilities.

3.15.8 Human–AI Relations as a Contemporary Case

Human–AI relations provide a contemporary case in which heterogeneity of subject form, intelligence, temporality, vulnerability, and value can appear simultaneously. GRE can analyze these relations without first resolving philosophical questions about machine consciousness or personhood. The immediate economic question is how human and artificial operational subjects become connected through production, decision, communication, ownership, infrastructure, and institutional authority.

The asymmetry is multidimensional. Artificial systems can process or generate large volumes of symbolic material rapidly, replicate outputs at low marginal cost, and operate continuously within suitable infrastructure. Humans retain forms of embodiment, lived vulnerability, social membership, legal standing, moral responsibility, contextual experience, and value formation that are not established by computational performance. Organizations often mediate between the two, determining data access, deployment goals, review procedures, liability, and the distribution of gains.

This heterogeneity creates complementary possibilities. Artificial systems can extend search, translation, drafting, prediction, pattern recognition, or simulation. Human participants can contribute contextual interpretation, problem selection, normative judgment, embodied knowledge, accountability, and decisions concerning what purposes should be pursued. The generative question is how the relation changes the capabilities of both the immediate participants and the surrounding institutions.

It also creates new dependencies. Workers can become dependent on tools they do not control. Organizations can become dependent on model providers, computational infrastructure, or proprietary interfaces. Users can rely on systems whose update cycles alter behavior faster than institutional procedures adapt. Expertise can shift from producing outputs directly to evaluating, directing, integrating, or contesting machine-generated outputs. These changes can redistribute bargaining power even when aggregate productivity rises.

Human–AI coexistence therefore should not be analyzed through replacement alone. Substitution is one possible relation. Others include complementarity, supervision, delegation, contestation, infrastructural dependence, mutual adaptation, and reorganization of occupational or institutional roles. The relevant GRE object is the evolving relational configuration: who controls the system, who defines objectives, who bears error, who receives generated value, which human capacities are strengthened or weakened, and how future alternatives are shaped.

The case also clarifies partial mutual intelligibility. Humans may use outputs without understanding every internal computational process, while artificial systems operate on representations that do not amount to human understanding in any straightforward sense. Economic coordination can nevertheless occur through interfaces, tests, standards, feedback, and institutional review. The adequacy of that partial intelligibility should depend on stakes. A low-risk drafting aid and a system affecting liberty, livelihood, healthcare, or public authority require different evidential and governance conditions.

GRE therefore treats human–AI relations as an important contemporary domain of heterogeneous coexistence, while maintaining ontological and normative caution.

Operational capability does not settle personhood. Performance difference does not settle moral status. Economic usefulness does not settle legitimacy. These questions remain connected but analytically distinct.

3.15.9 More-than-Human and Ecological Relations

Economic systems also coexist with organisms, ecosystems, climatic processes, material cycles, and other more-than-human structures whose dynamics are constitutive of production and life. GRE includes these relations because economic generation depends on ecological and material conditions even when those conditions are poorly represented by conventional economic subjects.

More-than-human analysis requires ontological care. A forest, river, species, or ecosystem need not be treated as a subject in exactly the same sense as a human person or organization for its relational role to be economically consequential. Ecological systems can impose constraints, provide capacities, absorb waste, regenerate resources, transmit disturbances, and respond to interventions through dynamics that exceed the intentions of economic actors. Some legal or cultural traditions may also recognize nonhuman entities through forms of representation or standing. GRE can study these arrangements without requiring one universal theory of nonhuman subjecthood.

Ecological heterogeneity is strongly temporal. Soil formation, forest succession, hydrological cycles, species recovery, and climate processes can unfold at rates that differ from market, budgetary, and political cycles. An economic system can therefore appear productive within a short window while drawing down slower regenerative capacities. Conversely, ecological protection can impose immediate costs while preserving long-horizon generative conditions. The choice of temporal scale becomes part of evaluation rather than a neutral technical setting.

Vulnerability is likewise heterogeneous. An industrial actor may be able to relocate while a local ecosystem cannot. A community may depend on a specific river or coastal system whose loss is not replaceable by monetary compensation. Species and ecological processes can cross thresholds beyond which recovery becomes difficult or impossible on humanly relevant timescales. These differences complicate models that assume reversible substitution among resources.

Partial intelligibility appears here as well. Human institutions do not fully observe ecological systems. Models, indicators, monitoring networks, local knowledge, and scientific interpretation provide partial representations. Intervention therefore occurs under uncertainty about feedback, thresholds, and delayed effects. GRE's epistemic commitments require the distinction between ecological reality and its representation to remain explicit, especially where uncertainty interacts with potentially irreversible change.

The economic question is how relations with more-than-human systems affect present and future capacities. Extraction, cultivation, conservation, restoration, pollution control, infrastructure, and land-use rules all modify ecological conditions from which later economic possibilities emerge. More-than-human coexistence is thus central to generative analysis because the future economy is partly generated through relations with systems that exceed the boundaries of human institutions.

3.15.10 Boundary Cases of Radically Different Subjects

The most demanding cases for GRE arise when participants differ so substantially that ordinary assumptions of shared preference, common language, reciprocal recognition, or comparable vulnerability become unreliable. These boundary cases may involve relations among human communities with sharply different ontologies, future artificial systems with unfamiliar forms of agency, interspecies relations, intergenerational relations in which one party is not yet present, or institutional interactions with ecological systems that cannot participate in negotiation in conventional terms. The purpose of considering such cases is not to classify every entity as a subject. It is to test which parts of GRE remain usable when mutual similarity is minimal.

The first requirement is to separate relation from reciprocity. A subject or system can be economically affected by another without being able to respond in the same channel. Future generations can bear consequences of present debt, infrastructure, ecological damage, and knowledge preservation without participating in present bargaining. Nonhuman systems can constrain or respond to economic activity without expressing preferences through markets or language. An artificial system can alter human opportunities while its own status as a bearer of interests remains unsettled. Economic relation can therefore exist under asymmetric capacities for representation and response.

The second requirement is representational humility. When one side cannot articulate its interests through the dominant institutional interface, another actor often speaks on its behalf. Guardians, regulators, scientific experts, community representatives, trustees, legal advocates, or technical proxies can perform this role. Representation may be necessary, but it creates a second-order relation in which the representative's categories can shape what becomes visible. GRE analysis should therefore examine not only the represented subject or system but also the institutions that authorize, translate, and contest representation.

The third requirement is to distinguish coordination from assimilation. Radically different subjects need not become similar in order to coexist. Governance can instead create protected distances, limited interfaces, non-interference rules, thresholds, buffer zones, rights, or protocols that make coexistence possible while preserving difference. In some cases the appropriate relation is closer integration; in others it may be separation or restriction of contact. GRE does not prescribe one universal form of coexistence because the relevant vulnerabilities, values, and generative effects differ.

Boundary cases also expose the limits of commensuration. Where interests or values cannot be credibly translated into one metric, decision may require procedural legitimacy, precaution, rights, representation, plural evaluation, or explicit acknowledgment of unresolved disagreement. A decision can still be made, but the residual disagreement remains part of the record rather than disappearing into a scalar result. This is especially important where the affected party cannot later recover from the imposed decision.

The broader constitutional implication is that GRE should be able to study economies composed of heterogeneous forms without making homogeneity a hidden precondition of analysis. Economic relation can persist through partial intelligibility,

bounded interfaces, heterogeneous values, differentiated temporalities, unequal vulnerabilities, and incomplete commensurability. The task is to identify which differences matter to the relation, which interfaces make coordination possible, which conversions obscure residual losses, and how the terms of coexistence alter future generative possibilities.

Heterogeneity therefore belongs inside the GRE problem-space rather than at its margins. It prevents the economic subject from being silently standardized, prevents intelligence from being reduced to one ranking, prevents temporality from being treated as uniform, prevents vulnerability from being inferred from formal equality, and prevents value from being collapsed into a single measure. It also provides a bridge to the next constitutional problem. Once GRE accepts heterogeneous forms as legitimate participants and objects of inquiry, it must state more precisely where its own disciplinary boundaries lie and how it relates to neighboring economic and social-scientific traditions. The following section therefore turns to the boundaries of Generative Relational Economics.

3.16 Boundaries of Generative Relational Economics

Generative Relational Economics is intended to remain intellectually permeable without becoming disciplinarily indeterminate. The role of this section is to specify the principal boundaries through which GRE relates to neighboring economic and social-scientific traditions while preserving a recognizable problem-space of its own. Its objective is neither to rank adjacent approaches nor to absorb them into a single synthesis. Instead, the section clarifies where GRE can borrow concepts, methods, evidence, and explanatory mechanisms; where genuine overlap exists; and where a distinction should be maintained because the neighboring tradition asks a different primary question, uses a different evaluative register, or makes commitments that GRE does not need to adopt. The discussion proceeds through mainstream economics, political economy, relational economics, economic sociology, complexity economics, evolutionary economics, capability approaches, ecological and regenerative economics, generative justice, and general Generative Relational Theory. The method is boundary-setting rather than genealogical. Chapter 2 reconstructed intellectual lineages; the present task is to define interfaces for an emerging research programme.

A disciplinary boundary in this sense is not a wall. GRE can use optimization, causal inference, institutional analysis, network models, historical interpretation, capability concepts, ecological accounting, or justice-oriented evaluation whenever those tools are appropriate to the claim under investigation. The boundary concerns the conditions under which such borrowing remains intelligible. A borrowed method does not make a study identical with the field from which that method came, and a shared object does not erase differences in analytical emphasis. Firms, households, technologies, institutions, ecosystems, capabilities, and power can all be studied by several traditions at once while being rendered differently by each.

This openness is necessary because many GRE questions are intrinsically composite. A study of platform labor may require conventional price and labor-market analysis, institutional and legal interpretation, network structure, computational measure-

ment, political-economic analysis of control, and normative evaluation of capability or dependency. A study of agricultural transition may require cost and productivity analysis, ecological constraints, household reproduction, institutional history, technological coevolution, and long-horizon generative effects. GRE contributes when the inquiry asks how relations among these elements generate, distribute, stabilize, transform, or foreclose later capacities and possibilities. It does not require every neighboring perspective to be translated into GRE terminology.

Boundary maintenance therefore serves two purposes. First, it protects GRE from conceptual inflation. If every relational, dynamic, institutional, or justice-oriented economic study were automatically classified as GRE, the programme would lose analytical content. Second, it protects neighboring fields from retrospective appropriation. GRE can inherit and recombine resources while acknowledging that those resources have their own histories, standards, and unresolved debates. The disciplinary identity developed in this chapter depends on dialogue without theoretical identity.

3.16.1 GRE and Mainstream Economics

GRE has no constitutive need to define itself through opposition to mainstream economics. Standard economic analysis contains powerful tools for studying prices, incentives, choice under constraints, equilibrium, strategic interaction, causal effects, welfare consequences, production, and allocation. Where a research problem is adequately specified by those objects, GRE gains little by redescribing the same analysis in relational vocabulary. The boundary is therefore positive: GRE becomes useful when the research question concerns how the relevant preferences, capacities, constraints, institutional positions, relations, or future opportunity sets are themselves generated and transformed through economic processes.

This distinction can be stated through analytical depth rather than disciplinary hierarchy. A conventional model may treat preferences as given over the horizon of analysis. GRE can accept that local simplification when preference formation is irrelevant to the question. A different study may need to explain how advertising, institutions, peer relations, platform design, education, or repeated participation reshape preferences or salience. In that setting, what was reasonably exogenous in the first model becomes an object of inquiry. The same logic applies to technology, endowments, legal categories, information structures, capabilities, and market boundaries.

Equilibrium analysis provides another example. GRE does not reject equilibrium as a mathematical or empirical concept. A stable or approximately stable configuration can be analytically important. The additional GRE question concerns what relations sustain the configuration, how the stability distributes capacities and vulnerabilities, whether the configuration generates new conditions that alter its own persistence, and what happens when the relevant state space or institutional rules change. Equilibrium can therefore appear within GRE without defining the whole research programme.

The relation is similarly complementary in empirical work. Econometric identification, experimental design, structural estimation, administrative data analysis, and causal inference can provide strong evidence for particular mechanisms or effects.

GRE should use such evidence where available and should not substitute relational prose for identification. At the same time, an estimated local causal effect does not automatically reveal downstream institutional transformation, changing subject positions, altered exit conditions, or long-run generative consequences. Those further claims require further evidence.

The boundary can thus be summarized in terms of problem selection. Mainstream economics often provides the strongest available analysis when the relevant agents, constraints, preferences, technologies, and institutional rules can be treated as sufficiently stable. GRE becomes especially relevant when those conditions are part of what must be explained. The relationship is therefore one of selective extension and mutual correction rather than displacement.

3.16.2 GRE and Political Economy

GRE overlaps substantially with political economy because both can treat economic outcomes as inseparable from institutions, power, historical formation, distribution, and collective organization. Questions concerning ownership, labor, state capacity, financial structure, class, technological control, colonial legacies, regulation, and asymmetric dependence are naturally shared terrain. GRE does not need a separate vocabulary when political economy already provides an adequate account of the relevant mechanism.

The principal difference lies in analytical center of gravity. Political economy frequently organizes inquiry around the distribution and exercise of power among classes, states, firms, institutions, or social groups. GRE includes these objects but asks an additional family of questions concerning what those relations generate over time: capacities, subject positions, dependencies, values, institutional pathways, representational structures, ecological conditions, and the possibility of later action. Power remains central, yet GRE does not make every economic relation reducible to power.

This distinction matters because a relation can be generatively important even when domination is weak or absent. Cooperative institutions can generate capabilities and norms. Public infrastructure can create new spaces of participation. Educational systems can alter the subjects capable of entering later markets or political processes. Technological standards can coordinate activity without being explainable primarily through coercion. Political-economic analysis may already address these effects; GRE emphasizes their generative structure as a recurring cross-domain problem.

Conversely, GRE should not dilute political-economic mechanisms by translating them into neutral language of relation. Ownership, coercion, exclusion, dispossession, monopoly, dependency, and state authority possess specific institutional and historical content. When such mechanisms explain an outcome, they should be named directly. Relational vocabulary is not a substitute for analyzing who controls resources, who bears risk, who sets rules, or who can credibly exit.

GRE therefore sits near political economy while preserving a broader generative question. It can investigate how power structures generate future inequalities and institutional lock-in, but it can also study relations of learning, cooperation, care, eco-

logical reproduction, or symbolic orientation whose economic importance is not exhausted by power. The boundary allows GRE to inherit political economy's seriousness about history and asymmetry without treating political-economic conflict as the sole grammar of economic generation.

3.16.3 GRE and Relational Economics

The strongest conceptual overlap may appear between GRE and approaches that explicitly place relations at the center of economic analysis. Relational economics, relational goods, network-based economic analysis, and other relation-sensitive traditions already challenge the assumption that economic value and behavior can always be understood through isolated individuals and possessed objects. GRE shares the view that access, interaction, recognition, coordination, dependency, and participation can be economically constitutive.

The boundary arises from the second term in the name: generative. GRE is interested not only in the existence or quality of relations but also in what relations bring into being, reproduce, transform, or foreclose. A relation can connect already-defined actors, but it can also alter their capabilities, identities, institutional positions, preferences, expectations, and future relations. The analytical question moves from the structure of a relation to the consequences of participating in and reproducing that relation.

This distinction prevents a relation-first approach from becoming static. Two networks can share similar topology while differing in what their ties generate. Two contractual arrangements can appear similar at one moment while producing different long-term capabilities or dependencies. A cooperative relation can initially create shared capacity and later become exclusionary. A market relation can transmit value while also changing the conditions under which future exchange occurs. GRE therefore requires temporal and generative specification beyond identifying relational structure.

At the same time, GRE does not claim that every relation generates deep transformation. Many relations may be transient, weak, or analytically negligible for the research question. The researcher must establish which relations matter, through which mechanisms, and over what horizon. Relation itself is not an explanatory endpoint.

The boundary with relational economics is thus narrow but meaningful. GRE belongs naturally within a wider family of relational economic approaches, while adding a systematic focus on downstream generation, recursive transformation, heterogeneous forms of value, changing subjects, and future possibility. That addition should be treated as a research orientation rather than as a claim that earlier relational work failed to recognize change or emergence.

3.16.4 GRE and Economic Sociology

Economic sociology provides many of the concepts required for GRE to avoid an overly thin account of economic action. Institutions, social networks, conventions, organizations, classifications, trust, status, embeddedness, cultural interpretation, and

collective identity can all shape what economic relations are possible and how they are understood. GRE therefore shares a substantial empirical and conceptual domain with economic sociology.

The boundary is not based on a sharp separation between "economic" and "social" facts. GRE rejects such a simple partition. The distinction is better located in the organizing research problem. Economic sociology can ask how markets, firms, money, organizations, or valuation are socially constituted. GRE can use those analyses and then ask how the resulting economic relations transform later capacities, values, constraints, subject positions, and structures of possibility. The two directions can be mutually reinforcing.

GRE also retains an explicitly economic concern with allocation, production, circulation, extraction, capability, scarcity, and the organization of resources. These objects prevent the programme from dissolving into a general sociology of relations. A sociological account of trust may explain why exchange becomes possible; GRE may further analyze how the exchange redistributes capacity, creates dependency, alters future bargaining positions, or changes the institutions that sustain trust. A sociological account of classification may explain category formation; GRE may examine how that classification changes access to credit, work, insurance, mobility, or recognition.

This interface is especially important for symbolic and representational objects. Prices, ratings, credentials, risk scores, categories, and rankings can be both social facts and economic mechanisms. GRE can study their generative effects without claiming that economic sociology is merely a precursor to GRE. The traditions differ in disciplinary history and in the questions they prioritize.

The boundary therefore remains porous. GRE depends on sociological evidence whenever economic relations are constituted by social meaning, institutional recognition, or organizational form. It remains recognizably economic when the inquiry centers on how such relations organize resources, capacities, value, scarcity, exchange, production, and future economic possibility.

3.16.5 GRE and Complexity Economics

Complexity economics and GRE share an interest in heterogeneous agents, nonlinearity, adaptation, path dependence, interaction effects, emergent macro-patterns, and systems that change outside simple equilibrium descriptions. Complexity methods can be especially valuable when aggregate outcomes arise from distributed interactions and when feedback alters the trajectory of the system.

The overlap is methodological as well as conceptual. Agent-based models, network models, simulation, nonlinear dynamics, and computational experiments can all contribute to GRE where the research problem is compatible with their assumptions. These tools allow researchers to study distributed generation, threshold effects, coordination, cascading change, and multiple possible trajectories.

GRE nevertheless remains broader than a complexity methodology. A GRE contribution need not contain a simulation, a network model, or a nonlinear formal system. Historical interpretation, institutional analysis, qualitative research, comparative case studies, legal analysis, causal inference, and participatory inquiry can all

be appropriate. Complexity is one representational and explanatory family among several.

A second boundary concerns the representation of emergence. A computational model can demonstrate how a macro-pattern emerges from specified micro-rules. That result is important, but it establishes emergence within the model. GRE must still ask whether the selected agents, rules, state variables, and interactions adequately represent the empirical process. It may also need to explain how the rules themselves were historically generated, interpreted, contested, or transformed.

A third boundary concerns normativity and meaning. Complex adaptive behavior can persist without being desirable. A resilient system can stabilize exclusion, ecological harm, or domination. Actors can interpret the same rule differently, and those interpretations can alter later action. GRE therefore combines complexity-sensitive analysis with explicit attention to historical meaning, institutional authority, heterogeneous value, and normative evaluation.

The relationship is consequently close but non-identical. Complexity economics supplies powerful tools for distributed and nonlinear generation; GRE adds a wider methodological repertoire and makes the generation of rules, subjects, meanings, and evaluative conditions available as research objects where evidence permits.

3.16.6 GRE and Evolutionary Economics

Evolutionary economics offers another close interface because it treats economic systems as historically changing populations of technologies, routines, organizations, practices, and institutions. Innovation, variation, selection, retention, path dependence, learning, and coevolution provide important resources for analyzing processes that cannot be reduced to static optimization.

GRE shares the historical and processual orientation while avoiding an automatic translation of every generative process into evolutionary terms. Generation can occur through variation and selection, but it can also arise through deliberate institutional design, legal reclassification, collective interpretation, negotiated coordination, education, care, public investment, conflict, or sudden technological recombination. Evolutionary mechanisms are therefore important members of a broader generative repertoire.

The distinction is also useful for normative analysis. Persistence or selection does not demonstrate efficiency, justice, desirability, or superior adaptive value in every relevant sense. Institutions can survive because alternatives are suppressed, switching costs are high, incumbents control infrastructure, or vulnerable groups bear the costs of persistence. GRE therefore treats selection outcomes as explanatory objects that may require separate normative evaluation.

Coevolution provides particularly fertile common ground. Firms and technologies, institutions and practices, infrastructures and habits, or policies and expectations can change in mutually conditioning ways. GRE extends the question when the process changes the kinds of subjects, capacities, value forms, or relations that can exist in the next period. The interest lies not only in reciprocal adaptation but in transformation of the conditions under which later adaptation occurs.

GRE can thus use evolutionary models and concepts whenever variation, selection, retention, innovation, and coevolution explain the empirical process. Its boundary lies in refusing to make those mechanisms exhaustive. The programme remains open to generative processes whose historical logic is interpretive, institutional, juridical, ecological, political, or deliberately designed rather than primarily evolutionary.

3.16.7 GRE and Capability Approaches

Capability approaches and GRE share a concern with what people and other relevant subjects are substantively able to do and to become. This creates a natural interface between the evaluation of resources and the analysis of conversion conditions. Equal resources can produce unequal capabilities when subjects face different institutions, environments, social relations, embodied conditions, or access structures.

GRE adopts this insight without treating capability as its sole evaluative language. Capability is one dimension of generative consequence. Economic relations can generate or erode capabilities, but they can also transform dependency, recognition, institutional participation, relational quality, ecological conditions, symbolic orientation, and the possibility of collective action. Some of these effects can be translated into capability terms; others may be better preserved as distinct analytical objects.

The temporal orientation also differs in emphasis. Capability analysis can evaluate the substantive opportunities available at a given time. GRE places particular attention on how those opportunities were generated, how they are maintained, and how present relations alter the capability-generating conditions of the future. This makes capability formation, reproduction, concentration, and erosion central dynamic questions.

Capability asymmetry further enters the analysis of power. A difference in capability does not automatically create domination, but it can become leverage when one subject controls an infrastructure, knowledge resource, legal permission, computational system, or exit option required by another. GRE therefore connects capability analysis to relational conversion mechanisms without reducing capability to power.

The boundary is normative as well as analytical. GRE can use capability-oriented evaluation without claiming to settle the philosophical questions that capability theories address concerning freedom, human flourishing, lists of central capabilities, or the justification of public priorities. Those debates remain neighboring normative resources. GRE's contribution is to investigate how economic relations generate and distribute the conditions under which capabilities become possible, durable, or foreclosed.

3.16.8 GRE and Ecological and Regenerative Economics

Ecological and regenerative economics provide essential resources for any GRE analysis in which economic generation depends on material, energetic, ecological, or more-than-human conditions. Production cannot be understood solely through monetary circulation when it depletes soils, water, biodiversity, climate stability, or other conditions required for future activity. Conversely, economic relations can sustain and regenerate ecological capacities under some institutional arrangements.

GRE shares the emphasis on stocks, flows, throughput, ecological limits, interdependence, and long-horizon reproduction. It also shares the concern that apparent short-term gain can undermine the conditions of later possibility. Generative foreclosure has a direct ecological meaning when present extraction damages the ecological capacities through which future livelihoods or social systems could otherwise be sustained.

The boundary again concerns scope and normativity. GRE uses "generative" in a broader sense than ecological regeneration. A process can generate institutions, subject positions, knowledge, technological capacities, dependencies, or symbolic values while degrading ecological conditions. Conversely, ecological regeneration can occur within social arrangements that distribute benefits or burdens unjustly. The descriptive fact of regeneration therefore requires separate social and normative evaluation.

GRE also avoids treating circularity, resilience, regeneration, and generativity as synonyms. A circular material flow can preserve an unjust labor relation. A resilient system can stabilize harmful dependence. A regenerative ecological practice can impose burdens on communities whose knowledge or land is appropriated. The relevant analysis must specify what is being regenerated, for whom, through which relations, and with what consequences elsewhere.

The relationship is therefore strongly complementary. Ecological and regenerative economics prevent GRE from treating future possibility as socially generated in isolation from biophysical conditions. GRE contributes a wider account of how ecological and economic processes interact with institutions, power, subjects, value forms, and the distribution of future generative capacity.

3.16.9 GRE and Generative Justice

Generative justice is one of the closest normative neighbors of GRE because it directs attention to the circulation and return of generative value and to the conditions under which communities retain control over the processes that produce value. Earlier in the book, this lineage was treated as an established theoretical resource rather than as a retrospective expression of GRE. That distinction remains important at the disciplinary boundary.

GRE shares the concern that evaluation should extend beyond the immediate allocation of outputs. A relation can appear distributively acceptable at one moment while extracting the capacities, knowledge, infrastructures, or ecological conditions that enable future generation. Conversely, an arrangement can strengthen future capability by returning value, knowledge, authority, or productive infrastructure to the subjects and communities involved.

The two programmes nevertheless have different scope. Generative justice is explicitly normative. GRE combines descriptive, explanatory, causal, historical, formal, computational, normative, and intervention-oriented modes. A GRE study can analyze how value recirculates or is extracted without concluding that a particular pattern is just. Normative judgment requires additional premises concerning participation, domination, capability, harm, ecological sustainability, procedural legitimacy, plural values, and future possibility.

GRE also uses a wider conception of what may be generated. Material wealth and productive capacity are central, but economic relations can also generate subject positions, representations, institutional authority, dependencies, expectations, knowledge, ecological conditions, and future option structures. Return of value is therefore one important pattern among several possible generative trajectories.

The boundary preserves attribution and conceptual clarity. GRE can learn directly from generative justice while maintaining a broader economic research programme whose normative analysis remains open to several theories of justice and to the neighboring work of GREthic. The overlap is substantive, but theoretical identity would obscure differences in purpose and scope.

3.16.10 GRE and General Generative Relational Theory

The final boundary is internal to the wider research programme. General Generative Relational Theory provides the broader conceptual space in which relations, generation, ontological emergence, epistemic mediation, historical transformation, power, normativity, and praxis can be studied across domains. GRE is the economic instantiation of that wider framework. The distinction is necessary because not every generative-relational problem is an economic problem.

GRE therefore adopts only the amount of general GR required to investigate economic objects. It studies production, allocation, circulation, exchange, extraction, capability, scarcity, institutions, economic subjecthood, value, power, ecological dependence, and the transformation of future economic possibility. General GR may address analogous structures in law, politics, education, science, aesthetics, knowledge, culture, or other domains where the primary research problem is not economic.

This distinction prevents disciplinary expansion by analogy. A relational pattern discovered in economic analysis should not automatically be generalized to every social domain. Conversely, a concept developed in another GR domain may require translation before it becomes economically meaningful. The relevant mechanisms, evidence, units of analysis, institutions, and normative stakes can differ substantially across domains.

The relation is nevertheless recursive. GRE can contribute concepts and findings back to general GR. Economic studies may reveal new mechanisms of generative foreclosure, recursive power, value conversion, subject formation, or cross-scale transformation that later become useful outside economics. Other GR domains can likewise correct GRE by showing that an apparently economic process depends on legal, political, epistemic, cultural, or ecological structures that GRE alone cannot adequately explain.

General GR should therefore function neither as a doctrinal authority over GRE nor as a collection of metaphysical propositions that economic research is expected to confirm. It is a broader, revisable framework that can coordinate comparison among domains while remaining open to correction from domain-specific work. GRE retains disciplinary responsibility for the quality of its economic evidence and explanation.

The boundaries established across this section give GRE a position that is open without being unlimited. The programme can use mainstream economic models, political-

economic accounts of power, relational and sociological analyses, complexity and evolutionary methods, capability concepts, ecological and regenerative analysis, and generative-justice insights. None of these interfaces requires GRE to become identical with the neighboring field. The criterion is whether the borrowed resource helps explain how economic relations generate, reproduce, distribute, transform, or foreclose later capacities and possibilities.

This boundary-setting also prepares the next task of disciplinary constitution. Once GRE's neighboring interfaces have been identified, a further question becomes unavoidable: what would make a particular study count as a contribution to GRE rather than merely a study that uses relational language? The following section therefore turns from external boundaries to internal research standards, specifying the criteria by which a GRE contribution can state its relational problem, generative claim, evidence, boundary conditions, normative commitments, and cumulative contribution with sufficient clarity to be evaluated and revised.

3.17 Criteria for a GRE Research Contribution

The preceding sections have defined the problem-space, analytical objects, scales, modes of inquiry, epistemic commitments, praxis orientation, normative concerns, and disciplinary boundaries of Generative Relational Economics. A research programme, however, also requires internal standards by which particular studies can be recognized, criticized, compared, and accumulated. The role of this section is to state those standards. Its objective is neither to create a rigid checklist nor to police disciplinary membership through terminology. It is to specify the minimum analytical work required for a contribution to make a recognizably GRE claim. The discussion proceeds through ten criteria: specification of the relational problem; explicit scale and boundary conditions; identification of the generative claim; evidence appropriate to that claim; distinction between representation and relational reality; attention to downstream effects; consideration of alternative generative mechanisms; normative transparency; reproducibility and interpretive traceability; and contribution to cumulative knowledge. The method is constitutional and methodological. These criteria are intended to make GRE research more contestable, revisable, and cumulative rather than more doctrinal.

A study need not satisfy every criterion with the same intensity. A conceptual paper may contribute primarily through category formation and theoretical clarification. A historical study may establish a generative mechanism through archival reconstruction. An econometric study may identify a restricted causal relation while leaving wider ontological questions open. A simulation may explore the consequences of a specified generative mechanism without claiming empirical completeness. An intervention study may generate evidence about relational change that could not be obtained through detached observation alone. The relevant standard is proportionality: the claims made should be supported by an appropriate combination of analytical specification, evidence, and methodological transparency.

GRE therefore treats disciplinary contribution as a relation between a problem, a claim, a representation, evidence, and a cumulative research context. Relational vo-

cabulary alone does not establish that relation. A paper that describes a network, invokes emergence, or discusses downstream effects is not thereby a GRE contribution. The GRE character becomes substantive when the research shows how a specified economic relation contributes to the generation, reproduction, transformation, distribution, or foreclosure of later capacities, values, subjects, constraints, structures, or conditions of possibility, and when that claim is made in a form that other researchers can examine and revise.

3.17.1 Specification of the Relational Problem

A GRE contribution begins by specifying the relational problem under investigation. This requirement is stronger than stating that the topic is "relational." The study should identify which subjects, entities, institutions, infrastructures, representations, ecological conditions, or other analytically relevant configurations are connected, what kind of relation is at issue, and why that relation matters to the economic problem being studied.

The relation may involve exchange, production, financing, employment, ownership, access, dependence, coordination, classification, care, information, legal recognition, infrastructure use, platform participation, resource extraction, ecological dependence, or another economically consequential connection. Its empirical form may be contractual, informal, symbolic, technical, organizational, institutional, spatial, ecological, or distributed across several of these forms. GRE does not require a single taxonomy of relations. It requires enough specification for the researcher and reader to know what is being claimed to connect what.

Relational specification should also identify the economically relevant incidence of the relation. The administrative recipient of a resource, policy, payment, model, or intervention may be only one locus within a wider relational field. A subsidy to a firm can affect workers, suppliers, competitors, financial institutions, local communities, infrastructure demand, and future investment. A credit decision can affect households, landlords, employers, insurers, and later access to other services. A platform rule can alter users, complementors, advertisers, content producers, and labor conditions. The research problem becomes relational when these connections are treated as analytically constitutive rather than as residual externalities added after the main analysis.

The study should further clarify whether the relation is itself the principal object or whether it mediates another object of interest. A paper may examine the formation of a labor relation, the consequences generated through that relation, or the way the relation transforms its own future conditions. These are different research problems. Stating the relation precisely prevents a general language of interdependence from substituting for explanation.

Relational specification does not require exhaustive mapping. Every inquiry selects some relations and leaves others outside the active representation. The contribution lies partly in justifying why the selected relations are sufficient for the local question and in making visible which important relations have been bracketed. A study that names its relational problem clearly can later be extended, challenged, or re-scaled. A study that leaves the relation implicit is harder to evaluate because dis-

agreement about evidence can conceal disagreement about what the object actually is.

3.17.2 Explicit Scale and Boundary Conditions

Every GRE contribution should state the scale and boundary conditions within which its claims are intended to hold. Economic relations change character across temporal, organizational, spatial, institutional, ecological, and analytical scales. An apparent entity at one scale can decompose into heterogeneous relations at another. A mechanism visible in a household, firm, or platform may operate differently at sectoral, juridical, ecological, or transnational scales. Explicit scale selection therefore belongs to the substance of the analysis rather than to a technical appendix.

Boundary conditions specify what is treated as inside the active system of analysis, what is treated as an environment or background condition, and what is excluded. These boundaries can be geographical, institutional, temporal, jurisdictional, organizational, technological, ecological, or representational. They can also be nested. A study of a labor platform may define the platform ecosystem as the primary boundary while treating labor law, payment infrastructure, and macroeconomic conditions as surrounding systems that enter through specified interfaces.

Temporal boundaries require particular care because generative effects can be delayed. An intervention that raises income over six months may reduce a productive or ecological capacity over five years. A technology that expands access in one period can create dependence on proprietary infrastructure later. A relational configuration that appears stable during one institutional regime may dissolve when law, prices, expectations, or political authority change. A GRE contribution should therefore identify the temporal horizon of the claim and, when appropriate, distinguish immediate effects from slower structural or generative transformations.

Explicit boundary conditions also constrain generalization. Evidence from one sector, jurisdiction, historical period, or technological architecture does not automatically establish the same mechanism elsewhere. A GRE study can make a narrow claim and still be theoretically important if it states the conditions under which the mechanism is expected to operate. Conversely, broad claims require correspondingly broad evidence or a carefully justified theoretical argument.

Scale and boundary transparency creates a path for cumulative research. Later studies can test whether a mechanism persists under different institutional arrangements, whether a relation changes when the scale is expanded, or whether a boundary previously treated as external should become endogenous to the analysis. Boundary choice is therefore both a limitation and a research instrument.

3.17.3 Identification of the Generative Claim

A GRE contribution should identify its generative claim explicitly. The generative claim states what the specified relation is proposed to generate, reproduce, transform, distribute, or foreclose, through which mechanism, and over what temporal horizon. This is the criterion that most clearly distinguishes a GRE contribution from a study that merely uses relational language.

The generated object can take many forms. It may be a capability, resource, institutional position, subject identity, expectation, dependency, value form, knowledge structure, ecological condition, network topology, bargaining position, classification, infrastructure, norm, or future option. It may also be a change in the conditions under which further generation occurs. The generative claim should therefore name the analytical object rather than relying on the generic statement that a relation "creates value" or "produces effects."

The mechanism also matters. A relation may generate later capacity through learning, investment, access, network reinforcement, institutional recognition, technological complementarity, legal stabilization, reputational accumulation, ecological regeneration, coordination, or another process. It may generate foreclosure through extraction, depletion, lock-in, exclusion, deskilling, dependency, displacement, institutional erosion, or destruction of alternatives. Different mechanisms can produce similar observed outcomes, and the same mechanism can have different consequences under different conditions.

Generative claims can vary in strength. A descriptive contribution may show that a relational configuration is systematically associated with later capacity formation. A historical contribution may reconstruct a plausible mechanism across a sequence of institutional changes. A causal contribution may identify the effect of a specified relation on a downstream outcome under defined assumptions. A formal contribution may demonstrate that a mechanism can generate a class of patterns within a model. A simulation may explore the conditions under which a proposed mechanism becomes sufficient or insufficient. These claims should be distinguished rather than compressed into one category of proof.

A strong GRE contribution also clarifies whether the mechanism concerns generation within an existing structure or transformation of the structure itself. Creating additional productive capacity under stable rules differs from changing ownership, classification, institutional authority, or the effective rules by which future capacities are generated. The distinction helps prevent ordinary output expansion from being mislabeled as deep generative transformation.

The purpose of requiring an explicit generative claim is therefore diagnostic as well as disciplinary. It enables readers to ask whether the claimed generated object actually changes, whether the proposed mechanism is observed or inferred, whether alternative mechanisms fit the evidence, and whether the effect persists beyond the immediate horizon. Generativity becomes a researchable proposition rather than an honorific description.

3.17.4 Evidence Appropriate to the Claim

Evidence in GRE should be appropriate to the epistemic form and strength of the claim. No single evidential hierarchy governs every generative question. Historical reconstruction, ethnography, interviews, administrative records, experiments, quasi-experiments, surveys, network data, financial records, ecological measurements, computational traces, legal documents, formal proofs, and simulations can each support different kinds of inference. Methodological pluralism therefore requires disciplined matching between claim and evidence.

A claim about lived dependency may require qualitative or interpretive evidence that cannot be replaced by aggregate transaction data. A claim about population-level incidence may require quantitative evidence that interviews alone cannot establish. A claim about historical institutional transformation may require archival evidence and temporal reconstruction. A causal claim about an intervention may require an identification strategy capable of distinguishing the effect from confounding processes. A formal claim requires internally valid derivation under stated assumptions. A simulation establishes consequences of modeled rules and parameters rather than direct observation of the empirical target.

The evidence should also correspond to the downstream object named in the generative claim. If a paper claims that a financing relation generates capability, it should observe or defensibly proxy the relevant capability rather than infer it solely from the initial allocation of finance. If a platform intervention is claimed to increase autonomy, measures of throughput or usage alone are insufficient unless the relation between those measures and autonomy is theoretically and empirically justified. If an ecological practice is claimed to regenerate future production conditions, evidence should reach beyond current output toward the ecological capacities that support future activity.

Mixed evidence can be especially valuable when the generative mechanism crosses representational levels. Quantitative data may reveal a distributional pattern while interviews clarify how the relation operates. Institutional documents can establish formal authority while observed practice reveals its implementation. Simulation can explore whether a proposed mechanism is sufficient to produce an observed macro-pattern while empirical data constrain the plausible parameter range. Such combinations should be integrated through a stated inferential logic rather than accumulated as decorative methodological diversity.

Evidence appropriateness also includes negative evidence and failed expectations. When a proposed generative mechanism predicts downstream change that does not occur, the absence can narrow the mechanism, reveal a missing condition, or indicate that the representation is wrong. GRE should therefore retain evidential structures that permit a generative claim to be weakened or rejected. A programme that can only reinterpret every outcome as evidence of hidden generativity would cease to be empirically corrigible.

3.17.5 Distinction between Representation and Relational Reality

A GRE contribution should distinguish the representation used in analysis from the relational reality the representation is intended to illuminate. Networks, graphs, categories, state spaces, fields, equations, indicators, taxonomies, maps, legal classifications, interview codes, and computational models are analytical constructions. They can disclose important structure while also suppressing, aggregating, or transforming aspects of the target.

The distinction is particularly important because relational analysis often makes structure visually or mathematically compelling. A network diagram can make nodes and edges appear ontologically given even when node identities, tie definitions, missing relations, and temporal aggregation are products of the data-generating process.

A scalar indicator can make heterogeneous value appear commensurable. A field representation can suggest continuity where the empirical system contains discontinuities or institutionally discrete categories. A model can hold agents or rules fixed even when historical change in those objects is part of the substantive problem.

GRE does not therefore require researchers to distrust representation. Representation is unavoidable and productive. The requirement is reflexive specification. A contribution should explain what the representation makes visible, what it treats as stable, what it aggregates, what it excludes, and how those choices affect the claim. The more strongly the conclusion depends on a representational choice, the more important sensitivity to alternative representations becomes.

This criterion also applies to institutional representations. Legal categories, accounting classifications, platform metrics, credit scores, productivity measures, and administrative identities can become economically operative representations. They are not merely researcher-created descriptions. Their use can shape access, recognition, risk, resource allocation, and subject positions. A GRE study may therefore analyze a representation both as an epistemic device and as an economic mechanism.

Maintaining the distinction between representation and relational reality supports ontological suspension. Researchers can use network, field, dynamical, or computational language without claiming that the empirical economy literally possesses the complete ontology of the formalism. The analytical question is whether the representation is adequate to the local problem and generative claim. Competing representations can remain simultaneously useful when they disclose different aspects of the same economic configuration.

3.17.6 Attention to Downstream Effects

A GRE contribution should examine downstream effects far enough to evaluate the stated generative claim. This requirement does not demand infinite causal tracing. It requires the researcher to look beyond the immediate administrative output when the theoretical claim concerns later capacities, relations, values, constraints, or possibilities.

Downstream analysis begins by identifying plausible channels of propagation. A transfer to one organization may alter wages, procurement, investment, debt, market entry, local prices, or political influence. A new classification system may affect eligibility, insurance, credit, employment, or legal recognition. An AI system deployed to increase productivity may alter skill formation, supervision, bargaining power, organizational knowledge, and dependency on technical infrastructure. A conservation intervention may change ecological capacity, land access, community authority, and future livelihood options.

GRE should distinguish propagation from attribution. Observing a downstream change after an intervention does not establish that the focal relation generated it. The contribution should specify the pathway through which the effect is expected to travel and identify evidence consistent with that pathway. Where causal identification is unavailable, the claim should remain calibrated accordingly.

Downstream attention should also include distribution. The same relation can gen-

erate gains for one subject while shifting risk, depletion, dependency, or opportunity loss to another. Aggregate improvement can therefore coexist with localized generative foreclosure. A GRE contribution should identify who receives immediate outputs, who gains later capacity, who bears costs, and whose future options become more or less available when these differences are material to the research question.

Temporal depth matters as well. Some generated effects decay quickly; others accumulate or become self-reinforcing. A short evaluation horizon can misclassify a process whose main economic significance lies in later lock-in, learning, institutionalization, ecological regeneration, or erosion. Researchers should therefore justify the chosen horizon in relation to the mechanism rather than treating the observation window as analytically neutral.

The downstream criterion ultimately protects the concept of generativity from collapsing into ordinary output measurement. GRE asks what a relation leaves behind in the capacities and conditions from which later economic processes proceed. The appropriate downstream horizon is the one required to make that question empirically meaningful.

3.17.7 Attention to Alternative Generative Mechanisms

A GRE contribution should consider plausible alternative mechanisms capable of generating the observed pattern. This criterion follows directly from epistemic humility and from the fact that similar outcomes can emerge from different relational configurations. Mechanism identification becomes stronger when the researcher explains why the preferred account fits the evidence better than important alternatives.

Alternative mechanisms can operate at the same scale or at different scales. Increased productivity within a firm may result from worker learning, capital deepening, selection of more productive workers, changes in task allocation, demand expansion, or measurement artifacts. Increased community income after an intervention may reflect genuine local capability generation, temporary transfers, migration, price effects, or extraction from another location. Institutional persistence may arise from legitimacy, coordination benefits, legal coercion, network lock-in, sunk costs, or the absence of viable alternatives.

GRE should also remain attentive to equifinality: different histories can produce similar configurations. The existence of a stable relation does not uniquely reveal how it was generated. Comparative, historical, and process evidence can help distinguish pathways. In formal or computational research, sensitivity analysis can show whether the result depends on a narrow mechanism or emerges across several model structures.

Alternative mechanisms include representational alternatives. An apparent relation can arise because of measurement, classification, selection, aggregation, or omitted variables. A network pattern can change when edge definitions change. A capability indicator can move because the proxy changes while the underlying capability does not. A historical discontinuity can reflect an archival or institutional change in what was recorded. These possibilities do not invalidate the analysis; they specify additional hypotheses that should be considered where material.

The purpose of this criterion is not to require exhaustive refutation of every imaginable mechanism. It is to prevent a favored generative narrative from becoming insulated from competition. A GRE contribution should identify the most consequential alternatives given the domain, evidence, and claim strength, and state what additional evidence could discriminate among them. Competing mechanisms are part of cumulative research rather than threats to disciplinary coherence.

3.17.8 Normative Transparency

A GRE contribution should make its normative premises transparent whenever evaluative language enters the argument. Terms such as improvement, harm, empowerment, exclusion, justice, sustainability, resilience, capability, autonomy, participation, regeneration, and desirable generation carry normative content that should not be smuggled into a descriptive mechanism claim.

Normative transparency begins by distinguishing what the study observes from how it evaluates what is observed. A relation may generate new productive capacity while also increasing domination. A technology may expand access while weakening privacy or exit. A policy may preserve an institution while reducing the possibility of alternative forms of organization. A regenerative ecological intervention may improve biophysical conditions while distributing burdens inequitably. These cases cannot be evaluated solely by establishing that generation occurred.

The relevant evaluative principles should therefore be stated at the level needed for the claim. A study may adopt a capability perspective, a rights-based standard, a distributive criterion, a relational account of domination, a procedural standard, an ecological constraint, a plural-value framework, or another justified normative basis. GRE does not require one universal normative theory at the level of research contribution. It requires researchers to distinguish the empirical and generative analysis from the premises through which consequences are judged.

Normative transparency is equally important when a study refrains from full evaluation. Researchers may state that a mechanism increases a capability, concentrates control, or changes future options while leaving the overall justice of the arrangement unresolved. Such restraint can be more informative than forcing heterogeneous effects into a single welfare ranking.

Value plurality further requires explicit treatment of commensuration. If a study aggregates several forms of value into one index, score, monetary measure, or optimization objective, it should explain the justification and consequences of that aggregation. Practical commensuration may be necessary for decision-making without establishing that the underlying values are genuinely commensurable. A GRE contribution should preserve this distinction when it matters.

Normative transparency thus protects both positive and normative inquiry. It prevents descriptive evidence from carrying more evaluative force than it can support, while allowing ethical and political judgments to enter economic analysis openly rather than being hidden in model structure, metric selection, or outcome definition.

3.17.9 Reproducibility and Interpretive Traceability

A cumulative research programme requires other researchers to be able to reconstruct how a conclusion was produced. GRE therefore treats reproducibility and interpretive traceability as complementary standards. Their concrete form varies by method, but the underlying requirement is that the pathway from material or data to claim should remain inspectable.

For quantitative and computational work, reproducibility may involve accessible data where ethically and legally possible, documented preprocessing, variable definitions, code, model specifications, parameter choices, random seeds, robustness checks, and version information. Where data cannot be shared, the study should provide enough procedural detail to clarify what another researcher would need to reproduce the analysis under authorized access.

For qualitative, historical, and interpretive research, exact replication may be impossible or conceptually inappropriate. Interpretive traceability becomes the more suitable standard. The researcher should document source selection, coding or interpretive procedures, archival boundaries, translation choices, interview protocols, contextual assumptions, and the evidential basis for major interpretive moves. Readers should be able to distinguish the source material from the interpretation built upon it.

Formal research requires a related form of traceability. Definitions, assumptions, derivations, propositions, and the relation between formal objects and empirical interpretation should be explicit. A proof can be reproducible while its empirical meaning remains ambiguous; both layers therefore need documentation. Simulation requires the same separation between reproducibility of the computational experiment and validity of the modeled representation.

Traceability also applies to boundary and category revision. If a study changes the definition of a subject, relation, value form, or relevant system during analysis, the change should be visible. Such revision can be intellectually productive, especially in relational research where the empirical material may reveal that initial categories are inadequate. The contribution becomes stronger when readers can see why the revision occurred and how it affected the result.

These standards are not merely procedural ideals. They distribute epistemic authority. A claim whose evidential path can be inspected is easier to contest, reinterpret, update, and reuse. Reproducibility and interpretive traceability therefore support the broader GRE commitments to revisability, methodological pluralism, and re-epistemization across time.

3.17.10 Contribution to Cumulative Knowledge

A GRE contribution should clarify what becomes more knowable because of the study and how that result can enter a cumulative research programme. Novel terminology alone is insufficient. A contribution may refine a concept, establish a new typology, identify a mechanism, map a relational configuration, provide comparative evidence, develop a formal representation, test an intervention, construct a measure, document a boundary condition, falsify an earlier claim, or expose an unresolved contradiction.

These are different forms of cumulative advance.

Cumulative contribution requires relation to prior work. A study should indicate which GRE problem, concept, mechanism, or empirical domain it extends, revises, or challenges. Because GRE is an emerging programme, this relation may initially be internal to the book's preliminary constitution or to a small body of subsequent work. The standard should nevertheless be established early: later research should not repeatedly reinvent the same relational vocabulary without specifying what has changed.

Negative and limiting results are especially important. Demonstrating that a proposed generative mechanism fails under certain institutional conditions can advance the programme by specifying its scope. Showing that two indicators previously treated as proxies diverge can improve measurement. Identifying a case in which downstream generation is negligible can prevent overextension of the framework. Revealing that competing representations yield materially different conclusions can redirect theoretical development. Cumulative knowledge includes disciplined contraction as well as expansion.

A contribution should also preserve reusable analytical objects where possible. Clearly defined categories, documented datasets, mechanism diagrams, typologies, validated measures, formal models, intervention protocols, comparative cases, and explicit boundary conditions can support later synthesis. Reusability does not require standardization of every method. It requires enough conceptual and evidential continuity for results to be compared rather than remaining isolated narratives.

Cumulative knowledge in GRE is expected to remain historically revisable. Concepts adequate to one technological or institutional period may become insufficient as economic subjects, relations, infrastructures, and forms of value change. The purpose of accumulation is therefore not to build an immutable doctrinal core. It is to build a record of concepts, mechanisms, evidence, boundary conditions, disagreements, and revisions from which later inquiry can proceed with greater precision.

Taken together, the criteria in this section provide a practical threshold for recognizably GRE research. A contribution should specify the relation under study, state its scale and boundaries, articulate the generative claim, match evidence to the claim, distinguish representation from relational reality, trace relevant downstream effects, consider plausible alternative mechanisms, disclose normative premises, preserve reproducibility or interpretive traceability, and explain how the result contributes to cumulative knowledge. The criteria remain proportional to the type of inquiry, but they create a common language for criticism across heterogeneous methods.

These standards also shift Chapter 3 from disciplinary constitution toward research development. Once contributions can be evaluated individually, the next question concerns how they can accumulate across projects into a programme that develops concepts, typologies, maps, mechanisms, formal models, simulations, intervention evidence, measures, and revisions over time. The following section therefore turns from the criteria for a single GRE contribution to the architecture of a cumulative GRE research programme.

3.18 Cumulative Research Programme

The preceding section specified the standards by which an individual contribution can be recognized as part of Generative Relational Economics. A research programme, however, requires more than a sequence of individually competent studies. It requires mechanisms through which concepts can be stabilized and revised, cases can become comparable, mechanisms can be accumulated across contexts, formal and computational representations can become reusable, interventions can generate transferable evidence, measures can be improved, and theoretical claims can contract as well as expand. The role of this section is therefore to specify how GRE can develop cumulatively without converting cumulative development into doctrinal closure. Its objective is to identify several forms of accumulation through which a still-emerging research programme can become more precise, more testable, more comparable across domains, and more corrigible over time.

Cumulative development in GRE is expected to be heterogeneous. Historical reconstruction, conceptual clarification, comparative case analysis, mechanism identification, formal modeling, simulation, intervention research, and indicator construction do not accumulate in identical ways. A concept can become more precise without becoming more universal. A mechanism can recur across cases while remaining conditional on institutional context. A formal model can improve analytical discipline without establishing empirical adequacy. An intervention can generate evidence about a relational configuration that cannot be transferred unchanged to another scale. The programme therefore needs forms of accumulation that preserve local differences while still allowing knowledge to travel.

The central commitment is that accumulation should increase the quality of future inquiry rather than merely increase the quantity of publications. A cumulative programme should make later researchers better able to distinguish objects, specify boundaries, formulate mechanisms, compare cases, identify failed expectations, construct representations, and revise earlier claims. Accumulation is therefore closely related to memory: the programme must preserve not only successful formulations but also boundary conditions, null findings, abandoned distinctions, incompatible representations, and reasons for revision. This historical record is part of the epistemic infrastructure through which GRE can remain generative without repeatedly rediscovering its own problems.

3.18.1 Conceptual Development

Conceptual development provides one of the earliest forms of cumulative work in an emerging research programme. GRE depends on terms such as relation, generativity, capacity, subject, field, orientation, propagation, conversion, foreclosure, and generative condition. These terms can guide inquiry only when their meanings become sufficiently explicit for disagreement, comparison, and revision. Conceptual development therefore concerns the progressive clarification of what a term denotes, what it excludes, how it differs from neighboring terms, which empirical indicators can bear upon it, and under what conditions the concept ceases to be useful.

Such development should proceed through distinction rather than inflation. A

concept becomes stronger when researchers can identify nearby phenomena that it should not subsume. Generativity, for example, should not become a general synonym for causation, productivity, innovation, emergence, or social change. Relationality should not become a label attached to any situation containing more than one actor. Orientation should not become equivalent to intention. Power should not become interchangeable with every asymmetry. Conceptual accumulation therefore requires negative space: a concept is partly stabilized by the cases and mechanisms that researchers agree belong elsewhere.

Conceptual development is also historical. A distinction useful in one institutional or technological period may become insufficient when the object changes. The meaning of economic subjecthood may need revision when artificial systems undertake increasingly consequential operational roles. The concept of resource may change when informational, ecological, infrastructural, or symbolic forms become central to production. The concept of value may require further differentiation when heterogeneous value forms interact without stable conversion ratios. GRE should therefore treat conceptual stabilization as provisional achievement rather than final definition.

A cumulative conceptual record should preserve successive formulations and their reasons. Later versions should make visible whether a term was broadened, narrowed, divided, or replaced. This allows conceptual disagreement to become cumulative rather than repetitive. Researchers can then ask whether a difference arises from incompatible definitions, different empirical domains, different scales, or genuinely competing theoretical commitments. Conceptual development becomes part of research infrastructure when it reduces ambiguity while preserving the possibility of revision.

3.18.2 Typology Development

Typologies allow recurrent heterogeneity to be organized without requiring reduction to a single scalar dimension. They are especially important for GRE because many objects of inquiry are structurally plural: economic subjects can differ in kind, relations can differ in direction and persistence, value can take multiple forms, generative effects can propagate through different channels, and interventions can create benefits and harms through distinct mechanisms. A typology provides a way to preserve these differences while making comparison possible.

Typology development should begin from analytically relevant distinctions rather than from the desire to populate a classificatory table. A useful typology changes what can be observed or compared. Distinguishing resource asymmetry from capability asymmetry, for example, matters because possession and effective capacity can diverge. Distinguishing relational dependence from domination matters because dependence can exist without one subject acquiring durable control over another. Distinguishing propagation, conversion, recirculation, dissipation, and extraction matters because downstream value trajectories differ even when an initial allocation is identical.

Typologies should also remain open to overlap. GRE objects are frequently multidimensional, and a single case can instantiate several types at once. A platform may be simultaneously an organizational actor, a field-structuring infrastructure, a rep-

resentational system, and a locus of institutional power. A transfer programme can be allocative, capability-enhancing, dependency-producing, and institution-forming at different stages. Typological clarity therefore does not require exclusive membership unless exclusivity is substantively justified.

Cumulative typology development requires empirical confrontation. Categories should be revised when recurrent cases do not fit, when two categories fail to produce meaningful explanatory differences, or when one category hides internally distinct mechanisms. Cross-case work is especially important because a typology derived from one institutional context may mistake a local classification for a general one. Typologies accumulate when their boundary conditions, empirical uses, exceptions, and revisions are recorded rather than when their labels simply proliferate.

3.18.3 Relational Mapping

Relational mapping concerns the systematic representation of economically consequential connections among subjects, institutions, resources, infrastructures, representations, capacities, and environments. The purpose is not to impose a universal network ontology. It is to make relational structure visible enough that claims about mediation, dependence, propagation, power, or generation can be examined rather than assumed.

Different research problems require different maps. A transaction map may trace flows of money or goods. An authority map may represent legal and organizational powers. A capability map may identify which relations enable access to knowledge, infrastructure, care, finance, or mobility. A representation map may show how classifications and metrics connect institutional decisions to subject positions. A temporal map may represent the order through which one relation conditions a later possibility. Ecological or supply-chain analysis may require several of these layers simultaneously.

Cumulative relational mapping depends on comparability without forced standardization. Researchers should document node definitions, relation types, temporal windows, missing-data assumptions, scale choices, and the meaning of direction or weight where these are used. When mappings from different studies cannot be directly combined, the reasons should be visible. Differences in mapping conventions can then become substantive evidence about how the object itself is differently constituted across contexts.

Relational maps can also accumulate historically. Repeated mapping can show how a configuration changes, which ties persist, which dependencies become concentrated, where new intermediaries emerge, and whether an intervention alters the topology of opportunity or control. Longitudinal mapping is particularly useful for GRE because generative claims often concern changes in the conditions from which later actions become possible. The cumulative product is not a final map of the economy, but a set of documented representations that can be compared, revised, and linked to mechanism claims.

3.18.4 Mechanism Identification

Mechanism identification provides a central bridge between relational description and generative explanation. GRE is concerned not only with whether two conditions are associated, but with how a relation contributes to the production, reproduction, transformation, or foreclosure of later capacities and possibilities. A cumulative programme therefore needs recurrent mechanism families that can be investigated across settings without assuming that the same mechanism operates universally.

Mechanisms may involve resource access, learning, coordination, institutional recognition, bargaining leverage, infrastructural dependence, feedback, expectation formation, classification, imitation, exclusion, risk transfer, ecological regeneration, or many other processes. What makes such a process a useful GRE mechanism is not its novelty of name but its role in connecting a relational configuration to a downstream change. The mechanism should specify intermediate transformations sufficiently clearly that evidence can support, weaken, or reject the claim.

Cumulative mechanism work benefits from decomposition. A broad claim that an intervention ”builds capability” may contain several distinct processes: it may increase material resources, reduce uncertainty, create social recognition, provide technical knowledge, alter institutional eligibility, or change expectations about future access. Disaggregating these processes allows later studies to test whether the same downstream effect arises through different mechanisms or whether similar interventions produce different outcomes because only some mechanism components are present.

Mechanism accumulation should therefore include enabling conditions, inhibiting conditions, competing mechanisms, and failure modes. A mechanism that appears robust in one setting may depend on trust, legal enforceability, technological infrastructure, social norms, or complementary public goods. Recording these conditions turns isolated explanations into a comparative mechanism library. Such a library remains revisable and context-sensitive, but it gives later researchers a stronger starting point than an undifferentiated appeal to relational complexity.

3.18.5 Comparative Case Accumulation

Cases become cumulative when they are documented in ways that permit meaningful comparison. GRE therefore requires comparative case accumulation rather than a collection of richly described but analytically disconnected examples. The purpose of comparison is not necessarily to produce universal laws. It can identify recurring relational configurations, clarify boundary conditions, distinguish mechanisms, reveal alternative pathways, and show how similar interventions generate different outcomes under different institutional or historical conditions.

Comparison can be organized around cases, mechanisms, trajectories, scales, or interventions. Two regions may receive similar infrastructure investments yet generate different capability effects because institutional access differs. Two platforms may use similar algorithms but create different labor dependencies because ownership and exit options differ. Two ecological restoration projects may produce comparable short-term outputs while diverging in long-run regenerative capacity. A com-

parative design becomes especially informative when the axis of comparison corresponds to a plausible mechanism difference.

Cumulative case repositories should therefore preserve more than outcome variables. They should record relational boundaries, subject categories, institutional context, temporal horizon, intervention history, relevant value forms, and evidential limitations. Standardized metadata can help without forcing all cases into identical theoretical categories. The aim is to make later synthesis possible while retaining the contextual features through which generative mechanisms may differ.

Negative and anomalous cases are particularly valuable. A case in which a predicted mechanism fails can identify a missing enabling condition or expose an overgeneralized concept. A case that produces an unexpected downstream effect can reveal a propagation channel absent from the original theory. A cumulative programme should therefore preserve cases that resist prevailing formulations rather than treating them as noise to be excluded from the archive.

3.18.6 Formal Model Development

Formal models can contribute cumulative value by making assumptions, relations, and implications explicit. In GRE, formalization may represent dynamics, networks, allocation processes, bargaining relations, value conversion, capability change, field-like influence, institutional rules, or recursive transformations of generative conditions. The purpose is analytical discipline rather than formalization for its own sake.

A cumulative formal programme should preserve model lineage. Later models should indicate which assumptions are inherited, relaxed, extended, or replaced. If one model treats subject identities as fixed while another allows subject formation, the difference should be explicit. If one model uses scalar value while another represents plural value dimensions, the comparison should identify what explanatory capacity is gained and what tractability is lost. Formal accumulation then becomes a sequence of interpretable modifications rather than a disconnected set of mathematical constructions.

Model families can also help identify which conclusions depend on which assumptions. Robustness across several formal representations strengthens confidence that a result reflects a structural feature rather than an artifact of one specification. Divergence across models can be equally informative when it reveals sensitivity to boundary conditions, topology, time horizon, or behavioral assumptions. GRE should therefore treat model disagreement as a source of theoretical information rather than merely as a problem to be eliminated.

Formal development remains subject to ontological suspension. A model can establish the consequences of stated relations without proving that the empirical economy possesses the model's ontology. Cumulative formal progress therefore requires empirical interpretation and clear links to the concepts or mechanisms represented. Reusable models, documented assumptions, and transparent derivations can become infrastructure for later studies even when empirical validation remains partial.

3.18.7 Simulation and Computational Exploration

Simulation and computational exploration extend formal development when analytic solutions are unavailable, when interaction structures are heterogeneous, or when researchers want to examine the consequences of alternative rules and parameter regimes. GRE can use agent-based models, network simulations, dynamical systems, optimization procedures, synthetic populations, and other computational methods to explore how local relations may generate larger-scale patterns.

Cumulative computational work requires reproducible experimental design. Code, parameter ranges, initialization procedures, random seeds, stopping rules, and output measures should be documented where possible. More importantly, the relation between computational objects and theoretical concepts should remain explicit. A simulated agent may represent a household, firm, algorithm, institution, or abstract decision unit, but that mapping is a modeling choice rather than an ontological fact.

Computational exploration can support cumulative knowledge by identifying candidate mechanisms, sensitivity regions, threshold behavior, path dependence, or unexpected interactions. It can also help discriminate among theories by showing that some verbal mechanism claims are insufficient to generate the observed pattern under plausible assumptions. Such findings remain conditional on the model, but they can direct empirical work toward the variables and relations most likely to matter.

Simulation results should accumulate together with failed parameterizations and negative results where feasible. If a proposed mechanism produces a target pattern only under implausibly narrow conditions, that fact is theoretically relevant. Computational archives can therefore preserve the history of model development, including abandoned specifications, so that later researchers can distinguish genuine theoretical progress from repeated rediscovery of previously rejected configurations.

3.18.8 Intervention Evidence

Interventions provide a distinctive source of evidence because they modify the relational configuration under study. Policy changes, institutional reforms, experimental programmes, platform redesigns, governance mechanisms, public investments, organizational changes, and community initiatives can reveal how relations respond when constraints or enabling conditions are altered. GRE treats such evidence cautiously because intervention effects can be path-dependent, scale-specific, and entangled with adaptation.

A cumulative intervention programme should document design, implementation, context, immediate outputs, downstream effects, unintended consequences, and later structural changes. Evidence about failure is as important as evidence about success. An intervention that produces an initial benefit but creates long-term dependency contributes different knowledge from an intervention whose effects persist after external support is withdrawn. An intervention that changes institutional recognition without altering material capacity reveals a different mechanism from one that changes both.

Intervention evidence also benefits from variation in intensity, timing, sequence, and institutional setting. Comparative intervention research can identify whether an

effect depends on complementary relations, threshold conditions, or prior histories. Where randomized or quasi-experimental identification is possible, it can strengthen causal claims. Where it is not, careful process tracing, comparative design, and longitudinal evidence can still contribute to mechanism understanding if the limits of attribution are explicit.

Cumulative praxis requires preserving correction histories. Researchers should record when an intervention was modified, suspended, reversed, or repaired and why. These histories provide evidence about the adaptability of both the intervention and the governing institutions. They also help later researchers understand which apparent outcomes were produced by the initial design and which emerged through iterative revision.

3.18.9 Measure and Indicator Development

Measures and indicators allow recurrent GRE concepts to become empirically tractable, but measurement should follow conceptual clarification rather than substitute for it. Possible GRE measures may concern relational dependence, capability access, exit conditions, propagation, concentration of generative control, value conversion, institutional recognition, ecological capacity, or forms of generative foreclosure. Each indicator compresses a more complex concept and therefore requires explicit justification.

Cumulative indicator development should include validity, reliability, sensitivity, and domain restrictions. An indicator useful in one institutional setting may fail elsewhere because the same observable carries a different relational meaning. A measure of platform dependence based on revenue concentration may miss infrastructural lock-in. A measure of capability based on resource possession may ignore conversion constraints. A measure of generativity based on output growth may overlook depletion of future enabling conditions. Indicator accumulation therefore depends on comparison with alternative measures and on documented cases where the proxy fails.

Composite indices require particular caution. Combining heterogeneous value dimensions into one score can aid communication or decision-making, but the weighting rule performs substantive evaluative work. GRE should distinguish between an index created for practical coordination and a claim that the underlying values are intrinsically commensurable. Sensitivity analysis can show how rankings or conclusions change under alternative weighting schemes.

A mature cumulative programme can maintain indicator families rather than seeking one universal GRE metric. Different measures may be appropriate for different objects, scales, and purposes. The cumulative goal is not metric unification but increasing clarity about what each measure captures, what it omits, and how it relates to the generative claim being tested.

3.18.10 Theory Revision

Theory revision completes the cumulative architecture because accumulation without revision would convert GRE into a repository of additions rather than a research

programme. Concepts, typologies, mechanisms, models, indicators, and intervention assumptions should all remain revisable when evidence, comparison, formal analysis, or historical transformation shows that earlier formulations are inadequate.

Revision can take several forms. A concept can be narrowed because it was applied too broadly. A typology can be divided because one category contains distinct mechanisms. A mechanism can be reclassified as conditional rather than general. A formal model can replace a fixed parameter with an evolving relation. An indicator can be abandoned because it tracks a proxy rather than the target concept. A normative criterion can be separated from an empirical one when the two were previously conflated. Revision is cumulative when the reason for change is documented and the consequences for earlier findings are made visible.

GRE should also preserve superseded formulations. Historical traceability allows later researchers to understand why a theory changed and whether an earlier version may still be useful in a restricted domain. Erasing theoretical history would make apparent progress difficult to evaluate because researchers could not distinguish genuine correction from terminological replacement.

Theory revision may also be triggered by transformations in the object of inquiry. New technologies, institutional forms, ecological conditions, legal arrangements, or types of economic subject can make previously adequate categories insufficient. A research programme committed to historical dependence should expect some of its own concepts to age. Revisability is therefore not a weakness added to GRE from outside; it follows directly from the claim that economic relations and their generative conditions are historically transformable.

Taken together, the ten forms of accumulation described in this section define a research programme that can grow without equating growth with theoretical expansion. Conceptual clarification can narrow terms. Typologies can remove distinctions that fail empirically. Comparative cases can reveal boundary conditions. Mechanism research can reject attractive explanations. Formal and computational work can expose contradictions. Intervention evidence can show that a promising design generates harmful dependencies. Indicators can be retired. Theory can contract. Cumulative development is therefore the organized capacity to preserve, compare, test, reuse, and revise knowledge across heterogeneous forms of inquiry.

This cumulative architecture also prepares an important disciplinary problem. As GRE develops, researchers will not necessarily converge on one ontology, one preferred method, one formal representation, one account of value, or one definition of generativity. A cumulative programme therefore requires a way to distinguish productive internal plurality from conceptual fragmentation. The following section turns to internal pluralism and competing formulations, asking how divergent approaches can coexist, criticize one another, and become comparable without forcing premature theoretical unification.

3.19 Internal Pluralism and Competing Formulations

The preceding sections have progressively specified the identity, objects, scales, questions, epistemic commitments, praxis, normative interfaces, power problems, contri-

bution standards, and cumulative structure of Generative Relational Economics. A cumulative research programme, however, cannot remain open merely by permitting new topics to be added. It must also preserve the possibility that several incompatible or partially incompatible formulations of the same problem coexist long enough to be compared, criticized, revised, and sometimes rejected. The role of this section is therefore to specify the place of internal pluralism within GRE. Its objective is to distinguish productive plurality from conceptual indeterminacy: GRE can sustain multiple ontologies, methods, formalisms, evidential strategies, value representations, and accounts of generativity without treating every formulation as equally adequate or every disagreement as irreducible.

Internal pluralism follows from the programme's earlier commitments. Ontological suspension limits the authority of any single representational scheme. Methodological pluralism recognizes that different research questions warrant different modes of access. Heterogeneous subjects and values make premature commensuration hazardous. Scale-relative entityhood means that the same economic configuration can be represented differently at different analytical resolutions. The cumulative programme further requires that alternative formulations remain visible so later work can determine which distinctions travel across contexts, which mechanisms recur, and which representations fail. Pluralism is therefore not an exception to GRE's constitution. It is one of the conditions under which the programme can remain corrigible.

Pluralism nevertheless requires discipline. A research programme becomes weak if incompatible claims are retained merely because they use different vocabularies. It also becomes weak if every disagreement is redescribed as a matter of perspective before empirical or conceptual comparison has occurred. GRE should therefore distinguish plurality of representation from incompatibility of prediction, plurality of method from contradiction in evidence, plurality of value from inconsistency in stated normative commitments, and plurality of ontology from unrestricted metaphysical permissiveness. Competing formulations become productive when their objects, boundaries, assumptions, inferential claims, and failure conditions can be made sufficiently explicit for comparison.

3.19.1 Ontological Pluralism

Ontological pluralism in GRE begins from the recognition that economic inquiry can require several kinds of object-description. A firm can be represented as a legal person, an organization, a nexus of contracts, a hierarchy of authority, a network of relations, a bundle of capabilities, an institutionalized process, or a temporally persistent configuration. These descriptions do not necessarily refer to different empirical worlds. They select different features of the same or overlapping configurations for different analytical purposes.

The earlier principle of ontological suspension therefore does not prohibit ontological language. It restricts the movement from analytical usefulness to ultimate metaphysical commitment. GRE can state that a corporation is treated as an economic subject in one analysis, a relational configuration in another, and an institutional field component in a third. Each formulation must explain what distinctions it pre-

serves, what mechanisms it makes visible, and what questions it suppresses. Ontological pluralism is legitimate when alternative object-descriptions improve inquiry without being silently conflated.

This plurality becomes especially important when objects change historically. A category that functions as a relatively stable entity during one period may later require decomposition because its internal relations become explanatory. Conversely, a dense set of relations may become sufficiently stabilized that entity-level treatment is efficient and empirically adequate. GRE therefore permits movement between entity-centered and relational descriptions as the problem changes. The choice is governed by explanatory and evidential adequacy rather than by a requirement that one level possess permanent ontological priority.

Ontological pluralism does not imply that every proposed object deserves equal standing. Some entities may be administratively convenient yet analytically misleading. Some relational categories may be too broad to identify mechanisms. Some field descriptions may erase important discontinuities. Some claims of emergence may simply rename aggregation. Competing ontological formulations should therefore be assessed by the empirical distinctions they sustain, the mechanisms they clarify, the observations they organize, and the errors they make possible to detect.

A plural programme can also contain genuine ontological disagreement. Researchers may disagree about whether a particular social fact should be treated primarily as an emergent property, an institutional rule, a represented category, a distributed relation, or a relatively autonomous object. GRE need not resolve such disagreements through constitutional fiat. It should require the competing formulations to state their consequences. If two ontologies generate indistinguishable descriptions, predictions, or interpretations for the relevant problem, the dispute may remain underdetermined. If they imply different observations, interventions, or normative diagnoses, the disagreement becomes a substantive research question.

3.19.2 Methodological Pluralism

Methodological pluralism concerns the coexistence of different strategies for producing warranted claims. GRE admits historical, interpretive, qualitative, quantitative, causal, comparative, formal, computational, and intervention-oriented inquiry because its objects can be only partially accessible through any single mode. The justification for plurality is therefore epistemic rather than diplomatic. Different methods disclose different aspects of relational and generative processes.

A historical reconstruction can identify how categories, institutions, or subject positions came to exist. Ethnographic or interpretive work can reveal meanings, tacit practices, and situated understandings that are unavailable in administrative data. Quantitative analysis can estimate distributions, associations, heterogeneity, and temporal regularities at scales difficult to observe directly. Causal designs can test specific intervention or mechanism claims under stated assumptions. Formal models can expose logical consequences and structural possibilities. Computational models can explore high-dimensional, adaptive, or path-dependent systems. None of these capacities automatically contains the others.

Methodological pluralism therefore requires claim-method matching. A computa-

tional simulation cannot by itself establish that its mechanism generated an observed historical outcome. A historical narrative cannot by itself estimate the magnitude of a population-level effect. A statistically identified average treatment effect may not explain the meanings through which the treatment was received or the institutional conditions through which it propagated. An interpretive account may clarify subject formation while leaving distributional prevalence unresolved. The value of a method depends on the claim it is used to warrant.

Pluralism also permits methodological competition. Two studies can approach the same generative claim through different designs and produce conflicting evidence. Such conflict should not be resolved automatically by a fixed hierarchy of methods. The programme should examine differences in population, scale, measurement, boundary selection, intervention timing, model specification, and inferential target. Sometimes one method will expose a limitation in another. Sometimes the disagreement will reveal that the original theoretical claim was underspecified.

The strongest form of methodological pluralism is therefore cumulative correction. Methods become mutually informative when they identify each other's blind spots and help refine the target of inquiry. GRE does not require every project to use mixed methods. It requires the programme as a whole to remain open to correction from methods capable of observing dimensions that another approach leaves unresolved.

3.19.3 Formal Pluralism

Formal pluralism extends the same principle to mathematical and computational representation. GRE has inherited resources from dynamical systems, complexity theory, network science, higher-order and multilayer representations, field formalisms, information theory, computation, and simulation. These formalisms organize different kinds of structure. A dynamical system emphasizes state, trajectory, stability, and transformation through time. A network emphasizes patterned relations among identifiable nodes. A higher-order representation can make irreducibly multi-actor interactions explicit. A field representation can describe distributed conditions that vary across a domain. Agent-based or computational models can explore local rules, heterogeneity, and emergent aggregate behavior.

GRE therefore has no constitutional reason to privilege one formal language as the universal representation of economic relations. Formal choice should follow the structure of the research problem. A model of propagation through contractual dependencies may be naturally network-based. A problem concerning distributed accessibility or exposure may be represented more effectively through a field. A question about transition between regimes may require dynamical analysis. A question about heterogeneous adaptive actors may benefit from simulation. Several representations may be needed for the same empirical system.

Formal pluralism also protects the programme from a recurrent category error: mathematical elegance should not be mistaken for ontological authority. Two mathematically distinct representations can sometimes encode the same empirically relevant relation. Conversely, one formalism can fit several empirical situations whose mechanisms differ. Formal equivalence, approximation, simulation, or mapping therefore needs to be distinguished from substantive equivalence of the

represented processes.

Competing formalisms should be compared through their assumptions, representational losses, empirical accessibility, computational tractability, and consequences for inference. A more complex formalism is not necessarily better. Additional dimensions, layers, parameters, or interacting fields can increase expressiveness while reducing identifiability. A simpler model can be preferable when its omissions are explicit and its inferential target is narrow. Formal pluralism is productive when representational choice remains accountable to evidence and purpose.

3.19.4 Quantitative and Qualitative Approaches

Quantitative and qualitative approaches often differ in data structure, inferential form, sampling logic, and the kinds of uncertainty they make visible. GRE treats these differences as analytically important rather than as a division between rigorous and non-rigorous inquiry. Quantitative work can establish patterns across large populations, estimate magnitudes, compare distributions, and model temporal or relational structures. Qualitative work can reconstruct meaning, institutional practice, local causal process, category formation, tacit knowledge, and the situated experience through which economic relations become operative.

The distinction is particularly important for generative analysis. A downstream effect can be quantitatively measurable while its mechanism remains poorly understood. Conversely, an interactional mechanism can be richly documented in a small number of cases while its prevalence, distribution, or aggregate contribution remains uncertain. GRE should therefore resist converting one form of evidence into claims warranted only by the other.

Mixed designs can be valuable when the forms of evidence address complementary parts of the same generative claim. A qualitative study can help identify mechanisms, categories, or boundary conditions that later quantitative work tests across cases. Quantitative anomalies can direct qualitative inquiry toward previously invisible heterogeneity. Administrative or network data can identify patterns of propagation, while interviews or archival evidence reveal why particular pathways existed. Such integration should be designed around a shared research problem rather than around the ceremonial inclusion of multiple methods.

Qualitative and quantitative approaches can also disagree productively about the object itself. A variable that appears stable in a dataset may combine historically different institutional meanings. A locally salient category may have no reliable population-level measure. A statistically robust association may depend on classifications whose social production requires separate analysis. GRE's relational commitments make these disagreements substantive because measurement categories can participate in the relations they represent.

The programme therefore treats quantitative and qualitative approaches as mutually corrective without requiring symmetry in every project. The relevant question is which claims remain unsupported when only one form of evidence is available and whether the resulting limitation materially changes the argument.

3.19.5 Causal and Interpretive Approaches

Causal and interpretive approaches address different but frequently intersecting questions. Causal inquiry asks whether and through what mechanisms a change in one condition contributes to a change in another under specified assumptions. Interpretive inquiry asks how actors, institutions, representations, and practices acquire meaning within a situated historical and relational context. GRE requires both because economic relations can operate through mechanisms whose effectiveness depends on interpretation.

A legal classification, price signal, credential, ranking, or algorithmic recommendation can alter behavior partly because subjects recognize, contest, trust, misunderstand, or strategically use what the representation means. In such cases, interpretation is not merely commentary after causal analysis. It can be part of the causal mechanism. At the same time, the existence of meaning does not establish the magnitude or distribution of its effects. Interpretive adequacy and causal identification remain distinct epistemic achievements.

The same distinction applies to subject formation. Researchers may interpret how a worker, consumer, creditor, beneficiary, or platform participant is institutionally constituted and how that subject position is experienced. A causal study may then examine whether entering that position changes behavior, income, access, or later opportunities. The two analyses can support each other without collapsing into a single method.

Competing causal and interpretive accounts become especially useful when they disagree about where the mechanism lies. A causal model may attribute an effect to incentives, while interpretive evidence suggests that the intervention changed recognition, legitimacy, or perceived obligation. Rather than treating one vocabulary as necessarily deeper, GRE should ask what observable consequences follow from the alternative mechanism accounts and whether both processes operate at different stages or scales.

Causal and interpretive pluralism therefore requires translation without reduction. Researchers should state when an interpretive category enters a causal model, how it is observed, and what is lost in operationalization. Conversely, causal evidence can constrain interpretations by showing that a proposed meaning-making mechanism does not produce the expected distributional or temporal pattern. Productive integration occurs when each approach can expose conditions under which the other's claims fail.

3.19.6 Network and Field Representations

Network and field representations provide a concrete example of formal pluralism because they organize relational structure differently. A network begins from distinguishable nodes and relations among them. It is well suited to questions concerning adjacency, centrality, brokerage, diffusion, dependence, multilayer connectivity, and evolving topology. A field representation describes conditions distributed across a domain and can be useful when influence, accessibility, exposure, salience, or constraint varies continuously or when pairwise ties provide an incomplete description.

These representations can overlap without being interchangeable. A network of financial obligations can identify who depends directly or indirectly on whom. A field representation may instead characterize how liquidity conditions, regulatory exposure, information availability, or market accessibility vary across positions. The network makes discrete relational pathways explicit; the field can make distributed background conditions visible. A system can contain both.

Choice between network and field representation should therefore follow the mechanism. If transmission occurs through identifiable connections, a network may be the natural first representation. If subjects respond to a spatially, institutionally, or symbolically distributed condition, a field can be more informative. Some problems require hybrid representations in which nodes and edges evolve within fields that also respond to network activity.

The competing representations can generate different intuitions about intervention. Network analysis may suggest altering connections, central nodes, or dependency pathways. Field analysis may suggest changing distributed conditions that shape many interactions simultaneously. GRE should not infer that one intervention is superior from the representation alone. The empirical question is which representation captures the mechanisms through which the relevant generative effects actually propagate.

The plurality also reinforces ontological suspension. Network nodes need not be ultimate entities, and fields need not be literal physical fields. Both are representational devices whose adequacy depends on what they permit researchers to observe, explain, predict, or intervene upon.

3.19.7 Scalar and Non-Scalar Value Representations

Value presents a particularly consequential case of internal pluralism. Some economic questions require scalar representation. Prices, costs, quantities, income, expected returns, or index values can support comparison, optimization, aggregation, and accounting. Other forms of value resist stable reduction to one dimension because they involve heterogeneous goods, rights, relationships, capabilities, ecological conditions, meanings, or obligations whose trade-offs are context-dependent or normatively contested.

GRE therefore permits scalar and non-scalar representations of value. The choice must be justified by the evaluative task. A scalar representation can be useful when a common unit is institutionally established, empirically meaningful, and relevant to the question. It becomes misleading when the numerical scale hides changes in what is being valued, who has authority to define the conversion, or which losses cannot be represented adequately by the chosen unit.

Non-scalar representation can preserve plurality through vectors, partial orderings, categorical distinctions, threshold conditions, lexicographic priorities, narrative evaluation, or explicit statements of incommensurability. Such representations do not eliminate the need for decisions. Institutions frequently must act even when values cannot be reduced to a common metric. The analytical task is to distinguish practical commensuration from demonstrated commensurability and to make visible who establishes the conversion rules.

Competing value representations can lead to different judgments about the same intervention. A project may generate positive monetary returns while degrading ecological resilience, increasing dependency, or reducing future option sets. A multidimensional representation can reveal this divergence. Conversely, retaining every value dimension without prioritization can make decision procedures indeterminate. GRE therefore treats value representation as part of the problem rather than assuming that either scalarization or irreducible plurality is universally preferable.

Comparison among value representations should examine what each includes, excludes, weights, converts, and renders visible. It should also ask how the representation itself affects institutional action. An indicator that becomes a target can reorganize behavior; a price can alter the relation it measures; a ranking can generate new incentives and subject positions. Value representation is therefore both epistemic and potentially generative.

3.19.8 Competing Accounts of Generativity

Generativity is the organizing concept most likely to produce internal theoretical disagreement within GRE. The term can refer to several related but distinct phenomena: production of downstream capacities, emergence of new entities or relations, transformation of subject positions, expansion or contraction of future possibilities, creation of new value forms, alteration of institutional pathways, or modification of the effective rules through which later change occurs. These processes can coexist, but they should not be treated as interchangeable by definition.

One account of generativity may emphasize the creation of capacities. Another may focus on the reproduction and transformation of relational structures. A third may treat generativity primarily as alteration of future possibility spaces. A fourth may emphasize recursive change in the mechanisms that produce subsequent outcomes. GRE should allow these accounts to compete because their differences can clarify what exactly is claimed to be generated.

Competing accounts should state their unit of analysis, temporal horizon, baseline, mechanism, and observable consequences. A claim that a relation generates capability requires evidence different from a claim that it generates institutional persistence. A claim that an intervention expands future possibility requires a specification of whose possibilities, over what horizon, under which constraints, and relative to which counterfactual or historical baseline. A claim that a rule transforms its own conditions of reproduction requires evidence beyond ordinary downstream effects.

The programme should also permit the possibility that generativity is not a single natural kind. Different domains may contain several mechanisms that share a family resemblance but cannot be reduced to one formal definition. In that case, cumulative research should develop a typology of generative mechanisms rather than force premature unification. Conversely, if apparently different mechanisms can be shown to instantiate a common structure, theory can become more parsimonious.

Internal competition around generativity is therefore desirable when it increases discriminability. A successful formulation should make it easier to determine when a process is merely productive, causal, adaptive, or reproductive and when a stronger generative claim is warranted. The concept becomes weaker when it absorbs every

form of change and stronger when competing accounts specify different empirical commitments.

3.19.9 Productive Disagreement

A plural research programme depends on disagreement that can change what researchers subsequently do. Productive disagreement is therefore more demanding than the coexistence of opinions. It requires disagreement to be localized sufficiently that evidence, argument, or comparison can alter the standing of competing claims.

Researchers can disagree about concepts, boundaries, mechanisms, measurements, formal representations, empirical generalization, normative premises, or intervention implications. These forms of disagreement should be distinguished because they require different responses. A definitional disagreement may be resolved through conceptual clarification. A measurement disagreement requires validity evidence. A mechanism disagreement may require process tracing, experiments, comparative cases, or temporal data. A normative disagreement may persist even after empirical questions are settled because the disagreement concerns values or justificatory principles.

Productive disagreement also requires preserving losing formulations long enough to understand why they failed. If a model is rejected because its mechanism does not fit observed timing, that reason should become part of programme memory. If a concept is narrowed because it collapsed several distinct phenomena, the earlier broader usage should remain traceable. If two formulations apply at different scales, the outcome is not necessarily victory of one over the other but clarification of boundary conditions.

Disagreement becomes unproductive when formulations shift whenever evidence challenges them, when different vocabularies hide identical claims, when claims are insulated from possible counterevidence, or when normative and empirical disagreements are repeatedly confused. A plural programme therefore needs conventions for making commitments explicit enough that revision is possible.

The social organization of disagreement also matters. Dominant institutions, disciplines, languages, data infrastructures, or publication norms can determine which formulations are visible enough to be contested. GRE's own commitment to pluralism therefore includes attention to the conditions under which alternative formulations can enter the research programme. Inclusion of alternatives, however, does not suspend standards of evidence or argument. Productive pluralism widens the space of contestation while preserving the possibility of criticism.

3.19.10 Conditions for Theory Comparison

Internal pluralism becomes cumulative only when competing formulations can be compared under explicit conditions. Theory comparison in GRE should therefore begin by determining whether the formulations address the same object, scale, temporal horizon, and inferential target. Apparent disagreement can disappear once researchers recognize that one theory describes short-run adjustment while another describes long-run institutional transformation, or that one concerns individual be-

havior while another concerns field-level conditions.

Where the targets overlap, comparison should examine at least six dimensions: conceptual clarity, empirical scope, mechanism specification, evidential support, representational cost, and capacity for revision. Conceptual clarity concerns whether the theory distinguishes its principal objects and mechanisms from neighboring concepts. Empirical scope concerns the domains and boundary conditions within which the theory is expected to apply. Mechanism specification concerns what processes connect conditions to outcomes. Evidential support concerns whether available observations discriminate the theory from alternatives. Representational cost concerns the assumptions, data, computation, and abstraction required to use the formulation. Capacity for revision concerns whether failure can lead to identifiable modification rather than indefinite accommodation.

Predictive accuracy can be important but should not become the sole criterion. Some GRE problems concern historical explanation, interpretation, institutional constitution, normative evaluation, or intervention design where prediction is only one dimension of adequacy. Conversely, conceptual richness should not excuse a formulation from empirical consequences when it makes empirical claims. The criteria for comparison should therefore track the kind of contribution being evaluated.

Theories can also be compared by their generative usefulness for further research. A formulation can be valuable because it produces new measurable distinctions, suggests discriminating cases, clarifies a previously vague mechanism, or exposes a class of interventions whose consequences can be studied. Such usefulness does not establish truth, but it can justify continued investigation when direct adjudication remains incomplete.

Some competing formulations may remain partially incommensurable because they begin from different objects, values, or explanatory purposes. GRE should not manufacture a single ranking when the comparison lacks a common criterion. It should instead identify the dimensions on which comparison is possible and preserve the residual disagreement. Partial comparability is preferable to either false unification or premature declaration of complete incommensurability.

The constitutional role of internal pluralism can therefore be stated compactly. GRE should remain open to multiple formulations while requiring each formulation to expose enough of its objects, assumptions, mechanisms, evidence, values, and failure conditions to permit criticism. Pluralism protects the programme from premature closure; theory comparison protects it from indiscriminate accumulation. Together they allow disagreement to become part of cumulative inquiry.

The existence of a plural and revisable research programme also means that several difficult questions remain unresolved even after its disciplinary constitution has been specified. The following section turns from the permitted diversity of formulations to the substantive open problems that future GRE research must address.

3.20 Open Problems

The preceding sections have specified the preliminary identity, objects, scales, modes of inquiry, epistemic commitments, praxis, normative interfaces, contribu-

tion standards, cumulative structure, and internal pluralism of Generative Relational Economics. A research programme becomes more credible, however, when its unresolved problems are stated with comparable precision. The role of this section is therefore to identify several problems that remain open after the current constitution of GRE has been articulated. Its objective is neither to close those problems through definition nor to convert uncertainty into a rhetorical virtue. The aim is to distinguish questions for which GRE already has an analytical vocabulary from questions for which the mechanisms, measurements, evidential strategies, or normative criteria remain materially underdeveloped.

The open problems considered here concern identification, attribution, measurement, boundary selection, changing transformation rules, heterogeneous value, justice, symbolic reification, governance under persistent asymmetry, and long-horizon evaluation. These problems are connected, but they should not be collapsed. Better identification of a generative relation does not by itself solve downstream value attribution. A useful indicator of generativity does not establish normative desirability. A formally specified transformation rule does not guarantee that the relevant rule remains stable through the period being studied. A governance mechanism that mitigates one asymmetry can create another. The purpose of separating the problems is therefore to make future progress discriminable.

Open problems also differ in the kind of resolution they permit. Some may yield to better data, identification strategies, historical reconstruction, or formal representation. Others arise because economic relations are reflexive, boundaries are purpose-dependent, values are only partially comparable, and future possibilities cannot be observed before they are realized. GRE should therefore allow for the possibility that some uncertainty can be reduced while other uncertainty remains structural to the object of inquiry. A mature research programme needs both ambitions: to improve what can be known and to specify what remains underdetermined.

3.20.1 Identification of Generative Relations

The first open problem concerns the identification of generative relations. GRE frequently asks whether a relation contributes to the production of later capacities, institutions, subject positions, value forms, or conditions of possibility. Such claims are stronger than statements that two variables covary or that one event precedes another. They also exceed the observation that a relation participates in ordinary causal production. A relation becomes generatively relevant when its operation changes what can subsequently be produced, sustained, accessed, recognized, or transformed. The empirical difficulty lies in demonstrating that stronger claim.

Identification requires a specification of the relation, the object said to be generated, the time horizon over which generation occurs, and the mechanism that connects them. These elements can be difficult to observe simultaneously. Some relations operate through repeated interaction rather than singular events. Some produce latent capacities that become visible only when later conditions activate them. Some operate through institutional recognition or symbolic classification rather than directly observable material transfer. Some are distributed across several actors or infrastructures, making bilateral attribution misleading.

A further difficulty is that generative relations may be constitutive rather than merely productive. A worker's access to a professional network, for example, can affect opportunities while also contributing to the formation of recognized expertise, identity, or standing. A credit relation can transfer purchasing capacity while simultaneously generating dependency, reputational records, or future exclusion. In such cases the relation changes properties of the participating subjects and the environment in which later action occurs. Identification must therefore distinguish immediate output from transformation of later possibility.

Progress on this problem will require multiple forms of evidence. Longitudinal observation can reveal whether capacities persist beyond the originating relation. Comparative cases can test whether similar relational configurations produce similar downstream structures under different contexts. Process tracing can identify intermediate mechanisms. Experiments or quasi-experiments can help isolate particular pathways when intervention is possible. Formal or computational models can clarify what observations would discriminate generative mechanisms from ordinary transmission. Interpretive evidence can be necessary when generation operates through meaning, recognition, or institutional classification.

No single identification strategy is likely to cover the full range of GRE objects. The open task is therefore to develop a disciplined family of identification standards. Such standards should make it possible to distinguish a plausible generative hypothesis from a demonstrated mechanism, and a demonstrated local mechanism from a general claim about generativity across contexts.

3.20.2 Attribution of Downstream Value

A second open problem concerns attribution once value has propagated beyond an initial relation or intervention. Economic processes commonly produce effects through chains of mediation. Training can alter later employment, organizational practice, peer learning, and household security. Infrastructure can generate uses that were not anticipated by its designers. Knowledge can be recombined by actors distant from its original producer. Institutional reforms can change incentives, expectations, classifications, and later policy capacities. GRE needs ways to analyze such downstream value without converting every remote benefit into a claim of credit for the initial source.

Attribution becomes difficult because downstream effects are usually co-produced. Later value can depend on complementary resources, independent decisions, institutional environments, accumulated knowledge, ecological conditions, and subsequent interventions. A generative relation can be necessary without being sufficient. It can raise the probability of an outcome without determining it. It can create an enabling condition whose significance varies strongly across contexts. A later actor can transform an inherited resource so substantially that simple origin-based attribution becomes conceptually misleading.

The problem therefore has at least three dimensions. Causal attribution asks whether the earlier relation materially contributed to the later outcome. generative attribution asks whether it altered the conditions from which later value could emerge. Distributive attribution asks how recognition, return, responsibility, or

claims on value should be allocated among contributors. These dimensions should remain distinct because evidence for causal contribution does not settle the distributive question, and normative entitlement cannot be inferred directly from causal ancestry.

Future GRE work requires methods for tracing contribution without assuming additive decomposition. In some domains, contribution analysis may be approximately scalar. In others, interaction effects, complementarities, threshold behavior, or non-substitutable roles make scalar shares unstable or arbitrary. Network and process representations may help locate pathways without requiring a single attribution percentage. Counterfactual analysis can identify whether a contribution changed the set of feasible trajectories. Historical reconstruction can reveal how later actors transformed inherited conditions.

The objective should therefore be calibrated attribution. GRE should become better at saying that an upstream relation enabled, constrained, amplified, redirected, or conditioned later value while preserving uncertainty about the exact share attributable to that relation. Such calibrated language is important both for explanation and for later questions of return, compensation, responsibility, and justice.

3.20.3 Measurement of Generativity

The measurement of generativity presents a related but distinct problem. The concept is attractive because it directs attention toward effects on later productive and transformative possibilities. Yet the concept can become analytically weak if every beneficial downstream effect is redescribed as generativity. Measurement therefore requires a more discriminating account of what is being measured and at which scale.

Several candidate dimensions are possible. One study may measure new capabilities acquired by participants. Another may measure the diversity of subsequent activities enabled by an intervention. A third may examine persistence of effects after direct support ends. A fourth may study whether new actors can enter a domain, whether dependence on a central provider declines, or whether local reproduction becomes possible. A fifth may examine changes in the range of feasible future states. These measures capture different aspects of generativity and should not automatically be aggregated.

The temporal horizon also changes the result. An intervention can generate high short-run activity while degrading future ecological or institutional capacity. Another can impose substantial near-term cost while creating durable infrastructure or knowledge. A third can generate options that remain unused for years. Measurement therefore requires explicit time horizons and, where possible, sensitivity to delayed activation and depreciation.

Baseline selection is equally important. Generativity can be expressed relative to a prior state, a plausible counterfactual, an alternative intervention, or a historically available possibility set. These baselines answer different questions. A project can be generative relative to local past conditions while remaining less generative than another feasible arrangement. A technology can expand one actor's possibilities while narrowing those of another. A scalar score that suppresses these distinctions can obscure more than it reveals.

GRE should therefore resist the premature construction of a universal generativity index. The more promising direction is a family of measures tied to explicit objects: capability generation, institutional reproduction, option expansion, relational diversification, knowledge recombination, ecological regeneration, or transformation of future constraints. Some domains may support quantitative indicators; others may require ordinal, categorical, historical, or qualitative evidence.

The open problem is to determine when these heterogeneous measures can be compared and when they should remain separate. Measurement should increase discriminability while preserving the multidimensional character of generation. A measure becomes useful when it makes a claim more testable or comparable, not merely when it assigns a number to a concept.

3.20.4 Relational Boundary Selection

Every relational analysis requires a boundary, yet the boundary can materially determine the result. A firm can be analyzed through internal employment relations, supply chains, financial dependencies, legal institutions, ecological inputs, community effects, or global infrastructures. A household can be treated as a unit or decomposed into members with different resources, vulnerabilities, and bargaining positions. A platform can be bounded by formal ownership or expanded to include complementors, users, data providers, moderators, advertisers, and regulatory institutions. Each choice creates a different relational object.

Boundary selection is therefore more than a technical preprocessing decision. It affects which mechanisms are visible, which costs are externalized, which subjects count as participants, and which downstream effects are attributed to the focal process. A narrow boundary can produce apparent efficiency by excluding displaced burdens. An excessively broad boundary can make explanation indeterminate by treating nearly everything as part of the system.

GRE currently has principles that help discipline boundary choice: explicit scale selection, ontological suspension, claim-relative objecthood, and attention to downstream effects. These principles do not yet provide a general procedure for deciding how far a relational analysis should extend. The appropriate boundary depends on the claim. A study of contractual propagation may require one boundary; a study of ecological regeneration may require another; a study of institutional recognition may require several overlapping boundaries.

One direction for future work is sensitivity analysis across relational boundaries. Researchers can ask whether the principal inference changes when adjacent actors, longer time horizons, or additional infrastructures are included. Another direction is boundary justification through mechanism: include relations that participate materially in the mechanism under investigation and distinguish them from contextual conditions whose role is secondary. A third is normative boundary review, especially where exclusion from the analytical boundary also removes affected populations from evaluation.

The deeper problem is that boundaries can themselves be generated and contested. Legal categories, accounting rules, administrative jurisdictions, platform architectures, and disciplinary conventions determine what appears internal or external.

GRE therefore needs methods for studying boundary formation while still selecting workable boundaries for empirical research. This is an inherently reflexive task: the researcher must construct a boundary without mistaking that construction for a natural edge of the economic world.

3.20.5 Dynamics of Changing Transformation Rules

GRE places particular emphasis on situations in which the effective mechanisms of change are themselves transformed. This possibility is analytically important because many models assume that states change under a rule that remains sufficiently stable for the period of analysis. Economic history repeatedly presents harder cases: technologies alter feasible production processes, institutions modify incentives and classifications, learning changes decision procedures, political settlements alter property and authority, and adaptive systems modify the relations through which later adaptation occurs.

The open problem is empirical representation of these changing transformation rules. It is relatively straightforward to estimate changing states under a fixed model. It is harder to determine whether parameter drift is sufficient, whether the structure of interaction has changed, whether new variables have become relevant, or whether the model class itself must be revised. A sudden forecasting failure can indicate structural transformation, measurement change, omitted context, or ordinary stochastic variation. The observation alone does not identify rule change.

Different forms of rule transformation should therefore be distinguished. Parameters can change while the functional structure remains stable. Network topology can evolve while node types remain fixed. Agents can learn and alter local decision rules. Institutions can redefine available actions or recognized categories. New technologies can introduce previously unavailable operations. Symbolic changes can alter how subjects interpret the same formal option. More radical transformation can make earlier state variables inadequate because the kinds of economically relevant entities have changed.

Future GRE work requires diagnostics for these levels. Change-point methods, time-varying parameter models, adaptive networks, institutional process tracing, computational learning models, and historical comparison can each contribute. None should be treated as a universal representation. The important question is what evidence warrants movement from a claim of state change to a claim of structural change, and from structural change to transformation of the effective rule of change.

This problem also concerns anticipation. If governance relies on models whose rules can change in response to the intervention itself, policy evaluation becomes recursively difficult. Agents can adapt to incentives, classifications, metrics, and regulatory thresholds. Institutions can learn from being measured. Artificial systems can modify decision environments at high speed. GRE therefore needs forms of intervention design that monitor the stability of the assumed transformation rule rather than merely updating parameter estimates within it.

3.20.6 Heterogeneous Value Comparison

GRE's commitment to heterogeneous value creates an unresolved problem of comparison. Economic decisions frequently require choices among outcomes expressed through different value languages: income, time, health, dignity, ecological integrity, autonomy, knowledge, cultural continuity, security, care, or future option value. Practical governance cannot always defer choice until a complete theory of commensurability is available. Yet forcing these values into a single metric can erase the distinctions that motivated plural evaluation in the first place.

The problem is therefore to determine which forms of comparison are legitimate under partial commensurability. Some values may be monetizable for a specific administrative purpose while retaining dimensions not captured by price. Some can be ordered ordinally without meaningful cardinal distances. Some can be compared only within a domain. Some are subject to thresholds or rights that constrain trade-offs. Some are held by different subjects whose evaluative frameworks do not share a common scale.

GRE needs a vocabulary for these cases because generative effects often cross value domains. A policy can increase income while reducing ecological resilience. A technology can increase productivity while weakening autonomy or interpretive control. An institution can expand access for one population while eroding cultural continuity for another. The analytical challenge is to preserve these transformations without treating every trade-off as either fully aggregable or completely incomparable.

Several approaches are available for future development: vector-valued representation, partial ordering, threshold constraints, lexicographic priorities, multi-criteria analysis, deliberative comparison, qualitative matrices, and domain-specific indicators. Each imposes assumptions. The important task is to state those assumptions and to distinguish practical decision procedures from claims about underlying value equivalence.

Comparison also has a political dimension. Institutions that control the conversion interface between value forms can determine which values become legible enough to enter allocation decisions. Measurement systems, accounting rules, markets, legal standards, and algorithmic ranking can all privilege particular value representations. GRE should therefore study value comparison both as an analytical problem and as an object of economic power.

The open problem is not to eliminate heterogeneity. It is to make decision-relevant comparison possible while preserving residual differences that remain normatively or empirically meaningful.

3.20.7 Generativity and Justice

Generativity and justice intersect without being identical. An arrangement can generate substantial new capacity while distributing access, control, risk, or return unjustly. A restrictive intervention can reduce some forms of generation while protecting vulnerable subjects or preserving future ecological conditions. A relation can be locally reciprocal while depending on historical structures that shape who possesses the capacity to participate. GRE therefore needs a more developed account of how

generative analysis and theories of justice constrain, inform, and revise one another.

One unresolved issue concerns the object of justice. Evaluation can focus on resources, capabilities, recognition, participation, relations, procedures, generated opportunities, or future conditions of generation. These objects can point in different directions. Equal resource distribution can coexist with unequal conversion capacities. Broad participation can coexist with domination inside the participatory process. Expansion of future possibilities for one group can depend on ecological or social foreclosure for another.

A second issue concerns temporal distribution. Generative interventions often move value across time. Present actors can bear costs that create future capacities, while future actors can inherit both benefits and constraints without having participated in the original decision. Justice therefore requires attention to who pays for generation, who controls the generated capacity, who receives later return, and who inherits the risks of failure or lock-in.

A third issue concerns agency and authorship. When value is co-produced through distributed relations, justice cannot rely only on a simple producer-recipient distinction. Contributors can include maintainers, caregivers, communities, infrastructures, knowledge traditions, ecosystems, and future institutions. Attribution uncertainty makes distributive claims more difficult but does not remove the normative problem.

GREthic provides a neighboring domain for deeper normative theory, while GRE retains responsibility for describing the economic relations through which capacities, dependencies, returns, and foreclosures are produced. The open problem is to build interfaces between these domains without allowing normative vocabulary to substitute for economic mechanism or economic description to settle normative judgment automatically.

Progress will likely require multiple justice criteria rather than a single principle centered on generativity. Generativity can become one object of justice—especially where institutions systematically capture others' capacity to generate—but justice also constrains which forms of generation are permissible and how risks, participation, recognition, and future possibilities should be distributed.

3.20.8 Symbolic Reification

GRE relies heavily on analytical concepts such as relation, field, subject, capability, generativity, value, constraint, and possibility. These concepts are necessary for inquiry, yet repeated use can create symbolic reification: a representation introduced to organize observation begins to be treated as if it were the stable object itself. This problem is especially significant for a programme that explicitly distinguishes relations from their representations.

Reification can occur through ordinary scholarly language. A network diagram can encourage researchers to treat nodes as naturally bounded entities even when the nodes are administrative constructions. A capability measure can become identified with capability itself. A field representation can be spoken of as if the measured scalar were literally the distributed social condition. A generativity score can transform a multidimensional hypothesis into an apparently objective property. Institu-

tional categories can become research variables and then return to practice with the authority of scientific classification.

The danger increases when representations become operational. Metrics influence funding, rankings, eligibility, regulation, and organizational behavior. Models can therefore participate in generating the reality they purport to describe. Subjects adapt to categories, optimize against indicators, and reorganize behavior around algorithmic classifications. A representation can acquire causal power through institutional uptake without becoming ontologically complete.

GRE needs practices that keep this reflexive relation visible. Researchers can document category construction, preserve alternative representations, test sensitivity to operational definitions, distinguish latent constructs from measured proxies, and monitor how measures alter behavior after institutional adoption. Historical work can show how categories change. Interpretive inquiry can reveal meanings lost in standardized representation. Formal work can state which properties are assumed rather than observed.

The open problem extends beyond avoiding conceptual error. Symbolic reification can become a mechanism of power when institutions control the categories through which subjects are recognized, evaluated, funded, or excluded. The study of representations therefore belongs within the economic analysis of generative conditions. GRE must remain capable of using symbols and models decisively while keeping open the possibility that its own categories become objects of later revision.

3.20.9 Governance under Persistent Asymmetry

Section 81 treated asymmetry as a durable feature of many economic relations and distinguished it from power. The open governance problem begins where complete equalization is unavailable, undesirable, or itself generative of new dependencies. Differences in expertise, capital, institutional authority, computational capability, ecological exposure, time horizon, or exit capacity can persist even under well-designed institutions. Governance must therefore operate in conditions where symmetry cannot be treated as the endpoint.

One challenge is preventing asymmetry from becoming unreviewable domination. Transparency, contestability, exit, representation, auditing, countervailing institutions, liability, redistribution, and public infrastructure can each constrain conversion of asymmetry into power. Their effectiveness depends on context. Transparency is weak where subjects lack capacity to interpret information. Exit is weak where alternatives are costly or unavailable. Counter-power can create another concentration. Redistribution can reduce resource asymmetry while leaving institutional or epistemic asymmetry intact.

A second challenge concerns dynamic asymmetry. Capabilities change at different speeds. Artificial systems, financial institutions, states, and large platforms can update or coordinate more rapidly than individuals or local communities. Governance mechanisms designed for a slower environment can become ineffective before formal rules change. Persistent asymmetry is therefore partly temporal: the ability to learn, respond, litigate, coordinate, or revise can itself be unequally distributed.

A third challenge concerns productive asymmetry. Some differentiation enables specialization, expertise, delegation, and coordination. Governance that attempts to eliminate every asymmetry can destroy useful capacities or impose high administrative cost. GRE therefore requires criteria for distinguishing asymmetries that are functionally productive from asymmetries that generate dependency, exclusion, capture, or foreclosure. The distinction is empirical and normative rather than definitional.

Future work should compare governance architectures by how they affect conversion mechanisms. Which institutions prevent expertise from becoming unaccountable authority? Which infrastructures reduce dependence without eliminating specialization? Which rights preserve contestability when exit is impossible? Which forms of public or cooperative capacity alter bargaining structure? Which monitoring systems remain revisable when the powerful actors being monitored can adapt strategically?

The open problem is governance that remains effective under durable difference. GRE should study how relations can remain productive and heterogeneous while limiting the recursive accumulation of asymmetry into structures that remove others' capacity to participate, contest, exit, or generate alternatives.

3.20.10 Long-Horizon and Intergenerational Evaluation

The final open problem concerns effects that extend beyond ordinary observational and political horizons. Generative analysis often directs attention toward future capacities, institutional trajectories, ecological conditions, knowledge infrastructures, and path-dependent constraints. These objects can persist for decades or generations. Evaluation therefore faces a fundamental difficulty: the most important consequences may occur after the period in which evidence can be directly collected or the relevant decision-makers remain accountable.

Long-horizon evaluation raises familiar forecasting problems and additional generative-relational problems. Future subjects may possess different preferences, technologies, institutions, vulnerabilities, and value languages. Interventions can change the categories through which later outcomes are evaluated. The relevant counterfactual can also evolve. A policy that appears option-expanding under present technology can become restrictive under a later technological regime, while an apparently conservative intervention can preserve ecological or institutional capacities whose future uses are presently unknown.

Discounting provides one way to compare temporally separated effects, but discount rates encode substantive assumptions and cannot resolve all intergenerational questions. Some future losses concern irreversible ecological damage, destroyed knowledge, institutional lock-in, or loss of option-generating capacity. These may be poorly represented as ordinary delayed consumption effects. GRE therefore needs temporal representations that distinguish delayed value from changes in the capacity to generate future value.

Uncertainty compounds the problem. Forecast distributions may widen with horizon; structural transformation can invalidate the model generating those distributions; unknown future innovations can alter feasible trajectories; and future actors

cannot participate directly in present deliberation. Evaluation must therefore combine prediction with robustness, precaution, reversibility, preservation of options, and explicit treatment of model uncertainty. Different domains will justify different combinations.

Intergenerational analysis also requires attention to inheritance. Future subjects inherit infrastructure, institutions, debts, ecological conditions, knowledge, classifications, and unresolved conflicts. These inheritances shape both their opportunities and the costs of changing course. A generative intervention should therefore be evaluated partly by what kinds of revision it leaves possible for those who come later.

This problem may retain irreducible uncertainty. Future possibility spaces cannot be observed in full, and the values through which future actors judge inherited conditions cannot be completely known. GRE should not treat this uncertainty as a reason to ignore long horizons. It should instead make the uncertainty explicit and examine which interventions preserve enough diversity, reversibility, capacity, and institutional corrigibility to support later adaptation and re-evaluation.

The ten problems in this section define a research frontier rather than a list of defects awaiting simple repair. Some require better measurement and identification; some require new formal or empirical methods; some concern interfaces with normative theory; and some arise from reflexivity, historical change, and the openness of future possibility. Progress in one area can also alter another. Better generativity measures can intensify symbolic reification if their institutional use is poorly governed. Broader relational boundaries can improve downstream attribution while increasing uncertainty. Stronger governance of asymmetry can change the mechanisms whose effects were initially being measured.

GRE should therefore preserve open problems as active components of its cumulative research programme. An unresolved question becomes productive when competing formulations, evidence, failed approaches, and revisions remain traceable. The next section turns from these substantive open problems to the architecture through which the wider GRE programme can organize their investigation across epistemology, methodology, praxis, formalization, governance, knowledge, artificial intelligence, and domain-specific applications.

3.21 Architecture of the GRE Research Programme

The preceding sections have specified the provisional identity, problem-space, objects, scales, modes of inquiry, epistemic commitments, praxis, normative interfaces, contribution criteria, internal pluralism, and open problems of Generative Relational Economics. The role of the present section is different. It organizes those commitments into a research architecture that can support the remainder of the book and, more importantly, a cumulative programme extending beyond this book. Its objective is to identify the principal domains of work that GRE requires, clarify their relations, and show how movement among them can remain coordinated without collapsing them into one method, one ontology, or one normative theory. The architecture is therefore neither a linear sequence nor a departmental division of labor. It is a set of connected research components whose outputs can constrain, revise, or redirect

one another.

The programme can be understood as having several recurrent movements. Epistemological work asks what kinds of relational and generative claims can be warranted. Methodological work develops procedures for observing, reconstructing, comparing, and testing those claims. Praxis links explanation to intervention under incomplete knowledge. Substantive economic work specifies economic objects, allocation processes, value trajectories, temporal organization, power, knowledge, artificial intelligence, and domain-specific mechanisms. Formal work provides representations that can clarify structure or generate implications without acquiring automatic ontological priority. Normative and governance work evaluates how generated capacities, dependencies, harms, and possibilities should be judged and governed. None of these components is sufficient by itself. Their interaction is what gives GRE the possibility of becoming a research programme rather than a vocabulary.

This architecture also gives the later chapters a disciplined relation to Chapter 3. The chapters that follow do not merely expand terms introduced here. They test whether the constitutional claims made in Part I can survive more demanding epistemic, methodological, formal, substantive, and applied development. A concept that proves unusable under empirical inquiry should be revised. A formal representation that cannot preserve relevant historical or interpretive distinctions should be limited. A normative framework that obscures economic mechanisms should not replace explanation. An intervention methodology that generates unanticipated dependency should feed back into the theory of power and praxis. The architecture is therefore recursive: later work is expected to modify the preliminary constitution from which it begins.

3.21.1 Epistemology of Relations

A GRE research programme requires an epistemology capable of supporting claims about relations without assuming that relations are directly given to observation. Economic inquiry usually encounters traces: transactions, documents, prices, classifications, narratives, institutional records, behavioral responses, network data, legal categories, measurements, and model outputs. From such traces, researchers infer relations of dependence, recognition, exchange, authority, mediation, constraint, influence, and generation. The first architectural component therefore concerns the conditions under which these inferences are warranted.

The epistemology of relations must keep at least four layers distinguishable. There is the relation or relational process posited as part of the target situation; there are the observations through which researchers gain partial access to it; there are the categories and representations used to organize those observations; and there are the claims made on the basis of those representations. Confusion among these layers produces many characteristic errors. A network edge can be mistaken for the relation itself. A legal category can be treated as a complete description of social participation. A repeated correlation can be interpreted as a stable generative relation even where the mechanism changes historically. GRE therefore requires explicit accounts of how observations become relational claims.

This epistemic component also has to accommodate different kinds of relational ev-

idence. Some relations are materially instantiated through contracts, infrastructures, ownership, payment, or legal authority. Others are reconstructed from repeated interaction, dependence, interpretation, or institutional practice. Still others concern counterfactual or generative effects that cannot be observed directly because they refer to capacities, alternatives, or future conditions. Evidence sufficient for one kind of relation may be inadequate for another. The programme should therefore resist a single criterion of relational observability.

Epistemology of relations also includes reflexivity. Economic categories can alter the relations they represent. Credit scores change access to credit; rankings alter institutional behavior; classifications determine eligibility; models influence expectations; and public descriptions can reshape coordination. The object of knowledge can therefore respond to the means of knowing. This makes epistemology an economic problem as well as a philosophical one. The programme must study how knowledge practices participate in the relational field whose properties they attempt to establish.

The output of this component is not a final theory of knowledge. It is a set of standards for relational claims: how objects are identified, how boundaries are selected, how observations are linked to relations, how representations are validated, how uncertainty is expressed, and how claims remain open to correction. Those standards provide the epistemic ground on which the methodological components of the programme operate.

3.21.2 Methodology of Relational Inquiry

Relational methodology concerns procedures for studying configurations in which the properties or effects of an object depend materially on its relations with other objects, institutions, environments, or representations. Its central task is to move analysis beyond isolated-unit description without treating every connection as equally significant. A relational study must identify which relations matter, how they are evidenced, what scale they operate at, and which consequences follow from their organization.

The methodological repertoire is necessarily plural. Historical reconstruction can identify how a relation formed and changed. Comparative inquiry can examine why similar entities occupy different relational positions. Network analysis can represent patterned connectivity. Institutional analysis can identify rules that stabilize or authorize relations. Ethnographic and interpretive work can reconstruct how participants understand obligations, identities, and meanings. Econometric and causal designs can estimate effects generated through specified relational exposures. Qualitative process tracing can examine mechanisms that are difficult to reduce to stable variables. None of these methods is intrinsically more relational merely because of its technique. Relationality enters through the structure of the research question and the specification of the object.

A developed relational methodology should make boundary construction explicit. Researchers need criteria for deciding which actors, institutions, ecological conditions, infrastructures, classifications, and temporal histories belong inside the analysis. Because boundaries are analytical choices with substantive consequences, sensitivity to alternative boundaries should become part of methodological practice where

feasible. The same transaction can look efficient within a firm boundary and extractive within a regional labor system; a technological intervention can look productive over one year and capability-destroying over a decade.

Relational inquiry also needs procedures for distinguishing direct from mediated effects. Economic outcomes often travel through chains of institutions, expectations, infrastructures, and social recognition. A transfer to one subject can alter bargaining conditions for another; a platform rule can change incentives through ranking systems; a legal reform can transform behavior through expectations before enforcement occurs. Methodological work must therefore support the reconstruction of mediation rather than stopping at the administrative point of intervention.

The programme should accumulate relational methods through reusable design patterns rather than prescribe one canonical protocol. Useful patterns may concern boundary selection, multi-source evidence, relation typing, temporal reconstruction, counterfactual comparison, cross-scale mapping, or identification of institutional mediation. These patterns become a methodological library that later studies can adapt while preserving transparent assumptions and limits.

3.21.3 Methodology of Generative Relational Inquiry

Generative relational inquiry adds a further question to relational analysis: what later capacities, structures, values, subjects, constraints, or possibilities are produced through a relation, and through what mechanism? This shift changes both the temporal horizon and the object of explanation. The researcher is no longer concerned only with what a relation currently connects or distributes. The inquiry follows how participation in the relation changes the conditions from which subsequent economic processes can occur.

This methodological component therefore requires explicit generative claims. A study should state what is alleged to be generated, over what period, for which subjects or systems, and through which mediating process. Generation may concern skills, trust, dependency, infrastructure, market access, organizational capacity, knowledge, subject positions, ecological resilience, future options, institutional lock-in, or the capacity to generate further value. These are heterogeneous objects, so no single metric can stand in for generativity across domains.

Generative inquiry also requires attention to counterfactual trajectories. The relevant comparison is frequently not simply between treated and untreated units at one time. It may concern how different relational configurations alter later pathways. This creates methodological difficulty because the treatment can change the variables, categories, or institutional environment through which later outcomes are measured. Longitudinal designs, historical comparison, mechanism-based simulation, qualitative reconstruction, and adaptive experimentation may therefore complement conventional causal identification.

A further methodological problem concerns recursion. Generated capacities can alter the relation that generated them. New knowledge changes bargaining power; institutional learning changes governance; accumulated infrastructure shifts future allocation; successful coordination changes expectations; artificial systems can alter the speed and scale of subsequent production. Generative relational methodology

must be capable of tracing such feedback without assuming that the original mechanism remains fixed.

The programme should therefore develop a family of generative research designs rather than one universal method. Their common requirement is disciplined movement from relation to mechanism to generated consequence to altered future condition. Where the chain cannot be established, the study should say so. Where several mechanisms remain plausible, competing explanations should remain visible. This methodological restraint protects generativity from becoming an all-purpose label for any downstream change.

3.21.4 Praxis and Intervention

Praxis connects GRE's explanatory programme to purposive attempts to alter economic relations. The architectural function of praxis is to prevent theory from ending at diagnosis while also preventing intervention from outrunning knowledge. GRE therefore treats intervention as an iterative research and governance process in which action generates new evidence, changes the relational field, and may require revision of both the intervention and the theory that justified it.

A GRE praxis architecture begins with relational and generative diagnosis. The analyst identifies the relevant subjects, institutions, dependencies, constraints, capacities, value trajectories, and asymmetries. Intervention design then specifies which relation or enabling condition is to be changed, what effects are expected, which subjects may bear risks, and what indicators or qualitative observations can reveal downstream consequences. Implementation becomes part of inquiry because it tests assumptions under conditions that may differ from those represented in the initial model.

Adaptive feedback is therefore central. Interventions should include monitoring capable of detecting effects beyond the intended recipient, changes in dependency, emergent exclusion, shifts in power, unexpected conversions of value, and damage to future options. Revision can concern intensity, targeting, institutional design, representation, or even the original diagnosis. Where harm or failure becomes sufficiently probable, withdrawal, reversal, and repair need to remain available.

Praxis also requires institutional design for learning. Organizations often collect data for accountability but not for theoretical correction. GRE would instead treat intervention records, failed mechanisms, participant interpretations, unexpected effects, and reversal attempts as cumulative research materials. This creates a bridge between application-dominant work and research-dominant work. Interventions become sites in which the adequacy of relational and generative hypotheses can be examined.

The praxis component does not imply that every GRE project must intervene. It specifies the architecture required when explanation is translated into action. Its standards are proportional to stakes and uncertainty. The more irreversible, asymmetric, or long-horizon the intervention, the stronger the need for monitoring, contestability, staged implementation, reversibility, and repair capacity.

3.21.5 Economic Objects and Relational Architecture

Substantive GRE begins by reconstructing the architecture of economic objects. Firms, households, platforms, markets, contracts, currencies, technologies, infrastructures, public agencies, communities, and ecological systems can all function as economic objects, but their economic significance depends on relations that constitute access, authority, dependence, recognition, exchange, coordination, and reproduction. The programme therefore needs systematic accounts of how economic objects are stabilized and connected.

Relational architecture concerns more than mapping connections. It asks which relations are constitutive, which are enabling, which are extractive, which are substitutable, and which create dependence or future capacity. It also examines how objects change when their relational architecture changes. A firm can retain a legal identity while its productive relations, knowledge base, ownership, labor dependence, and technological infrastructure transform substantially. An apparently stable object can therefore contain changing generative conditions.

This component also organizes scale. Economic architecture can be reconstructed within organizations, across supply chains, among institutions, between human and artificial subjects, or across economic and ecological systems. At one scale a platform is an entity; at another it is a field of relations among users, advertisers, workers, algorithms, legal authorities, and infrastructures. GRE should be able to move between these representations without presuming that one scale is ontologically final.

A mature programme would accumulate relational architectures comparatively. Which configurations support distributed capability? Which concentrate dependency? Which are resilient to shocks? Which permit exit and revision? Which externalize ecological or social costs? Which generate durable learning? Comparative architectural work can provide intermediate theory between highly local case description and universal claims about markets or institutions.

This substantive component prepares several later programme domains. Allocation changes relational architecture; value moves through it; generative spacetime records its historical and temporal organization; formal models represent selected features of it; governance attempts to alter its asymmetries. Economic architecture therefore functions as a central integrative object without becoming the sole object of GRE.

3.21.6 Relational Allocation

Allocation is conventionally concerned with who receives which resources under specified constraints. GRE retains that question but expands the analytical unit. An allocation also enters a relational configuration and can change bargaining positions, dependencies, recognition, coordination capacity, expectations, and future productive possibilities. Relational allocation is the programme component that studies these mediated effects systematically.

The relevant object is therefore not merely the resource transferred. It includes the route, institutional conditions, attached obligations, timing, visibility, substitutability, and relations through which the allocation is received and used. The same mone-

tary amount can produce different consequences depending on whether it arrives as wage, grant, debt, benefit, prize, investment, family transfer, or platform payment. The relational form can influence autonomy, stigma, risk, reciprocity, and future access even when nominal quantity is identical.

Relational allocation also widens incidence analysis. Effects can propagate beyond the administrative recipient through households, markets, organizations, networks, and institutions. A subsidy can change prices, a training programme can alter labor-market competition, a public infrastructure investment can change land values, and access to computation can reshape research capacity. GRE therefore asks which relations mediate the allocation and how those relations redistribute later opportunities or constraints.

The programme should develop both descriptive and intervention-oriented allocation research. Descriptive work can reconstruct relational incidence and downstream transformation. Formal work can model how allocation changes network positions or dynamic constraints. Comparative work can examine alternative institutional forms for delivering similar resources. Normative work can evaluate whether an allocation expands capability while generating dependency elsewhere. Application-dominant praxis can use these findings to redesign allocation mechanisms.

Relational allocation is thus a bridge between conventional economic analysis and the generative programme. It retains scarcity, incentives, incidence, and trade-offs while extending attention to how allocation changes the relational conditions under which later value and capability are generated.

3.21.7 Generative Value

Generative value concerns value that arises through the capacity of a relation, resource, institution, or process to enable further valuable activity. The concept does not replace exchange value, use value, welfare, capability, social value, ecological value, or other established categories. Its programme function is to make the production of future value-generating capacity an explicit economic object.

Generative value may appear through learning, infrastructure, trust, institutional competence, scientific knowledge, ecological restoration, network access, organizational routines, or the creation of new possibilities for participation. Its effects can be delayed, distributed, and difficult to attribute to one original intervention. The same process can generate several forms of value while also producing harm, dependence, or exclusion. The programme therefore requires plural representations rather than assuming that generative value is one scalar quantity.

Research in this component should address propagation and conversion. Value generated in one domain can move into another: knowledge can become productive capability, social recognition can become market access, infrastructure can become bargaining power, ecological conditions can enable future production, and data can become organizational advantage. Conversion can also be blocked or asymmetrical. Subjects may contribute to a generative process without capturing the value that later emerges from it.

This creates questions of return and distribution. Who receives the benefits of generated capacity? Which relations permit value to recirculate to those who sustained its emergence? Which institutional arrangements enable extraction by actors positioned downstream? How should delayed or diffuse contributions be recognized? These questions connect generative value to political economy and justice without making one normative rule part of the definition of value itself.

A cumulative research programme should develop typologies of generative mechanisms, methods for tracing value trajectories, domain-specific indicators, and comparative institutional studies. It should also preserve cases in which apparently generative investments fail to create durable capacity or create capacity that later becomes harmful. Generative value becomes analytically useful only if it remains distinguishable from the general fact that economic processes have consequences.

3.21.8 Generative Spacetime

Generative spacetime provides the programme's architecture for analyzing how economic relations are organized across heterogeneous spatial and temporal conditions. The term does not imply that social reality literally possesses the geometry of physical spacetime. It identifies a research problem: economic processes unfold through histories, delays, path dependencies, spatial distributions, institutional boundaries, and differently paced subsystems whose relations shape what can be generated later.

Time in GRE cannot be reduced to a neutral index. The order of events can matter. Early access to capital can alter later bargaining power; institutional sequencing can determine which reforms become feasible; technical standards can lock in infrastructure; educational investments can affect capabilities years later; ecological degradation can create long recovery periods. Identical quantities introduced at different moments can therefore have different generative effects.

Spatial organization is similarly relational. Geographic distance interacts with infrastructure, jurisdiction, logistics, language, data access, mobility, and ecological conditions. Digital mediation can reduce some distances while creating new forms of concentration in computation, platforms, standards, or data centers. A generative-spacetime analysis asks how locations become connected or separated through these economic relations rather than treating space as a passive container.

The programme also needs to study heterogeneous temporalities. Humans, firms, financial markets, states, ecosystems, infrastructures, and artificial systems can operate at very different speeds. Their coupling can generate asymmetry. A platform can change an algorithm faster than workers can reorganize; financial capital can exit faster than communities can replace employment; ecological recovery can be slower than investment cycles. Temporal mismatch therefore becomes an economic mechanism rather than merely a descriptive feature.

Generative spacetime should support historical reconstruction, dynamic modeling, spatial analysis, and long-horizon evaluation. Its contribution is to preserve the ordering, location, duration, and temporal coupling of generative processes. It thereby links historical analysis to formal dynamics without reducing one to the other.

3.21.9 Formal Models

Formal modeling provides GRE with tools for making assumptions explicit, deriving implications, comparing mechanisms, and exploring trajectories that are difficult to reason about verbally. The programme can draw on dynamical systems, networks, multilayer structures, agent-based models, optimization, game theory, probabilistic models, field-like representations, simulation, and other mathematical or computational techniques where they are appropriate to the object.

The architectural principle is representational pluralism under ontological restraint. A network model emphasizes connectivity; a dynamical model emphasizes state evolution; a game-theoretic model emphasizes strategic interaction; an agent-based model emphasizes local rules and emergent aggregate patterns; a field representation emphasizes distributed conditions. These models need not be translated into one universal formal language. Their adequacy depends on which features of the economic problem they preserve and which they suppress.

Formal work in GRE should state the status of each construction. Some models are descriptive summaries. Some identify structural possibilities. Some generate comparative statics or trajectories. Some serve as counterfactual laboratories. Some are fitted to empirical data; others are heuristic. A mathematically precise model can remain empirically weak if its variables or mechanisms lack adequate correspondence to the target system. Formal rigor therefore complements rather than substitutes for evidential warrant.

Generativity creates particular formal challenges. The variables, interaction structures, or effective rules may themselves change. Models can represent some forms of adaptation, network rewiring, rule learning, or changing parameters, but the programme should distinguish represented transformation from genuinely unforeseen category change. Where the formal state space excludes relevant novelty, model revision may be more appropriate than adding complexity to preserve a fixed representation.

The cumulative aim is a library of transparent formal models tied to clearly stated empirical and conceptual problems. Comparability should depend on assumptions, mechanisms, observables, and failure conditions, not on adherence to one mathematical paradigm. Formal models should remain instruments through which GRE sharpens explanation, tests implications, and explores possibilities.

3.21.10 Justice, Power, and Governance

Power and justice form a programme component because generative economic relations distribute more than current resources. They shape who can participate, who can exit, whose knowledge counts, who bears vulnerability, which alternatives remain feasible, and who captures value generated through collective processes. Governance concerns the institutional organization of these relations under persistent asymmetry and uncertainty.

Power research in GRE studies conversion mechanisms. Resource, capability, knowledge, institutional, vulnerability, and exit asymmetries become economically consequential when they can be converted into durable influence over others'

options or future conditions. The programme should identify the institutional arrangements that enable or constrain these conversions. Ownership, standards, law, infrastructure, platform design, intellectual property, credit, public authority, and organizational hierarchy can all mediate conversion.

Justice enters as a neighboring evaluative problem rather than a property automatically inferred from generativity. A highly generative arrangement can still distribute participation unequally, impose dependency, externalize harm, or foreclose alternatives. GRE therefore needs interfaces with distributive, procedural, relational, capability-oriented, ecological, and generative approaches to justice while remaining explicit about which normative principles are being used.

Governance research then asks how institutions can organize relations under conditions in which asymmetry cannot simply be eliminated. Relevant mechanisms include contestability, transparency, rights, public capacity, collective organization, auditing, representation, interoperability, liability, redistribution, and preservation of exit or voice. Each can itself generate new dependencies or concentrations. Governance must therefore be evaluated recursively.

This component connects explanation, normativity, and praxis. Its success should be judged not by whether it yields one constitutional ideal but by whether it improves the ability to diagnose power, compare governance architectures, evaluate their generated consequences, and revise institutions as relational conditions change.

3.21.11 Knowledge and Epistemic Economy

Knowledge is simultaneously an input, output, resource, relation, institution, and source of asymmetry. A GRE research programme therefore requires a substantive epistemic economy concerned with how knowledge is generated, validated, stored, circulated, priced, restricted, translated, forgotten, and converted into other forms of value or power.

The economic organization of knowledge affects who can generate further knowledge. Access to education, archives, computation, laboratories, data, journals, languages, expert communities, and institutional recognition shapes future epistemic capability. Knowledge production can therefore exhibit cumulative advantage and generative inequality even when individual information goods are non-rival. Ownership, paywalls, classification, secrecy, data governance, and platform control can influence the relational conditions of inquiry.

Epistemic economy also concerns recognition. Some observations become evidence, some questions become fundable, some methods acquire authority, and some speakers become credible. These processes are partly scientific and partly institutional. They can generate epistemic injustice when subjects are systematically excluded from contributing, being understood, or influencing the categories through which their situations are represented. At the same time, standards of evidence remain necessary; inclusion cannot mean suspension of criticism.

Artificial intelligence intensifies these questions by reducing some costs of synthesis, drafting, search, modeling, and content generation while increasing dependence on data, computation, model access, evaluation infrastructure, and epistemic filter-

ing. Abundance of generated text can make provenance, attention, verification, and question formation scarcer. The economic object is therefore not knowledge alone but the relational infrastructure through which epistemic capability is distributed.

The programme should study knowledge capital, epistemic labor, archive power, verification, provenance, scientific institutions, open infrastructure, education, and the generative conditions of inquiry. It should also examine how its own research practices distribute epistemic participation and authority.

3.21.12 Artificial Intelligence and Radical Asymmetry

Artificial intelligence provides a contemporary domain in which several GRE problems become unusually visible at once: heterogeneous subjecthood, rapid capability change, concentration of infrastructure, epistemic abundance, organizational transformation, power conversion, temporal mismatch, and uncertainty about future generative trajectories. The programme should therefore treat AI neither as a peripheral application nor as an all-explanatory paradigm. It is a demanding empirical case for testing GRE's concepts.

The central economic problem is not simply automation or substitution. AI systems can alter the cost and speed of cognition-like tasks, reorganize knowledge work, modify decision processes, enable new forms of coordination, and change who can produce valuable outputs. The consequences depend on ownership, access, interface design, labor relations, education, regulation, data, compute, and organizational capacity. Similar model capabilities can therefore produce different economic structures under different relational architectures.

Radical asymmetry refers to cases in which capability differences become large enough to transform bargaining, monitoring, production, or institutional response. Such asymmetry can occur among firms, states, workers, consumers, or human and artificial operational subjects. It does not establish moral or ontological equality among those subjects. The research problem concerns how capabilities are converted into economic power and how other subjects retain participation, contestability, learning, and exit under rapidly changing conditions.

AI also complicates the generative horizon. Systems that participate in research, design, education, administration, or cultural production can alter the rate at which new possibilities are generated. They can also narrow possibility through standardization, dependence, concentrated infrastructure, or recursive optimization around existing metrics. Evaluation must therefore attend to both capability expansion and generative foreclosure.

This component should integrate empirical labor economics, industrial organization, innovation studies, political economy, governance, epistemic economy, and technical understanding of AI systems. GRE contributes by coordinating these perspectives around relational and generative mechanisms rather than by replacing their specialized expertise.

3.21.13 Domain-Specific Applications

The final architectural component concerns domain-specific application. A research programme becomes substantive only when its concepts survive contact with cases in which institutions, evidence, values, scales, and mechanisms differ. GRE should therefore be tested across domains rather than developed indefinitely at the level of general vocabulary.

Candidate domains include labor, education, scientific research, health, finance, development, migration, humanitarian systems, urban infrastructure, digital platforms, ecological transition, public administration, innovation, culture, and international economic relations. Each domain brings specialized literatures and methods that GRE must respect. Domain application should begin from the empirical problem and available knowledge, then ask whether relational and generative analysis adds explanatory or practical value.

Applications serve several programme functions. They test concepts against heterogeneous evidence. They expose hidden assumptions imported from one domain into another. They identify mechanisms that may travel across cases and mechanisms that remain local. They provide intervention evidence. They reveal where value categories differ and where normative conflict becomes unavoidable. They can also demonstrate that GRE adds little to an already adequate established analysis, which is itself useful boundary knowledge.

Cross-domain comparison should therefore be careful. Similar labels can conceal different mechanisms. Dependency in finance, caregiving, digital infrastructure, and ecology need not be structurally identical. Generativity in education may concern capabilities and inquiry; in ecological restoration it may concern system resilience and future option spaces; in science it may concern knowledge and question formation. Comparative GRE should look for structural correspondence without presuming equivalence.

Domain-specific work also provides the main route through which the architecture remains corrigible. If concepts repeatedly fail in applied settings, they should be narrowed or abandoned. If new objects or mechanisms recur across domains, the programme can revise its typologies. If governance approaches generate predictable secondary harms, praxis should change. Application is therefore not the terminal stage of the programme. It is one of the principal sources through which the architecture itself evolves.

Taken together, these thirteen components define a preliminary architecture for GRE research. They do not form a pipeline in which epistemology is completed before methodology, methodology before substantive economics, and substantive economics before application. Work can begin in any component and move among several. An empirical anomaly can force epistemic revision; an intervention can reveal a new mechanism; a formal model can expose an ambiguous concept; a domain-specific case can require new governance categories; a normative conflict can reveal that a value representation is too coarse.

The architecture therefore functions as a coordination device. It indicates where a research question sits, which neighboring components are likely to constrain it, what forms of evidence or representation may be required, and how results can return to

the wider programme. It also gives the remaining parts of the book a common orientation: ontology and epistemology, research praxis and methodology, application-dominant intervention, substantive economic foundations, power and knowledge, artificial intelligence, domain applications, and the later disciplinary return are connected components of one revisable research programme rather than independent theoretical excursions.

The following section condenses this architecture into a preliminary constitution of GRE. That constitution does not close the field. It states, in compact form, what GRE studies, what it does not need to presume, what it attempts to explain and change, what can count as evidence and contribution, and which questions remain deliberately open to historical and theoretical revision.

3.22 A Preliminary Constitution of GRE

The preceding sections have developed Generative Relational Economics from a provisional disciplinary identity into a structured research programme. They have specified its problem-space, methodological primitives, objects and scales of inquiry, characteristic questions, analytical sequence, account of economic subjecthood, orientation of generation, modes of inquiry, epistemic commitments, praxis, normative interfaces, analysis of power and heterogeneity, disciplinary boundaries, contribution criteria, cumulative programme, internal pluralism, open problems, and wider research architecture. The role of the present section is to condense those commitments into a preliminary constitution. The term *constitution* is used here in a limited methodological sense. It denotes a compact statement of the conditions under which GRE can presently recognize its own objects, claims, evidence, interventions, contributions, and limits. It does not denote a final doctrine, a metaphysical settlement, or a fixed disciplinary code.

The objective of the section is therefore both consolidating and restrictive. Consolidation is needed because a research programme can become diffuse when its concepts expand faster than the criteria governing their use. Restriction is needed because GRE should remain distinguishable from any study that happens to mention relations, emergence, complexity, value, or future possibility. A preliminary constitution states what kinds of questions GRE takes responsibility for, which assumptions it withholds, what forms of explanation it seeks, how intervention enters the programme, what can count as evidence and contribution, and which questions remain deliberately unsettled. The method is synthetic rather than genealogical. No new lineage is introduced here. The section reorganizes the commitments already established in Chapters 1–3 into eight constitutional dimensions: domain, restraint, explanation, praxis, evidence, contribution, openness, and historical revisability.

The constitution is preliminary for a substantive reason. GRE studies processes in which relations, subjects, capacities, value structures, institutions, and conditions of generation can themselves change. A research programme directed toward such objects would contradict its own subject matter if it treated its present categories as permanently settled. Constitutional stability is therefore functional rather than absolute. The programme needs enough continuity for researchers to disagree about

the same problems, compare findings, and accumulate knowledge, while retaining enough revisability to alter its categories when empirical, historical, formal, or normative work reveals that they have become inadequate. The constitution presented below should be read in that spirit.

3.22.1 Domain and Objects of Study

GRE studies economic relations insofar as those relations help generate, reproduce, distribute, transform, or foreclose later capacities, constraints, values, subjects, institutions, trajectories, and fields of possibility. This domain statement is intentionally broader than the study of transactions and intentionally narrower than a general theory of social reality. GRE remains economic because its questions concern allocation, production, circulation, valuation, work, capability, institutional organization, economic power, dependence, resources, infrastructures, knowledge, and the conditions through which subjects participate in material and symbolic economies. It becomes generative-relational when those objects are examined through the consequences of their relational organization for what can subsequently exist, act, acquire value, coordinate, persist, or change.

The programme therefore treats the immediate recipient of an allocation or intervention as only one possible locus of effect. A subsidy may alter supplier capacity, household bargaining, regional infrastructure, expectations, or political legitimacy. An educational resource may change knowledge, confidence, social connection, question formation, institutional recognition, or later opportunity. A platform rule may change not only prices or matching efficiency but also visibility, dependence, subject formation, and the viability of alternative organizational forms. GRE asks which of these downstream effects are materially connected to the original relation and through which mechanisms they are generated. The downstream horizon is empirical and selective rather than indefinitely expansive: a GRE analysis is responsible for tracing consequences where plausible generative pathways and evidential access make them analytically relevant.

The objects admitted to this domain are correspondingly plural. Relatively stabilized entities, subjects, relations, resources, capacities, values, constraints, fields, processes, events, trajectories, institutions, social facts, and symbolic representations can each become objects of GRE inquiry. Their analytical status depends on the local problem. A firm may be treated as an entity in one study, as a field of internal relations in another, as an institutional rule complex in a third, and as a node within a wider production ecology in a fourth. GRE does not require one of these descriptions to exhaust the firm's reality. It requires the researcher to state which object construction is being used, at what scale, for which explanatory purpose, and with what evidential consequences.

The domain also includes heterogeneous subjects. Human persons, households, organizations, public bodies, communities, ecological systems, hybrid arrangements, and artificial operational agents may participate in economically consequential relations under different descriptions and with different normative statuses. Their inclusion within a common analytical field does not establish ontological or moral equivalence. It means only that their interactions can affect allocation, value, capability,

dependence, coordination, and future possibility in ways that economic inquiry may need to represent. The constitution therefore permits heterogeneous participation while reserving questions of personhood, consciousness, legal personality, moral status, and ecological standing for the appropriate neighboring domains and normative arguments.

A GRE study is consequently identified less by a proprietary object than by a characteristic relation between object and question. The same labor market, school, AI system, household, ecological project, financial institution, or humanitarian intervention can be studied through many legitimate economic approaches. It becomes a GRE problem when the inquiry asks how relational organization changes the capacities and conditions from which later economic and social possibilities are generated. This criterion preserves disciplinary openness while preventing the label GRE from becoming synonymous with any broad interest in complexity or interdependence.

3.22.2 Constitutive Restraints

GRE proceeds under several restraints that are constitutive rather than merely cautious. The first is ontological suspension. The programme can use entities, relations, processes, fields, networks, trajectories, categories, and generative structures without declaring any one of them the final metaphysical furniture of reality. Analytical usefulness establishes neither ontological priority nor completeness. A network representation may clarify connectivity; a field representation may clarify distributed conditions; a process description may clarify temporal transformation. Their value depends on the problem and the evidence. GRE therefore permits ontological commitment at the level required for a particular inquiry while withholding stronger closure.

The second restraint concerns explanatory universality. GRE does not presume that every economically relevant outcome requires a generative-relational explanation. Standard price theory, causal estimation, accounting, institutional description, optimization, historical narrative, or domain-specific expertise may already explain the relevant problem adequately. The programme earns analytical relevance where relational mediation, downstream generation, changing capabilities, path dependence, heterogeneous value, shifting subjecthood, power conversion, or transformation of future possibility materially improve understanding. The GRE label should therefore be unnecessary when a narrower account is sufficient.

A third restraint concerns generativity itself. Generation is not presumed to be beneficial, innovative, progressive, emancipatory, or just. Relations can generate dependency, exclusion, vulnerability, ecological degradation, epistemic closure, concentrated power, or the destruction of alternative futures. A highly generative system can reproduce harm more effectively than a weakly generative one. Evaluation must therefore remain separable from description. GRE can identify that a relation generates new capacities or reorganizes a field while leaving open whether that transformation should be encouraged, governed, limited, repaired, or reversed.

A fourth restraint concerns representation. Variables, categories, network edges, model states, indicators, simulations, legal classifications, and textual interpretations mediate access to the object; they are not automatically identical with it. GRE there-

fore distinguishes relational reality from its representation and treats boundary choice, measurement, coding, scale selection, and model specification as substantive parts of inquiry. This restraint is especially important where categories can become performative. Rankings, credit scores, eligibility classifications, productivity metrics, and AI-generated representations may alter the relations they purport to describe. The research instrument can become part of the generative field.

A fifth restraint concerns scalar and historical invariance. GRE does not assume that an object retains the same analytical identity across scale or historical transformation. A configuration that is stable enough to be treated as an entity at one level may decompose into changing relations at another. Categories such as worker, household, capital, platform, intelligence, capability, value, or market can change their institutional content over time. The constitution therefore requires explicit scale, boundary, and historical conditions whenever they materially affect the claim.

These restraints make the programme deliberately non-totalizing. They protect methodological pluralism, disciplinary interfaces, and corrigibility. They also impose costs: GRE must often carry more uncertainty, specify more boundaries, and resist attractive universal formulations. Those costs are accepted because a programme concerned with changing relations and future possibility requires a disciplined distinction between useful analytical commitment and premature closure.

3.22.3 Explanatory Commitments

GRE attempts to explain how economic outcomes and future possibilities arise through relations that mediate allocation, interaction, interpretation, institutional recognition, capability, and value. Its characteristic explanatory move is from a local intervention or observed configuration toward the mechanisms through which effects propagate and reorganize later conditions. This move does not replace causal inference. It expands the range of causal and generative questions that may need to be asked when the object cannot be understood adequately as an isolated unit responding to fixed incentives or constraints.

A generative explanation should identify more than temporal succession. It should specify a plausible mechanism connecting relational conditions to later changes. The mechanism may involve resource transfer, learning, coordination, reinforcement, institutional authorization, recognition, imitation, network exposure, expectation formation, technological complementarity, legal change, ecological feedback, symbolic classification, or another documented process. Claims of generation should remain proportionate to the degree to which such mechanisms can be evidenced. Where mechanism is uncertain, GRE should state the uncertainty rather than substituting the vocabulary of emergence for explanation.

The programme is especially interested in recursive transformation. Economic processes can change the conditions under which later processes operate. A policy can alter not only behavior but institutional trust; a technology can alter not only productivity but the skills and infrastructures required for participation; a market can alter not only allocation but the kinds of actors able to survive within it; an AI system can alter not only task performance but the organization of expertise, attention, and decision authority. In such cases, the effective rule governing later change may differ

from the rule that characterized the earlier system. GRE therefore treats transformation of generative conditions, and where warranted transformation of effective rules, as explanatory objects in their own right.

Explanation also requires attention to propagation, conversion, recirculation, dissipation, and extraction. Generated value can move among subjects and institutions, change form, accumulate, decay, or be captured. Knowledge can become capability; capability can become bargaining power; symbolic recognition can become access; ecological capacity can become economic resilience; public infrastructure can become private rent; care can sustain labor capacity without appearing in market price. GRE does not presume that these conversions are complete or commensurable. It seeks to identify the relations through which they occur and the losses, exclusions, and asymmetries that accompany them.

Power enters this explanatory programme as the conversion of asymmetry into durable influence over others' options, vulnerabilities, representations, exit conditions, or future generative possibilities. Resource asymmetry, capability asymmetry, knowledge asymmetry, institutional authority, vulnerability, and exit conditions can each contribute to power when relational conditions allow them to be converted into leverage. This formulation avoids treating all difference as domination while making the reproduction of asymmetry economically analyzable.

GRE also attempts to explain orientation. Economic systems do not only produce outputs; they distribute attention, visibility, curiosity, legitimacy, funding, search capacity, and institutional recognition. These processes influence which possibilities receive the conditions required for further development. An account of generation is therefore incomplete when it describes capacity while ignoring the mechanisms that direct capacity toward some questions, designs, values, or futures rather than others. Orientation can be intentional, institutional, market-mediated, algorithmic, cultural, or emergent. Its explanation belongs within the economic problem-space when it affects resource allocation and future generative capacity.

The constitutional explanatory commitment can therefore be summarized without reducing it to one model: GRE seeks mechanisms linking relational organization to the emergence, persistence, transformation, distribution, or foreclosure of later economic possibilities. Different studies may instantiate that commitment through historical reconstruction, causal inference, formal modeling, computational exploration, qualitative mechanism tracing, comparative inquiry, or combinations of these modes. The explanatory standard lies in the clarity of the claim and its warrant, not in adherence to one technique.

3.22.4 Praxis and Transformative Orientation

GRE is not constituted only as a descriptive programme. It also includes praxis: the disciplined movement from explanation toward intervention under incomplete knowledge. This practical orientation follows from the object of inquiry. If economic relations shape later capacities, dependencies, values, and possibilities, then allocation and governance decisions participate in the generation of future conditions. The research programme should therefore be capable of informing intervention while remaining explicit about the uncertainty and normative judgment that intervention

introduces.

Praxis begins with diagnosis rather than prescription. A relational diagnosis identifies the relevant subjects, institutions, infrastructures, dependencies, boundaries, and scales. A generative diagnosis asks which of those relations reproduce present conditions and which enable or foreclose change. Intervention design then specifies what is being altered: resources, constraints, access, recognition, information, rights, infrastructure, incentives, coordination mechanisms, or other conditions. This sequence prevents the language of generativity from becoming a license for indiscriminate experimentation.

Allocation is treated within this praxis as a relational intervention. The economic significance of allocating money, rights, infrastructure, education, information, or computational capacity depends on the relations into which the allocation enters. Identical resources can produce different effects under different conversion factors, institutional rules, recognition structures, ecological conditions, and power relations. GRE therefore asks how an intervention changes the field through which resources become capabilities and how those new capabilities affect other subjects and future options.

Intervention generates evidence as well as effects. Feedback, implementation failure, unanticipated dependence, unequal uptake, symbolic reinterpretation, ecological response, and strategic adaptation can reveal relations that were poorly represented in the initial model. GRE praxis should therefore preserve mechanisms for revision during and after intervention. Adaptive governance is valuable where it institutionalizes learning without turning affected populations into uncontrolled experiments. The practical requirement is not endless flexibility but explicit conditions under which evidence triggers continuation, modification, scaling, suspension, or termination.

Withdrawal, reversal, and repair form part of this constitutional praxis. Interventions can become harmful, obsolete, captured, or self-reinforcing in ways that diverge from their original aims. A programme concerned with generative effects must ask whether the conditions produced by an intervention can be undone and what restoration would actually mean after the system has changed. Repealing a rule may fail to recreate the earlier state because capabilities, expectations, infrastructures, relationships, and subject positions have already been transformed. Reversibility is therefore an empirical property, not an administrative assumption.

The transformative orientation of GRE remains normatively open in a specific sense. The programme can analyze which interventions expand participation, capability, resilience, plurality, or future possibility, but it does not derive a complete moral ordering from generativity alone. Normative appraisal can draw on justice theory, ethics, law, democratic processes, domain-specific standards, and the neighboring GREthic programme. Praxis is thus constituted by an obligation to connect explanation with action where useful, paired with an obligation to keep empirical mechanism and normative justification distinguishable.

3.22.5 Evidential Admissibility

GRE adopts evidential pluralism constrained by claim-specific standards. Evidence is admissible when it bears materially on the claim being made and when the path from observation or representation to inference is sufficiently explicit for criticism. The constitution therefore does not privilege one evidential form in advance. Administrative records, prices, transactions, experiments, quasi-experiments, surveys, interviews, ethnography, archives, legal materials, organizational documents, ecological measurements, network data, computational traces, comparative cases, formal implications, simulations, and intervention records can all contribute, but they warrant different kinds and strengths of claims.

Descriptive evidence can establish patterns without identifying mechanisms. Causal designs can estimate specified effects without exhausting interpretation or historical formation. Historical evidence can reconstruct sequence, contingency, and institutional development without producing a universal parameter estimate. Interpretive evidence can establish how categories, meanings, or obligations are understood by participants without by itself identifying every material consequence. Formal models can show what follows from specified assumptions without demonstrating that the target system satisfies those assumptions. Simulations can explore implications, sensitivity, and possible dynamics without becoming observations of the world merely through computational complexity. These distinctions are constitutional because GRE depends on combining modes without conflating their warrants.

Evidence for generative claims requires particular care. A downstream change occurring after an intervention is insufficient by itself to establish generation. Researchers should specify a mechanism, consider alternative pathways, examine temporal ordering, identify relevant mediators, and state the boundary over which the claim is intended to hold. Where direct identification is impossible, triangulation among historical, qualitative, quantitative, formal, or comparative evidence can strengthen the claim while preserving residual uncertainty. The programme accepts graded evidence; it does not require false certainty before relational mechanisms can be studied.

Counterfactual reasoning is often unavoidable. Claims about capability, foreclosure, resilience, opportunity, or future possibility concern alternatives that may never be fully observed. Evidence can include comparison across cases, natural experiments, historical alternatives, participant knowledge, structural models, simulation, sensitivity analysis, or explicit scenario construction. The relevant standard is transparency about which counterfactual is being invoked and why it is credible enough for the intended claim. Counterfactual richness should not be confused with evidential freedom.

Negative and disconfirming evidence also belongs within GRE. Failed interventions, absent downstream effects, unstable mechanisms, measurement failure, non-transportable cases, and situations in which a simpler established theory outperforms a GRE formulation should be retained as programme knowledge. Such evidence narrows the field's domain and improves theory comparison. A research programme that records only successful generative narratives would systematically

exaggerate its own explanatory scope.

Finally, evidence is historically situated. Data availability, categories, archives, measurement systems, institutional visibility, and computational capacity change over time. Some subjects leave extensive traces while others remain under-recorded; some value forms are priced while others are rendered administratively invisible. GRE therefore treats the evidential environment itself as potentially structured by power and institutions. Evidential admissibility includes attention to whose relations can be observed, which histories can be reconstructed, and which absences may reflect the organization of recording rather than the absence of the phenomenon.

3.22.6 Criteria of Contribution

A contribution to GRE is constituted by the structure of its research claim rather than by the presence of GRE terminology. At minimum, a recognizable contribution should specify the relational problem, the relevant scale and boundary, the generative or relational claim being advanced, and the evidence or representation that bears that claim. It should distinguish the modeled or represented relation from the target relation, calibrate its inference to the available warrant, and identify material alternative mechanisms where they are plausible.

A contribution may be conceptual. It can clarify a category, distinguish previously conflated mechanisms, develop a typology, or revise the programme's ontology under suspension. It may be empirical, identifying a generative relation or demonstrating a boundary condition. It may be historical, reconstructing how an economic subject, institution, value form, or generative condition emerged. It may be formal, providing a model that clarifies a mechanism or reveals implications. It may be computational, exploring dynamics inaccessible to analytic derivation. It may be normative, identifying evaluative conflicts or consequences that existing frameworks obscure. It may be practical, producing intervention evidence or governance procedures. No one form is constitutively superior.

GRE contribution also requires downstream discipline. A study need not trace every consequence of an intervention or relation, but it should explain why the chosen horizon is adequate to the research problem and acknowledge plausible effects excluded by that boundary. Where a claim concerns generativity, the analysis should identify what is being generated, for whom or for what system, through which mechanism, over what time horizon, and under what conditions. The term *generative* should carry analytical content rather than function as a general synonym for productive, innovative, or beneficial.

Normative transparency is another criterion. Researchers should distinguish descriptive claims, explanatory claims, forecasts, evaluations, and recommendations. If a contribution favors participation, capability, equality, resilience, pluralism, ecological integrity, autonomy, or another normative objective, the evaluative premise should be stated rather than embedded invisibly in the language of system improvement. GRE can support normatively engaged research while preserving the difference between evidence about consequences and judgment about their desirability.

Contribution further requires reproducibility or interpretive traceability appropriate to the method. Quantitative and computational work should expose data con-

struction, assumptions, code, parameters, and sensitivity where feasible. Historical and qualitative work should make source selection, interpretive steps, category construction, and evidential tensions sufficiently visible for another researcher to understand how the conclusion was reached. Formal work should state assumptions and domains of applicability. Traceability is the general constitutional requirement; exact replication is one method-specific realization.

The final criterion is cumulative relevance. A GRE contribution should leave the programme better able to inquire afterward. It may supply a reusable concept, map, dataset, mechanism, comparative case, formal model, indicator, intervention record, negative result, or theory revision. Cumulative relevance includes contraction. Demonstrating that a concept is too broad, a mechanism fails outside a narrow domain, an indicator systematically distorts value, or an intervention generates recurrent harm is a positive research contribution because it improves the programme's capacity to avoid error.

3.22.7 Open Constitutional Questions

The preliminary constitution deliberately leaves major questions open. The first concerns identification. Generative relations are often distributed, mediated, and historically formed, making it difficult to determine which relation produced which downstream capacity or constraint. Better causal designs, process tracing, comparison, formalization, and computational methods may improve identification, but some relations remain reflexive or multiply realized. The programme does not assume that every generative effect can eventually be assigned to a single source.

A second open question concerns measurement. Generativity can refer to capability formation, relation formation, value propagation, diversification of future possibilities, resilience, subject formation, institutional transformation, or changes in the effective rules of change. These may require different measures and may resist reduction to one scalar index. Measurement research should therefore explore domain-specific indicators, multidimensional representations, and comparative procedures without presuming a universal generativity metric.

A third concerns value. Economic relations can generate several forms of value simultaneously and can convert value across domains imperfectly. Monetary price, capability, symbolic recognition, ecological capacity, care, knowledge, institutional trust, public infrastructure, and future option value cannot be presumed fully commensurable. GRE requires practical ways to compare and govern heterogeneous values while preserving information about what is lost through commensuration. The relation between such comparisons and normative justification remains open.

A fourth concerns boundaries and scale. Relational systems rarely arrive with uniquely given analytical borders. Expanding a boundary can reveal hidden dependencies while making causal identification harder; narrowing it can improve tractability while externalizing relevant effects. Scale changes can also alter what counts as an entity, mechanism, or outcome. GRE therefore needs stronger procedures for boundary sensitivity, multiscale inference, and the comparison of explanations constructed at different resolutions.

A fifth concerns changing transformation rules. When institutions, technologies,

categories, expectations, or subject capacities evolve, the model adequate to an earlier period may cease to describe the later system. Some of this can be handled through time-varying or adaptive models; some may require changes in variables and model classes themselves. Distinguishing parameter change from structural change, and structural change from the emergence of new relevant categories, remains a central theoretical and empirical problem.

A sixth concerns justice and governance under persistent asymmetry. Economic relations often depend on differences in capability, information, authority, vulnerability, and exit. Equalization can be desirable in some dimensions while infeasible or counterproductive in others. Counter-power can reduce domination while creating new gatekeepers. Governance must therefore organize asymmetry while preserving participation, contestability, learning, and repair. The programme leaves open which institutional forms achieve those aims under different material and cultural conditions.

A seventh concerns heterogeneous subjects and artificial intelligence. Operational agency, legal personality, moral status, consciousness, accountability, and economic capability can diverge. AI systems can become economically consequential without resolving philosophical questions about machine subjecthood. GRE needs analytical conventions that allow such systems to be studied as participants or mediators where appropriate while preventing capability measures from silently determining ontological or normative status.

An eighth concerns long horizons. Generative effects can unfold across careers, institutions, ecosystems, and generations. Evidence weakens as horizons extend, while path dependence and rule change make extrapolation increasingly uncertain. Yet short-horizon evaluation can systematically favor interventions that consume the conditions of future possibility. Developing responsible long-horizon analysis without manufacturing spurious precision remains one of GRE's most important open problems.

These questions are constitutional because their unresolved status shapes how the programme should behave. Openness does not imply that anything is permitted. It means that GRE should preserve competing formulations, record uncertainty, compare methods, and allow evidence from later chapters and future research to revise the present constitution. A preliminary constitution identifies the space of legitimate disagreement as much as it identifies present commitments.

3.22.8 Historical Revisability of the Programme

GRE is constituted as a historically situated research programme. Its emergence is connected to changes described in Chapter 1: expanded relational production, globalization, digital mediation, artificial intelligence, ecological constraint, changing scarcity, capability asymmetry, new scientific and computational capacities, and altered conditions of evidence and governance. These conditions make certain relational and generative questions more visible and more tractable. They do not make GRE historically inevitable, universally necessary, or permanently adequate.

Historical situatedness has two implications. First, GRE concepts should be expected to change as the economy changes. Categories useful for contemporary

platform economies, AI-mediated production, or ecological transition may require revision under future institutional and technological arrangements. New forms of subjecthood, coordination, property, value, or infrastructure may emerge. Existing distinctions may lose relevance. A theory of historically changing economic reality should preserve the capacity to revise the categories through which it recognizes that reality.

Second, standards of inquiry can also evolve. New measurement technologies, archives, computational methods, legal institutions, participatory procedures, and epistemic practices can change what relations are observable and what interventions are ethically or practically possible. Methods and evaluative procedures therefore possess histories of their own. GRE should record those histories and remain capable of re-evaluating earlier findings when the epistemic resources available to later inquiry change. Revisability applies to methods and standards as well as to substantive theory.

Revision should nevertheless remain disciplined by programme memory. The replacement of one concept by another should preserve the reasons for the change; abandoned indicators, failed models, negative cases, and superseded mechanisms should remain accessible where possible. Otherwise a field can mistake forgetting for innovation. Cumulative knowledge requires both inheritance and correction. A historically revisable constitution therefore needs archives of its own revisions.

The present constitution can be revised through several routes. Empirical anomalies can show that a proposed relation does not operate as expected. Comparative work can reveal that a mechanism is culturally or institutionally specific. Formal work can expose inconsistency or hidden assumptions. Intervention can reveal unanticipated dependence or harm. Normative inquiry can show that an apparently desirable generative process rests on unjust relations. Historical analysis can demonstrate that a category treated as natural is institutionally recent. Domain applications can reveal objects that the existing typology cannot adequately represent. Each route provides a legitimate basis for constitutional amendment when the evidence is strong enough.

Revisability also protects GRE from disciplinary self-insulation. The programme should remain in dialogue with mainstream economics, political economy, economic sociology, complexity and evolutionary economics, capability approaches, ecological economics, legal and institutional analysis, philosophy, computer science, and other relevant fields. GRE has no constitutional entitlement to retain a concept merely because it originated within the programme. Where neighboring theories explain a problem better, GRE should borrow, narrow its own claim, or withdraw it. The integrity of the programme depends more on its capacity for correction than on the preservation of a proprietary vocabulary.

A preliminary constitution therefore combines continuity with amendability. GRE presently studies economic relations through their role in generating, distributing, transforming, and foreclosing later capacities and possibilities. It proceeds under ontological suspension, evidential pluralism, boundary and scale transparency, methodological pluralism, normative separability, and explicit attention to power, heterogeneity, historical dependence, and recursive change. It seeks explanations that identify mechanisms, praxis that remains revisable under feedback, contributions that

are traceable and cumulative, and a programme architecture capable of learning from failure as well as success. These commitments are strong enough to coordinate inquiry while remaining open to revision.

Chapter 3 thereby completes the preliminary constitution of Generative Relational Economics and closes Part I. Chapter 1 reconstructed the historical conditions under which the programme becomes intelligible; Chapter 2 reconstructed the intellectual lineages that make its conceptual vocabulary possible; Chapter 3 has stated the provisional research programme that follows from those conditions and inheritances. Part II now turns from constitution to deeper theoretical development. Chapter 4 examines the ontological view of Generative Relational Theory, beginning with the degree and form of ontological commitment that relational and generative inquiry requires. The constitution established here should therefore be treated neither as an endpoint nor as a summary detached from what follows. It is the provisional compact against which the later ontology, epistemology, methodology, formalization, political economy, governance, and applications of the book can be tested and revised.

Chapter 3

Constitution and Research Programme of Generative Relational Economics

Chapter 3 completes the foundational movement of Part I by turning historical emergence and intellectual possibility into disciplinary constitution. Chapter 1 examined the historical conditions under which an economic framework centered on relations, generation, changing capacities, and future conditions of possibility becomes increasingly relevant. Chapter 2 reconstructed the philosophical, economic, social-theoretical, normative, scientific, and formal lineages from which such a framework can draw without treating their differences as reducible to a single doctrine. The present chapter asks a different question: what kind of research programme follows when those historical problems and theoretical resources are organized specifically around economic inquiry? Its task is therefore constitutive. It specifies the provisional identity, objects, scales, questions, epistemic commitments, modes of inquiry, normative interfaces, and boundaries of Generative Relational Economics (GRE).

The term *constitution* is used here in a methodological and disciplinary sense. GRE is still an emerging research programme, and its conceptual vocabulary remains open to revision through empirical inquiry, formal development, comparison with established economics, and criticism from neighboring disciplines. A preliminary constitution therefore does not fix an immutable doctrine. It makes explicit the commitments that currently organize the programme, the questions that distinguish it, the conditions under which a contribution can reasonably be described as GRE, and the domains in which theoretical disagreement remains legitimate. Such specification is necessary for cumulative research. An open programme becomes difficult to evaluate when its objects, boundaries, and standards remain entirely implicit; a rigid programme loses the capacity to learn when provisional commitments are transformed prematurely into protected axioms. Chapter 3 develops an intermediate institutional form: sufficiently explicit to support research coordination and sufficiently revisable to permit theoretical evolution.

The chapter begins from a domain distinction already established at the end of Chapter 2. Generative Relational Theory (GR) supplies a broader orientation toward relations, recursive generation, historical transformation, changing conditions of pos-

sibility, and the possible transformation of effective rules of change. GRE develops that orientation within economics. Its primary concern is therefore economic life: production, allocation, circulation, reproduction, labor, care, ownership, credit, valuation, institutions, technological infrastructures, ecological dependencies, economic power, and the distribution of future capacities. The broader GR framework can interact with law, political theory, education, ecology, history, aesthetics, artificial intelligence, and other domains, while GRE remains responsible for showing why a particular problem is economically significant and how its claims relate to economic evidence and existing economic knowledge.

This disciplinary positioning gives the chapter two complementary functions. The first is selective. GRE requires boundaries because relation and generation are extremely broad concepts. A study does not become GRE merely because it describes a network, identifies an interaction, invokes emergence, or discusses long-run consequences. The programme is organized around more specific analytical questions: how economic relations constitute subjects and objects; how allocations are mediated through relational configurations; how present arrangements generate later capacities, constraints, values, dependencies, institutions, and possibilities; how those effects propagate across scales; how heterogeneous forms of value are converted, circulated, captured, dissipated, or returned; how economic power alters generative conditions; and how the conditions that govern future change can themselves be transformed. The second function is pluralistic. These questions can be investigated historically, interpretively, qualitatively, quantitatively, causally, formally, computationally, normatively, and through intervention-oriented inquiry. GRE does not require a single privileged method or mathematical representation.

The chapter consequently moves from disciplinary identity to problem structure and then from problem structure to research architecture. It first specifies the scope of the emerging programme and the economic problems that motivate it. It then develops a minimal primitive vocabulary for ontological emergence and identifies the heterogeneous objects and scales that GRE may investigate. Subsequent sections formulate characteristic GRE questions and clarify the distinctive analytical movement from allocation through relational mediation, generation, propagation, conversion, recirculation, extraction, and structural transformation. The chapter then addresses economic subjecthood, the orientation of generation, modes of inquiry, epistemic commitments, praxis, normative evaluation, power, heterogeneity, disciplinary boundaries, and criteria for research contribution. Its final movement treats GRE as a cumulative and internally plural programme, states major open problems, maps the architecture of the wider research agenda, and offers a preliminary constitution that can guide later chapters without foreclosing revision.

Several restraints govern this constitutional exercise. Ontological suspension remains the default: useful relational, dynamical, network, field, geometric, or computational representations do not by themselves establish the ultimate ontology of economic reality. Descriptive generativity remains distinct from normative desirability: a relation can generate durable capacities or self-reinforcing structures while also generating domination, ecological damage, exclusion, or vulnerability. Representation remains distinct from represented reality: measures, categories, graphs, models, and simulations are epistemic constructions whose adequacy depends on the local

question and evidence. Finally, disciplinary openness remains reciprocal. GRE can borrow from neighboring traditions, and those traditions can expose GRE's errors, omissions, and domain limits.

The result is intentionally preliminary. Chapter 3 provides enough constitution for the rest of the book to proceed with a stable research language, while leaving empirical, methodological, formal, and normative disagreements available for later development. The subsequent chapters can therefore deepen GRE's ontology, epistemology, methodology, praxis, substantive economics, theories of power and justice, epistemic economy, artificial intelligence, and domain applications without repeatedly renegotiating the programme's most basic disciplinary identity.

3.1 Disciplinary Identity of Generative Relational Economics

The role of this section is to establish the preliminary disciplinary identity of Generative Relational Economics (GRE) before the chapter specifies its problem-space, objects, methods, and standards of contribution. Its objective is to explain what kind of intellectual formation GRE currently is, the scope within which it makes economic claims, and the commitments that give coherence to otherwise heterogeneous research practices. The argument proceeds from the transition between theoretical proposal and research programme to the scope of the field, the priority of economics as its primary domain, the organizing commitments of relation and generativity, and the conditions under which the programme should remain open and revisable. The method is constitutive rather than taxonomic: the section proposes a working disciplinary identity capable of coordinating research without presenting that identity as historically settled.

GRE is best understood at this stage as an *emerging economic research programme*. The phrase marks both ambition and restraint. It indicates an effort to organize a cumulative body of questions, concepts, methods, models, empirical inquiries, and normative debates around a distinctive analytical orientation. It also recognizes that GRE has not acquired the institutional history, stabilized professional community, canonical methods, or settled boundaries associated with an established discipline or mature subfield. Its identity therefore rests primarily on a coherent problem-space and a set of research commitments rather than on institutional recognition.

This distinction matters because the vocabulary of GRE ranges across several domains. Relations are studied throughout sociology, economics, anthropology, network science, political theory, ecology, and philosophy. Generation appears in theories of production, reproduction, development, evolution, emergence, innovation, complexity, and social formation. Value is central to economics and also to ethics, aesthetics, ecology, and political theory. Fields, trajectories, networks, capabilities, institutions, subject positions, and historical transformations already possess rich literatures of their own. GRE gains disciplinary identity neither by collecting these vocabularies under a new label nor by claiming ownership over their objects. Its identity arises from the specific economic questions produced when relational constitution and downstream generation are treated together as sustained objects of inquiry.

A characteristic GRE inquiry therefore asks how an economic arrangement changes more than the variables administratively attached to its immediate recipient or transaction. An allocation of money, land, information, compute, credit, legal recognition, care, education, infrastructure, or technological capability enters an existing relational configuration. The allocation can alter capacities, dependencies, bargaining positions, recognition, expectations, institutional practices, ecological conditions, or access to later opportunities. These changes can propagate through further relations, be converted into other forms of value or constraint, become self-reinforcing, dissipate, or transform the conditions under which subsequent economic action occurs. GRE treats these downstream and relationally mediated effects as part of the economic object rather than as automatically external to it.

The programme remains compatible with narrower analyses when they are adequate to the question. A price model, accounting identity, causal estimate, institutional comparison, historical interpretation, network representation, ethnography, or simulation can each provide the most appropriate access to a local problem. GRE does not require every study to represent the full relational and generative field. Its disciplinary claim is instead that certain economically consequential phenomena become visible only when analysis can move between immediate allocation and the relations through which future capacities and constraints are produced. This claim defines a research orientation rather than a mandatory universal model.

3.1.1 From Theoretical Proposal to Research Programme

A theoretical proposal can be organized around a small number of concepts. A research programme requires a wider architecture. It must identify recurring problems, specify objects of inquiry, permit methods appropriate to different forms of evidence, distinguish stronger from weaker claims, accumulate comparative findings, expose itself to revision, and provide criteria through which researchers can disagree productively. GRE enters this second task in Chapter 3.

The transition is significant because relation and generativity can otherwise remain suggestive but underspecified. A relational statement may simply observe that economic actors are connected. A generative statement may merely report that one event has consequences for another. A research programme needs sharper questions. Which relations are constitutive of the economic situation? What entities and subject positions are stabilized through them? Which changes can reasonably be attributed to a relation or configuration rather than to coincident conditions? Through what mechanisms do effects propagate? Which forms of value are generated, converted, captured, returned, or destroyed? How do effects vary across scale and historical time? Under what conditions does a generative process reproduce itself? When does it alter its own conditions of continuation? What evidence would count against a proposed account?

These questions turn GRE from a vocabulary into a programme of inquiry. They also make possible disagreement internal to GRE. Researchers can disagree about whether a particular relation is constitutive or incidental, whether a claimed downstream effect is causal or interpretive, whether a state-space model preserves the relevant distinctions, whether a value conversion is commensurable, whether an in-

tervention strengthens capability or dependence, or whether a historical transformation changes only outcomes or changes the effective rules through which outcomes are produced. Such disagreements are productive when the disputed objects, assumptions, scales, and evidential standards are made explicit.

A research programme also requires cumulative structure. One study may identify a recurring relational mechanism; another may test whether it travels across institutional contexts; a third may formalize the mechanism; a fourth may show where the formalization fails; a fifth may examine its normative consequences; and an intervention study may alter the relation and observe how the surrounding system responds. The contribution of GRE lies partly in making these inquiries legible to one another. Historical interpretation, qualitative evidence, quantitative estimation, formal modeling, and normative analysis can then address different aspects of a shared problem without being forced into a single epistemic hierarchy.

The programme should therefore distinguish several levels of theoretical commitment. Some propositions will function as organizing hypotheses: for example, that present economic relations can generate future capacities and constraints that are not well represented by immediate allocation alone. Others will be domain-specific empirical claims: a particular credit architecture may generate dependence under specified institutional conditions. Still others will be methodological proposals, formal representations, normative arguments, or exploratory analogies. Treating these levels as equivalent would weaken the programme. GRE becomes more rigorous when the standing of each claim is stated locally and can change through evidence or criticism.

The term *research programme* also protects GRE from premature closure. The field can contain competing accounts of generativity, alternative formal representations, and disagreements about value while retaining a recognizable common problem-space. A programme is strengthened when rival formulations expose assumptions that one formulation had made invisible. Internal plurality therefore becomes part of disciplinary development rather than evidence that the field lacks identity.

GRE's transition from proposal to programme can consequently be summarized through four requirements. It needs a stable enough vocabulary to support communication, a sufficiently explicit problem-space to distinguish relevant contributions, methodological openness appropriate to heterogeneous evidence, and institutionalized revisability through which its own categories can change. Later sections of this chapter elaborate each requirement. The disciplinary identity established here supplies their common orientation.

3.1.2 Scope of the Emerging Field

The scope of GRE is defined by an intersection rather than by a single class of objects. The first component is economic: the inquiry concerns production, allocation, exchange, circulation, reproduction, labor, care, ownership, credit, institutions, technology, ecological dependence, valuation, power, or other processes that materially organize economic life. The second component is relational: the analytical object includes relations or configurations through which subjects, capacities, constraints, values, and opportunities are constituted or mediated. The third component is gen-

erative: the inquiry examines how those relations contribute to later states, possibilities, structures, or rules of change.

This intersection permits a broad empirical range while limiting conceptual inflation. A study of a labor platform can belong to GRE when it investigates how contractual, algorithmic, reputational, and infrastructural relations shape workers' future bargaining capacity, subject positions, dependence, or access to opportunity. A study of agricultural credit can enter GRE through the way financing relations reorganize production choices, ecological risk, household vulnerability, and later credit dependence. A study of education can become economically relevant to GRE when it examines the generation and distribution of capabilities, knowledge, credentials, networks, and future participation in production or exchange. A study of artificial intelligence can enter through changing productive capability, ownership of computational infrastructure, knowledge concentration, labor transformation, or new asymmetries in the capacity to generate economically consequential outputs.

The same objects can also be studied outside GRE, and that coexistence is expected. A legal analysis may focus on doctrinal validity, a sociological analysis on status relations, a psychological analysis on cognition, and a GRE analysis on the economic generation and distribution of capacities through the same institution. Domain boundaries therefore concern the primary research problem rather than exclusive ownership of empirical objects. Interdisciplinary work becomes especially important when the economic mechanism cannot be understood without juridical, cultural, ecological, technological, or political relations.

Scope also varies by temporal depth. GRE can examine immediate relational mediation, medium-term capability formation, long-run institutional reproduction, intergenerational effects, or transformations in the conditions that govern later change. The appropriate horizon depends on the generative claim. A microcredit intervention may require months or years to evaluate changes in debt dependence and productive capacity. An infrastructure investment may reorganize settlement, land value, ecological conditions, and institutional expectations over decades. Knowledge and educational processes can generate effects whose later manifestations are difficult to attribute to a single intervention. GRE therefore treats temporal horizon as part of research design rather than assuming that the period convenient for measurement is identical to the period relevant to generation.

The programme is similarly multiscalar. Generative effects can occur within persons, households, organizations, communities, markets, institutions, states, ecosystems, or transnational systems, and they can propagate across these levels. A policy that expands aggregate productivity can simultaneously weaken a local community's bargaining capacity; a household intervention can change community norms; an institutional classification can alter individual access to credit; a technological standard can reorganize international production networks. GRE does not presume that effects observed at one scale aggregate straightforwardly into effects at another.

A useful boundary follows from this scope. Relational complexity alone is insufficient to define a GRE contribution. Many systems contain numerous relations. GRE becomes relevant when the inquiry identifies an economically meaningful process through which relations contribute to generation, reproduction, transformation, distribution, or foreclosure. The analytical burden is therefore positive: the researcher

should specify the relation, the generated object or capacity, the mechanism or interpretive pathway connecting them, the relevant scale and horizon, and the evidence appropriate to the claim.

This scope allows GRE to remain broad without becoming synonymous with social science. It welcomes interdisciplinary objects while retaining an economic center of gravity. It also leaves neighboring GR domains available for questions whose primary object lies elsewhere. The breadth of the programme is therefore an architecture of interfaces rather than a claim of disciplinary absorption.

3.1.3 Economics as the Primary Domain

GRE is constituted within economics because its motivating questions concern the organization of material and symbolic conditions through which economic life is produced and reproduced. Production, distribution, allocation, exchange, labor, care, investment, credit, ownership, technological capability, ecological dependence, institutions, and value formation remain central. The relational and generative vocabulary changes the analytical emphasis placed on these objects; it does not dissolve the obligation to engage economic mechanisms, evidence, and established economic explanations.

This primary-domain commitment has several consequences. First, GRE should be able to state what is economically at stake in an inquiry. A sophisticated relational description does not automatically become economic analysis. The researcher must connect the relational configuration to economically consequential capacities, constraints, valuations, flows, institutions, or distributions. Second, GRE remains answerable to existing economics. When a conventional model explains the relevant outcome more parsimoniously and with adequate empirical support, GRE has no disciplinary privilege that exempts it from that result. The programme earns analytical space by identifying dimensions that established representations omit or by connecting findings that remain separated across existing literatures.

Third, economics as the primary domain does not imply a narrow definition of economic value. Market prices, income, productivity, and output are indispensable in many inquiries, but economic life also depends on capabilities, care, ecological conditions, knowledge, institutional trust, infrastructure, social reproduction, and forms of relational value whose significance may be incompletely priced. GRE therefore studies how multiple forms of value enter economic processes, while preserving the distinction between economic relevance and universal commensurability.

Fourth, the economic domain contains both descriptive and normative questions. GRE can describe how a platform generates dependency or how an institution concentrates productive capacity without thereby deciding whether the arrangement is just. Normative inquiry enters when evaluative criteria are made explicit: distribution, capability, recognition, participation, ecological sustainability, generative justice, or other justified standards. Economics supplies part of the descriptive object; ethical and political reasoning remain necessary where evaluation exceeds positive explanation.

Fifth, the primary-domain commitment helps distinguish GRE from the wider GR framework. GR can investigate generative relations in history, law, education, epis-

temology, aesthetics, governance, or other domains without reducing those domains to economics. GRE concerns those interfaces when they materially affect economic processes or when economic arrangements shape the neighboring domain. A legal rule governing property, for example, is relevant to GRE because it constitutes ownership relations, allocative authority, collateral possibilities, and future investment conditions. The same rule can simultaneously require independent jurisprudential analysis concerning legal validity, interpretation, or rights. The interface is real while disciplinary identity remains differentiated.

This differentiation is important for the future development of the research programme. Without it, GRE could expand until every relational phenomenon becomes an economic phenomenon and the term loses discriminative value. With an explicit economic center, interdisciplinary expansion becomes more rigorous: each borrowing must show what economic problem it helps explain and what aspects remain better handled by another domain.

Economics also offers GRE a demanding test environment because economic systems combine formal institutions, strategic behavior, material constraints, symbolic valuations, historical change, quantitative data, and normative controversy. A viable GRE research programme must therefore interact with several established modes of economic reasoning rather than relying on a single philosophical language. The field's disciplinary identity is strengthened when relational and generative claims produce better questions, better explanations, better empirical distinctions, or more adequate evaluations within this demanding domain.

3.1.4 Relation and Generativity as Organizing Commitments

Relation and generativity provide GRE with its two principal organizing commitments. Neither concept functions as a universal explanation. Relation directs attention to the possibility that economic entities, capacities, positions, and values are partly constituted through connections, dependencies, institutions, recognitions, and repeated interactions. Generativity directs attention to the possibility that present relations alter what becomes possible later. Their conjunction gives GRE its characteristic analytical movement.

The relational commitment begins from specification. A relation should be identified with enough precision to distinguish it from mere co-presence or statistical association. Depending on the inquiry, the relevant relation may involve ownership, exchange, debt, employment, care, authority, information, recognition, technological dependence, ecological dependence, legal standing, platform access, infrastructural connection, or another structured linkage. Relations can be direct or mediated, durable or episodic, formal or informal, symmetric or asymmetric, cooperative or exploitative, visible or weakly represented in available data. GRE does not require these differences to be collapsed into a common relational metric.

Relations can also be constitutive at different levels. A contractual relation may connect already recognized legal persons while simultaneously contributing to their later capacities. Other relations help constitute the relevant economic subject or object itself. Employment relations can stabilize occupational identities and access to social insurance; credit relations can create debtor positions and classifications; plat-

form rules can constitute categories of worker or seller; property institutions can define the objects over which exchange rights are recognized. Relational analysis therefore includes both interaction among entities and the relational production of entityhood.

The generative commitment adds temporal and counterfactual depth. A relation matters not only through its current state but through the capacities, constraints, structures, values, and subsequent relations it helps produce. Generation can involve accumulation, learning, reproduction, institutionalization, path formation, trust, dependence, lock-in, ecological change, innovation, subject formation, or the creation of new option spaces. Some generative effects amplify later agency; others narrow the range of feasible action. Many do both for different actors or at different scales.

GRE consequently treats generativity as descriptive before it becomes evaluative. A relation can be highly generative because it reliably produces further structures or capacities while remaining normatively objectionable. Monopoly power can generate entry barriers; surveillance infrastructures can generate behavioral control; debt can generate productive investment and also dependency; extractive institutions can reproduce themselves. The strength of a generative mechanism does not determine its justice. Normative orientation must be supplied through explicit evaluative argument.

The two commitments become especially distinctive when the generated effects alter the conditions of further generation. A subsidy can increase productive capacity; the expanded capacity can change market structure; the changed market structure can alter bargaining power and investment incentives; those changes can influence the design of subsequent policy. A technology can alter productivity while also reorganizing skills, ownership, infrastructure, and standards in ways that change which technologies can be developed later. At this point, economic analysis concerns more than a sequence of outcomes. It concerns transformations in the field of future possibility.

This recursive feature explains why GRE pays attention to what later chapters call generative conditions and effective rules of change. The language should remain modest. Many cases can be modeled adequately with fixed rules and changing state variables. Stronger claims about rule transformation require stronger evidence and clearer specification. GRE does not infer meta-level transformation merely because a system changes. It asks whether the mechanisms through which future states are produced have themselves been altered and what observations would support that inference.

Relation and generativity therefore organize research without dictating a single ontology or method. A historical study may reconstruct how property relations generated institutional persistence. A causal design may estimate how access to credit changes later productive capacity. A network model may represent diffusion through relational structure. An ethnography may identify meanings and recognition processes omitted by administrative data. A formal model may examine self-reinforcing dependence under specified assumptions. These inquiries share an orientation while preserving different evidential objects and standards.

The disciplinary identity of GRE resides in this organized plurality. Relation speci-

fies the mediating architecture through which economic processes occur; generativity specifies the downstream production of capacities, constraints, values, structures, and possibilities. Their conjunction turns attention from isolated possession toward economically consequential histories of formation.

3.1.5 Openness, Revisability, and Disciplinary Development

An emerging research programme requires mechanisms for changing itself. GRE therefore treats openness and revisability as constitutive commitments rather than temporary concessions made during an early phase. Its concepts, categories, methods, and boundaries should remain corrigible through empirical failure, theoretical criticism, comparison with competing explanations, normative disagreement, and changes in the historical economy it attempts to understand.

Revisability begins with ontological suspension. GRE can use relational, processual, dynamical, network, field, geometric, or computational representations while leaving open the question of whether any one representation captures the ultimate ontology of economic reality. This stance permits formal development without transforming modeling convenience into metaphysical certainty. A network can be an excellent representation for one mechanism and an inadequate representation for another. A field model can capture distributed conditions while obscuring actor interpretation. A qualitative reconstruction can identify constitutive meanings that are difficult to parameterize while remaining unable to estimate population-level magnitude. Openness protects the programme from identifying one mode of access with reality itself.

Revisability also concerns the programme's own categories. Economic subjects, institutions, technologies, forms of labor, ownership arrangements, and modes of value production change historically. A research language adequate to one economic formation can become less adequate as new infrastructures and relations emerge. Artificial intelligence offers an obvious contemporary example: rapid changes in productive capability, knowledge generation, labor substitution and complementarity, compute ownership, and human-machine interaction may require categories that were less salient in earlier economic analysis. GRE's emphasis on historical generation would be inconsistent if GRE treated its own conceptual vocabulary as historically exempt.

The programme should therefore preserve records of theoretical change. When a category is revised, the earlier formulation should remain intelligible enough for researchers to understand what changed and why. This matters for cumulative inquiry. A field that silently changes the meaning of its central terms can create an appearance of agreement while losing comparability across studies. Explicit versioning of definitions, assumptions, measures, and model classes can make theoretical evolution a source of knowledge rather than a source of confusion.

Openness further requires external correction. GRE should remain answerable to mainstream economics, heterodox economics, economic history, sociology, anthropology, political theory, law, ecology, philosophy, computer science, and other relevant fields. The appropriate correcting discipline depends on the claim. A causal claim can fail under econometric scrutiny; a historical claim can fail under archival

evidence; a legal claim can misunderstand doctrine; an ecological model can omit biophysical constraints; a normative argument can rely on undefended values. Interdisciplinarity is therefore not only a source of concepts. It is a structure of accountability.

Internal pluralism performs a related function. Researchers working within GRE may prefer different ontologies, causal accounts, measures, formal systems, or normative theories. The field should permit such disagreement when the competing formulations remain explicit enough to compare. Productive pluralism differs from unrestricted eclecticism. Competing accounts should specify their domains, assumptions, explanatory targets, evidential support, and points of incompatibility. A programme grows when disagreement creates sharper tests and better distinctions.

Disciplinary development also depends on negative results and limits. A proposed generative mechanism may fail to replicate, operate only under narrow institutional conditions, or add little beyond an existing model. A relational representation may become computationally intractable without improving explanation. A broad concept of value may prove impossible to operationalize for a particular decision. Such findings belong inside GRE rather than outside it. A research programme that records only cases where its preferred vocabulary succeeds would gradually lose contact with the conditions under which that vocabulary is useful.

Finally, GRE should remain historically revisable in its normative orientation. The programme can state commitments to transparency, participation, non-domination, capability, ecological viability, generative justice, or other evaluative principles only by making their justification available for criticism. Historical change can reveal conflicts among values or forms of exclusion that an earlier framework failed to perceive. Normative learning therefore requires both continuity and openness: continuity sufficient to make commitments accountable, and openness sufficient to correct them.

The disciplinary identity proposed in this section is consequently provisional by design. GRE is an emerging economic research programme organized around relational constitution and generative consequence, committed to economics as its primary domain, open to methodological and formal plurality, and structured for revision through evidence and criticism. This identity is strong enough to distinguish a problem-space while remaining incomplete enough to learn from the research it enables. The next section can therefore move from the identity of the programme to the concrete classes of economic problems that give it substantive necessity.

3.2 The Problem-Space of Generative Relational Economics

The role of this section is to delimit the class of economic problems for which Generative Relational Economics (GRE) is intended to provide additional analytical leverage. Its objective is not to claim that these problems belong exclusively to GRE, but to identify the recurring situations in which analysis becomes incomplete when it stops at the immediate recipient, current output, present ownership, or a fixed description of economic actors. The section proceeds through eight problem families: relational effects of allocation, downstream generation, value beyond possession and

exchange, persistent asymmetry and power, changing economic subjecthood, symbolic abundance and representational instability, heterogeneous subjects and value structures, and transformation of future generative possibilities. The method is constitutive and problem-oriented. Each subsection identifies an analytical difficulty that already appears within economic life and states the additional questions that a generative-relational perspective places around it.

The problem-space of GRE begins from a simple observation with wide consequences: an economic intervention rarely terminates at the point where it is administratively recorded. A payment reaches a recipient, a loan enters a balance sheet, an educational opportunity is allocated to a student, infrastructure is installed in a locality, compute is assigned to an organization, legal recognition is granted to a category of actor, or information becomes available to a community. Each event can be represented as an allocation. Yet its economically consequential effects depend on the relations through which the allocated object becomes usable, convertible, reproducible, contestable, shareable, or restrictive. The immediate transfer is therefore one moment within a potentially longer generative process.

This does not make conventional measures irrelevant. Recipient-level outcomes, prices, quantities, income, productivity, ownership, expenditure, and welfare indicators remain indispensable where they answer the question at hand. GRE instead focuses attention on cases in which these measures capture only one layer of the economic transformation. The programme asks what new capacities, dependencies, relations, subject positions, institutional routines, representations, and later possibilities are generated after the administratively visible event. It also asks which possibilities are weakened, foreclosed, extracted, or displaced. The resulting problem-space extends economic analysis temporally, relationally, and across scales without presuming that every problem requires maximal complexity.

The eight problem families below are connected but analytically distinct. An allocation can alter future capability without changing formal ownership. A productive process can generate symbolic standing without generating transferable wealth. A capability asymmetry can remain benign in one relational configuration and become power in another. An artificial system can become economically consequential before its legal or moral subjecthood is settled. Symbolic abundance can expand expressive possibility while making evidence, attribution, and scarcity harder to stabilize. Heterogeneous actors can participate in one economic process while valuing its outcomes through partially incommensurable standards. GRE treats these differences as reasons to preserve a plural problem-space rather than compress them into one master variable.

3.2.1 Allocation beyond the Administrative Recipient

Many economic interventions are administratively organized around identifiable recipients. A household receives a transfer, a firm receives credit, a student receives a scholarship, a municipality receives infrastructure funding, a laboratory receives equipment, or a community receives access to a service. Administrative legibility requires such attribution because institutions must identify who qualifies, who receives, how much is transferred, and whether the transfer conforms to a rule. This

recipient-centered representation is operationally necessary, yet it can be analytically narrower than the economic effects that follow.

An allocation enters a pre-existing relational environment. A monetary transfer can alter bargaining positions within a household, reduce dependence on one employer, enable mobility, change creditworthiness, or increase the capacity to support others. A scholarship can generate knowledge, recognition, networks, migration opportunities, future income, or new asymmetries between the recipient and those who remain excluded. Infrastructure can alter land values, mobility, ecological pressure, political expectations, and patterns of settlement. Access to compute can enable research, automation, surveillance, artistic production, or organizational concentration depending on surrounding capabilities and institutions. The economically relevant object is therefore often larger than the administratively named recipient.

GRE treats the recipient as an important entry point rather than the presumed boundary of analysis. The analytical task is to identify which relations are activated, weakened, or reorganized by an allocation and which downstream effects are sufficiently connected to the intervention to warrant inclusion. This requires boundary discipline. Expanding the field indefinitely would make attribution impossible and turn relational analysis into a description of everything connected to everything else. A GRE inquiry therefore needs to justify why particular relational pathways are economically material to the problem under study.

The extension beyond the recipient also changes how incidence can be understood. Formal receipt and effective benefit can diverge. A subsidy assigned to one actor may partly accrue to landlords, intermediaries, suppliers, creditors, family members, or platforms through price adjustment, contractual dependence, or relational obligation. Conversely, an allocation formally directed at one person can generate benefits for a wider group through care, knowledge sharing, network access, or local demand. Recipient-level accounting remains informative, while the relational incidence of an intervention can require a different map.

This problem becomes especially important where institutions evaluate success shortly after delivery. Immediate uptake can coexist with longer-term dependence, capability loss, market concentration, ecological degradation, or institutional displacement. The reverse is also possible: modest immediate output can generate durable capabilities whose value becomes visible only later. GRE therefore places the administrative recipient inside a wider temporal-relational field and asks how the intervention changes the conditions under which later economic action becomes possible.

The resulting problem is not simply one of externalities. Externality language often begins from a focal transaction and asks which effects fall outside the prices or decisions of the transacting parties. GRE can include such effects, but its concern is broader. Some downstream consequences are constitutive of the recipient's own future capability; others alter the identities and relations through which the original economic categories remain meaningful. The issue is therefore not only what spills outward from a transaction, but how an allocation participates in the production of a subsequent economic configuration.

3.2.2 Generation beyond Immediate Output

Economic analysis frequently evaluates a process through an observable output: units produced, income generated, services delivered, learning achieved, emissions reduced, jobs created, patents filed, or profits realized. Such outputs matter, yet a process can also alter the capacity to produce later outputs. GRE distinguishes these two analytical moments. Immediate output concerns what is produced within a defined interval or activity. Generative effect concerns how the process changes the capacities, relations, constraints, orientations, infrastructures, or rules through which subsequent outcomes may be produced.

The distinction is visible in ordinary economic life. Training can produce a credential while also changing confidence, professional networks, problem-solving capacity, and access to later institutions. A research grant can produce papers while also creating laboratories, datasets, collaborations, techniques, reputations, and future questions. A platform can produce convenience while also establishing standards, behavioral routines, data assets, dependency relations, and barriers to entry. Care can meet an immediate need while also maintaining the bodily, emotional, and social capacities through which later participation remains possible. A failed project can produce little immediate output while still generating knowledge about constraints, new alliances, or institutional learning.

These examples show why generativity cannot be inferred mechanically from output volume. High output can consume the capacities on which future production depends. A firm can raise short-run productivity by exhausting workers, degrading equipment, externalizing ecological costs, or eliminating slack needed for adaptation. An institution can increase publication counts while narrowing intellectual diversity. A resource boom can raise current income while weakening alternative productive capacities. Conversely, a process can appear inefficient in a short horizon because it invests in capacities whose effects are delayed or uncertain.

GRE therefore treats the temporal relation between present production and future productive possibility as a central economic problem. This includes positive generation, maintenance, regeneration, reproduction, depletion, and foreclosure. The relevant question is not whether every activity has downstream consequences; that proposition would be trivial. The research problem is to identify which downstream changes are economically consequential, through what mechanisms they occur, how durable they are, who can access them, and whether they remain reversible.

Generation also differs from simple multiplication. A process is generative in the stronger GRE sense when it changes the conditions under which later states can be produced. Replicating an identical output can matter economically, but repetition alone does not establish transformation of generative capacity. A production system becomes analytically interesting to GRE when participation, accumulated resources, learned practices, institutional recognition, or altered relations change what can subsequently happen. The generated object may be material, organizational, epistemic, symbolic, ecological, juridical, or relational.

This distinction creates a problem of attribution. Later capacities usually have multiple antecedents. A newly capable organization may have received funding, benefited from favorable regulation, recruited skilled members, inherited prior infras-

tructure, and learned from failed experiments. GRE should therefore avoid attributing the whole later capacity to one relation merely because the relation preceded it. Generative claims require mechanism-sensitive reasoning and calibrated scope. The field's interest in downstream effects increases rather than relaxes the burden of specifying how generation is believed to occur.

3.2.3 Value beyond Possession and Exchange

Possession and exchange provide powerful ways of organizing economic value. Ownership establishes claims over resources; exchange reveals willingness to trade under particular conditions; prices coordinate decisions and permit aggregation across many activities. GRE retains these objects while addressing situations in which economically significant value depends on participation, relation, access, recognition, continued circulation, ecological condition, or future capability rather than possession alone.

A resource can have little value to an actor who lacks the relations required to use it. Data require interpretive and computational capacity. Credit requires institutional access and future repayment possibilities. Land depends on legal recognition, infrastructure, ecology, community relations, and permitted uses. Knowledge can gain value through dissemination and recombination rather than exclusion. Membership in a trusted network can create opportunities that cannot be transferred as a discrete owned object. Public infrastructures and commons can generate value through reliable shared availability. Care, reputation, cultural meaning, and institutional legitimacy similarly resist complete description through possession.

Value can also change form as it moves through relations. Economic resources can become educational capability, political access, symbolic standing, health, time, security, knowledge, or ecological resilience. These conversions are neither automatic nor necessarily commensurable. The same monetary amount can generate very different capacities under different institutional, bodily, geographical, or relational conditions. Conversely, forms of value that appear qualitatively different can sometimes be converted into economic advantage through mechanisms such as credentialing, collateralization, monetization, platform visibility, or legal recognition.

GRE treats these conversions as part of the economic problem because they influence who can participate in subsequent generation. The possession of a resource at time one may matter less than whether it can be converted into durable capability at time two. A person may formally possess information without possessing the literacy or authority required to act on it. A community may possess land while lacking political protection against dispossession. A researcher may possess an idea while lacking access to laboratories, collaborators, or publication channels. An organization may own technology whose value depends on ecosystems maintained by others.

This perspective also creates a problem of value trajectories. Value can circulate, recirculate, dissipate, be extracted, be destroyed, or become embedded in relations that outlast the originating exchange. An intervention that appears beneficial at one point may produce a later value transfer away from the original participants through debt service, rent, licensing, platform fees, intellectual-property claims, or unequal bargaining. Conversely, a resource can generate distributed value through open stan-

dards, shared knowledge, community infrastructure, or repeated reciprocal use.

The purpose of GRE is not to replace price with a universal alternative measure. Doing so would reproduce the commensuration problem in another form. The programme instead asks which forms of value are relevant to the generative process, how they are recognized or obscured, which conversions occur, and what is lost when heterogeneous values are forced onto one scale. Some studies may use monetary valuation; others may require capabilities, ordinal comparison, qualitative description, multidimensional indicators, or explicit acknowledgement of incommensurability.

The problem-space therefore includes a distinction between current value realization and future value generation. An actor can possess valuable assets while occupying relations that reduce future autonomy or capability. Another actor can possess few assets while participating in institutions that generate durable access, learning, security, or collective capacity. GRE does not assume that future generativity should replace present welfare as the evaluative objective. It instead treats the relation between present value and future generative conditions as an economic question requiring explicit normative and empirical analysis.

3.2.4 Persistent Asymmetry and Economic Power

Economic relations routinely contain asymmetries. Actors differ in wealth, productive capability, knowledge, computational capacity, institutional access, bargaining position, vulnerability, mobility, legal recognition, and ability to exit a relation. Difference alone does not establish domination. A doctor and patient, teacher and student, infrastructure provider and user, or advanced technical system and ordinary user can possess highly unequal capabilities while participating in relations that remain mutually beneficial. The analytical problem is to understand when persistent asymmetry becomes economic power and how that power affects later generative possibilities.

GRE approaches power through the conversion of asymmetry into the capacity to shape another actor's options, dependencies, classifications, resources, risks, or future relations. Resource asymmetry can become power when one party controls access to necessities. Knowledge asymmetry can become power when one party can define the relevant evidence or obscure the consequences of a transaction. Institutional asymmetry can become power when one actor controls eligibility, procedure, or recognition. Exit asymmetry can stabilize dependence even where formal participation appears voluntary. Computational or informational asymmetry can allow one actor to predict, rank, personalize, or intervene in another's behavior at a scale the other cannot reciprocate.

This problem is generative because power can reproduce or deepen the conditions from which it arises. Control over capital can generate further capital; control over data can improve prediction and attract further users; institutional authority can shape the categories through which later authority is exercised; reputational advantage can increase access to opportunities that generate additional reputation. Such processes are not inevitable. Competition, law, collective organization, technological change, public infrastructure, and countervailing institutions can interrupt them. GRE is interested in the mechanisms that determine whether an asymmetry decays,

persists, becomes self-reinforcing, or changes form.

Persistent asymmetry also complicates simple strategies of equalization. Some differences in skill, knowledge, role, or capability are produced by specialization and may be beneficial. Other differences may be difficult to eliminate or may arise continually through innovation. The problem for GRE is therefore not reducible to making actors identical. It concerns the relational conditions under which unequal capabilities remain compatible with meaningful participation, non-domination, contestability, access to alternatives, and the preservation of future capacity.

This issue becomes especially important under radical capability asymmetry. An actor may rely on another whose productive, predictive, cognitive, financial, or infrastructural capacity is orders of magnitude larger. Traditional bargaining models can become insufficient when one party cannot meaningfully evaluate the other's capabilities, reproduce the service independently, or exit without severe loss. GRE treats such situations as economic problems of relational architecture. Governance may need to address access, reversibility, auditability, representation, fallback options, common infrastructure, or limits on conversion of capability into control.

The programme also distinguishes power from observable coercion. A relation can shape behavior through dependence, standards, defaults, classification, architecture, or anticipated exclusion without direct commands. Conversely, strong influence can sometimes arise from trust, expertise, or voluntarily delegated authority without amounting to domination. GRE therefore requires local analysis of mechanisms rather than treating every asymmetry as evidence of one universal power relation.

3.2.5 Subjecthood under Changing Productive Relations

Economic theories require some account of the actors who produce, exchange, consume, invest, work, own, decide, cooperate, and bear risk. These actors are often represented as given units for analytical purposes. That representation is frequently useful. Yet productive relations can also change the capacities, roles, identities, and recognition through which an actor counts as an economic subject. GRE treats this instability of subjecthood as part of its problem-space.

Industrialization transformed relations among workers, firms, households, professions, and states. Corporate forms created collective economic actors with legal capacities distinct from their members. Welfare institutions established categories of claimant, beneficiary, dependent, contributor, and protected person. Digital platforms reorganized relations among user, worker, producer, advertiser, seller, and data source. Contemporary artificial systems further complicate the picture by performing economically consequential tasks that were previously associated with human expertise, agency, authorship, coordination, or judgment.

The GRE problem is not to settle the metaphysical status of every possible subject before economic analysis can begin. It is to examine how economic systems assign, stabilize, contest, and transform subject positions. Legal status, contractual capacity, ownership, accountability, recognition, access to institutions, technological mediation, and productive participation can all affect who is treated as an actor and which consequences attach to that treatment.

Changing productive relations can also alter human subjectivity without replacing human subjects. A worker who collaborates with automated systems may become responsible for supervision rather than direct production. A creator working through generative tools may occupy changing relations to skill, attribution, originality, and ownership. A consumer can simultaneously become a source of behavioral data, content, training material, reputation signals, and network effects. A household member can become an economically visible care provider when institutions change the classification of care. Subject positions are therefore partly produced through the categories and relations of economic organization.

This creates problems for models that assume stable preferences, capabilities, roles, or boundaries of agency across the period being analyzed. Participation in an economic relation can change what an actor knows, wants, can do, expects, or is permitted to become. These changes do not imply that subjecthood is infinitely fluid. Bodies, histories, institutions, legal status, material constraints, and persistent identities provide continuity. GRE's task is to identify which aspects of subjecthood are sufficiently transformed by economic relations to matter to explanation.

The problem also has distributive consequences. When productive systems redefine valued participation, some actors gain recognition while others lose it. Automation can reduce the market value of an existing skill while increasing the value of complementary judgment or coordination. Credential systems can open access while excluding actors whose competence is not institutionally legible. New categories can create rights and protections while also fixing identities in ways that become restrictive. GRE therefore studies subject formation together with the institutional conditions under which recognition generates capability or constraint.

3.2.6 Symbolic Abundance and Representational Instability

Contemporary economies increasingly operate through symbolic objects: data, classifications, scores, rankings, credentials, financial representations, software, models, digital identities, synthetic media, generated text, virtual assets, and machine-produced predictions. Symbolic production has become inexpensive in many domains, while attention, verification, trusted interpretation, and institutional recognition remain scarce. GRE treats this divergence between symbolic abundance and representational stability as a distinct economic problem.

A representation can influence economic reality even when it is incomplete. Credit scores affect access to lending; rankings affect applications and funding; metrics shape organizational behavior; maps and categories determine eligibility; recommendation systems alter visibility; forecasts influence investment; labels affect trust; and digital profiles mediate access to platforms or services. These representations do more than describe pre-existing actors. Once institutions act on them, they can change the relations and opportunities through which those actors subsequently develop.

Symbolic abundance intensifies this process because the cost of producing plausible representations can fall faster than the cost of verifying them. When text, images, claims, reports, credentials, signals, or forecasts can be generated at high volume, scarcity shifts toward provenance, attention, adjudication, trusted institutions, and

the ability to distinguish meaningful variation from noise. Economic value can then accumulate around infrastructures that organize visibility and credibility rather than around content production alone.

Representational instability also arises when the underlying object changes faster than the categories used to represent it. Occupational classifications can lag behind new forms of work. Legal categories can lag behind technological capability. Statistical indicators can retain the same name while their social meaning changes. A model trained on historical data can continue producing stable outputs after the relations that made the historical pattern informative have shifted. The representation may remain technically consistent while its relation to the target becomes weaker.

GRE is concerned with this problem because representations participate in generative processes. A classification used to allocate resources can alter behavior, incentives, identities, and institutional structure. A ranking can change the population it was designed to rank. A predictive system can influence the outcome it predicts by affecting who receives attention or opportunity. A narrative about economic risk can alter investment and thereby change the risk environment. Representation is therefore both epistemic and potentially causal.

This does not mean that symbols possess autonomous power outside institutions and practices. Their effects depend on recognition, enforcement, infrastructure, interpretation, and material consequence. A score ignored by all relevant actors remains economically weak; the same score embedded in lending, hiring, insurance, or governance can become highly consequential. GRE therefore studies the relation among symbolic objects, institutional uptake, material allocation, and downstream generation.

The contemporary problem of symbolic abundance also raises questions about knowledge capital. If the production of codified knowledge becomes much cheaper, advantage may shift toward actors who control data, evaluation systems, distribution channels, trusted identities, proprietary infrastructure, or the capacity to convert symbolic output into institutional action. The economic structure of knowledge can therefore change even when information becomes more abundant. GRE treats this as a problem of changing generative conditions rather than assuming that abundance automatically produces equal access or equal capability.

3.2.7 Heterogeneous Subjects and Value Structures

Many economic models gain tractability by representing actors through a common set of variables or a shared metric of preference and welfare. Such representations can be highly informative when the relevant differences are commensurable. GRE also addresses situations in which subjects differ more deeply: in embodiment, cognition, temporal horizon, vulnerability, institutional status, ecological dependence, forms of agency, or the values through which outcomes are interpreted. Heterogeneity then becomes a constitutive feature of the problem rather than a residual variation around one common type.

Heterogeneous subjects can still enter economic relations. A child and guardian, patient and care institution, local community and multinational firm, present generation and future generation, human user and artificial system, or human econ-

omy and ecological system may be connected through exchanges, dependencies, constraints, and value creation even where their capacities and evaluative structures differ sharply. The analytical challenge is to represent the relation without pretending that the parties are equivalent or completely mutually intelligible.

Value heterogeneity intensifies this challenge. Economic decisions can involve income, autonomy, cultural continuity, ecological integrity, security, dignity, recognition, knowledge, aesthetic significance, collective identity, and future possibility. Some of these values can be monetized for particular purposes; others resist stable conversion or lose important meaning when reduced to price. Conflict can therefore arise not only over the distribution of one value but over which values should count, how they should be represented, and who has authority to decide.

GRE approaches heterogeneous value through explicit pluralism. A study may compare several value dimensions, trace conversions among them, identify institutional priorities, or describe conflicts that remain partially incommensurable. The aim is not to prohibit aggregation. Aggregation can be indispensable for decision and coordination. The requirement is to distinguish the practical need for a decision rule from a claim that the underlying values are intrinsically reducible to one scale.

Heterogeneity also affects generative relations because the same intervention can expand one subject's capabilities while narrowing another's. Infrastructure can increase mobility while degrading an ecosystem or displacing a community. Automation can reduce routine labor while expanding organizational capability and concentrating control. Open information can increase public access while exposing vulnerable individuals. A generative process therefore needs to be indexed to subjects, scales, and value dimensions rather than described as generative in an unqualified sense.

The GRE problem-space consequently includes coexistence under incomplete commensurability. Economic relations often need to continue even where actors do not share one ontology, one value function, one time horizon, or one conception of flourishing. Governance then concerns the design of relations that preserve participation, contestability, translation, and revisability under difference. This is an economic issue whenever resources, capabilities, risks, and future possibilities are allocated through those relations.

The problem should also be distinguished from simple diversity. Diversity describes variation among actors or values. Heterogeneity in the stronger GRE sense becomes analytically significant when the differences affect what can be compared, exchanged, represented, or jointly generated. A heterogeneous relation may require several descriptive languages at once. Economic analysis must then resist both premature unification and the opposite conclusion that comparison is impossible.

3.2.8 Transformation of Future Generative Possibilities

The deepest extension in the GRE problem-space concerns interventions that change not only current states or future outcomes, but the space of possibilities from which later economic processes can unfold. An intervention can create new capacities, remove constraints, alter institutions, establish standards, transform expectations, reorganize infrastructures, generate new subject positions, or change the relations through which subsequent innovation and coordination occur. GRE refers to this

family of problems as the transformation of future generative possibilities.

The distinction can be illustrated through capability formation. Education does not merely raise an output variable at the moment instruction occurs. It can change which problems a person can recognize, which institutions can be entered, which collaborations become possible, and which future learning can be undertaken. Infrastructure does not merely deliver a service. It can alter settlement patterns, market access, technological adoption, and the feasibility of later investments. Legal reform can change not only current entitlements but the range of organizations, contracts, claims, and collective actors that can subsequently exist.

Technological platforms provide another example. A platform may begin as an intermediary and later become infrastructure on which other actors build businesses, identities, communities, data practices, and standards. At that point, changes to the platform's architecture affect a wide field of downstream possibilities. The economically relevant question extends beyond current user surplus or firm revenue toward the distribution of capacity to create, exit, interoperate, and develop alternatives.

Future possibility can also be narrowed. Debt can finance productive investment while creating obligations that restrict later choices. Monopoly can generate efficient infrastructure while reducing the space for alternative innovation. Environmental degradation can increase present output while eliminating future ecological options. Surveillance infrastructures can improve prediction while normalizing forms of control that become difficult to reverse. Educational standardization can improve comparability while reducing curricular diversity. These processes are generative in the sense that they shape future conditions, even where what they generate is constraint or foreclosure.

GRE therefore distinguishes generation from desirable expansion of possibility. More possibilities are not automatically better, and some constraints are constitutive of valuable order. Legal prohibitions can protect persons and ecosystems; technical standards can make cooperation possible; professional norms can sustain trust; ecological limits can preserve future viability. The analytical problem is to identify which possibilities are enabled or foreclosed, for whom, at what scale, through what mechanism, and according to which evaluative commitments.

Transformation of future possibilities also makes reversibility important. Two interventions with similar current benefits can differ greatly if one preserves exit and revision while the other creates lock-in. Reversible experimentation can support learning under uncertainty. Irreversible infrastructure, ecological change, institutional centralization, or path-dependent standards require stronger attention to long-horizon effects because later actors inherit conditions they did not choose. GRE therefore treats temporal asymmetry between present decision and future revisability as economically significant.

At the strongest level, an economic process can alter the effective rules through which later change occurs. A new legal form can change what organizations may be created. A communication infrastructure can transform how markets and communities coordinate. Artificial intelligence can alter the cost and distribution of cognitive tasks, thereby changing which activities are scarce and which forms of expertise remain economically valuable. Political-economic reforms can change not only alloca-

tions but the procedures through which future allocations are decided. The system's later transformations then occur under conditions partly generated by earlier transformations.

This does not imply that future possibility can be mapped exhaustively. Novelty, uncertainty, reflexivity, and incomplete knowledge place limits on prediction. GRE therefore treats generative possibility as an object of inquiry under uncertainty rather than as a fully enumerable state space. Researchers can identify enabling conditions, constraints, path dependencies, option structures, mechanisms of lock-in, and observed capability formation without claiming complete knowledge of the futures that may emerge.

The eight problem families together delimit the initial problem-space of GRE. Allocation can propagate beyond its administrative recipient; production can transform future productive capacity; value can depend on relations and conversion rather than possession alone; asymmetry can become self-reinforcing power; productive relations can reshape economic subjecthood; symbolic abundance can destabilize representation and shift scarcity toward verification and institutional recognition; heterogeneous subjects can remain economically connected without complete commensurability; and interventions can reshape the future conditions under which generation itself occurs. These problems share no single mechanism and should not be collapsed into one model. Their common feature is that economically consequential change exceeds the immediate state that conventional accounting or transaction-level description may record.

The next step is therefore conceptual rather than empirical. If GRE is to investigate these problems without presupposing a fixed ontology of entities, agents, relations, or values, it requires a minimal vocabulary from which richer economic objects can later be constructed. The next section introduces that primitive structure through change, structure, constraint, and difference, while retaining ontological suspension regarding their ultimate metaphysical status.

3.3 Primitive Structure for Ontological Emergence

The problem-space specified in the preceding section requires GRE to speak about entities, subjects, relations, capacities, institutions, values, and fields. Treating those objects as unquestioned primitives would, however, reintroduce many of the assumptions that a generative-relational analysis is intended to examine. The role of this section is therefore to establish a weaker conceptual starting point from which richer economic objects can become analytically available. Its objective is to specify four primitive distinctions—change, structure, constraint, and difference—and to explain how their interaction can support the emergence and stabilization of more determinate configurations. The discussion proceeds from each primitive separately to their interaction, the emergence of relative stability, ontological suspension, and multiple realization. Its method is constitutive and minimal: the section states the weakest commitments currently required by GRE while leaving stronger metaphysical claims open.

The term *primitive* is used here in a methodological sense. A primitive is a dis-

tinction that the present analytical framework takes as available before introducing more articulated objects. It is not thereby asserted to be metaphysically fundamental, indivisible, timeless, or ontologically prior in every possible theory. Another formalism may decompose one of these primitives further, replace it with a different basis, or represent the same empirical problem through another ontology. GRE's purpose in selecting a primitive structure is practical and epistemic: to begin with concepts weak enough to avoid presupposing the entities and relations whose emergence the programme may later wish to explain.

This choice also prevents a common circularity. If an economic subject is defined first and its relations are then studied, the analysis can miss processes through which subjecthood itself depends on recognition, law, infrastructure, classification, productive organization, or repeated participation. If a relation is defined first as a link between already constituted nodes, the analysis can miss cases in which the relation contributes to the differentiation or persistence of the nodes. If an institution is treated as a fixed background, the analysis can miss how repeated practices maintain or transform the institution. A minimal primitive structure postpones these commitments. It asks first what changes, what organization makes those changes intelligible, what conditions restrict or enable possible transformations, and what differences become consequential within the configuration.

The four primitives should not be imagined as four substances or four separable components of an economic system. They are analytical dimensions that become meaningful through one another. Change without structure is difficult to identify because change requires some organization within which a transformation can be distinguished. Structure without change becomes analytically inert because structure is known through persistence, variation, reproduction, or transformation. Constraint presupposes a space of possible differences or transitions whose accessibility is conditioned. Difference becomes economically consequential when a structure renders it perceptible, operative, classifiable, or capable of altering later possibilities. Their interaction supplies a minimal grammar for describing ontological emergence while leaving the ontology itself under suspension.

3.3.1 Change

Change is the first primitive because GRE studies economic processes in which later conditions differ from earlier ones. The minimal concept is deliberately broad: change designates a transformation that can be distinguished between configurations, positions, capacities, relations, classifications, rules, or other analytically relevant conditions. This formulation does not presuppose that the thing changing is already an entity with a fixed identity. It permits the identity, boundary, or kind of the relevant object to become part of the change being studied.

Several levels of change should therefore remain distinct. A variable can change while the relations among variables remain similar. A relation can form, intensify, weaken, reverse, or dissolve while the participating terms remain sufficiently stable for the relation to be tracked. A structure can change when patterns among multiple relations are reorganized. A constraint can change when possibilities previously unavailable become accessible, or when previously accessible transitions become costly,

prohibited, or practically unreachable. A classificatory or representational regime can change when actors are newly recognized, grouped, valued, or rendered visible. At a still stronger level, the effective rule through which later transformations occur can itself be modified. GRE eventually requires all of these possibilities, yet the primitive concept of change remains weaker than any one of them.

Change is therefore not synonymous with movement along a pre-specified coordinate. Many economic models legitimately represent change in exactly that way: price changes, employment changes, output changes, wealth changes, or probabilities change within a stable variable system. GRE retains such representations wherever they answer the research question. Its additional interest appears when the variable system itself is historically unstable. A category such as employment may change in prevalence while retaining a stable legal meaning, or the legal and organizational meaning of employment may itself be transformed by platform work, contracting arrangements, automation, or new institutional classifications. The first case can be represented as change within a category; the second includes change in the category's constitutive conditions.

This distinction also separates state change from generative change. A state can differ at two times without the transition altering the capacity to produce later states. By contrast, a generative change modifies some condition through which subsequent possibilities are produced, selected, stabilized, or foreclosed. Training that raises a measured skill level is a state change; when the training also alters future access to occupations, networks, credentials, confidence, or learning capacity, the economic significance includes a generative dimension. A regulation that changes a current price is one kind of intervention; a regulation that changes entry conditions, bargaining institutions, or the incentives through which future market structure develops reaches a different level of change.

The concept must also accommodate maintenance. Persistence across time can require continuous activity. A bridge remains usable because inspection and repair occur; a currency remains accepted through continuing institutional and social practices; an organization persists through recruitment, routines, accounting, authority, and repeated recognition; a relation of trust can remain stable because encounters repeatedly confirm expectations. In such cases, apparent sameness at the level of an outcome is produced through ongoing change at other levels. GRE should therefore avoid equating observable stability with absence of process.

Change also carries no intrinsic normative direction. Transformation can enlarge capability, reduce vulnerability, create knowledge, or regenerate ecological conditions. It can equally generate dependency, exhaustion, exclusion, concentration, ecological loss, or irreversible foreclosure. Even a change described as innovation is not thereby beneficial to all affected subjects. The primitive records transformation; the normative evaluation of that transformation requires additional criteria developed later in the programme.

Finally, change is always specified relative to an analytical resolution. A firm may appear unchanged because it retains the same legal identity while its workforce, technology, ownership, dependencies, and internal authority are transformed. A person may appear occupationally unchanged while the meaning and security of the occupation are altered. A market may display stable aggregate shares while the underly-

ing network of suppliers becomes more concentrated. GRE therefore requires the researcher to state which differences count as changes for the local question and which dimensions are being held provisionally constant. This dependence on resolution will become important when the programme later treats scale, boundary selection, and representation.

3.3.2 Structure

Structure provides the organization within which changes and differences become intelligible. In its minimal GRE sense, a structure is a pattern of organization that relates distinguishable components, positions, transitions, or conditions with sufficient regularity to support analysis. The term does not require a single formal representation. A structure may be institutional, relational, spatial, temporal, legal, organizational, symbolic, ecological, computational, or represented through several of these descriptions at once.

This minimal definition matters because structure is often confused with rigidity. GRE instead treats structure as compatible with extensive internal change. A labor market can preserve a recognizable structure while workers and firms enter and exit. A legal system can preserve institutional continuity while rules are amended. A network can preserve a degree distribution or community pattern while particular ties change. A household can remain an administratively recognizable unit while roles and resource flows are reorganized. Structural persistence therefore concerns patterned organization at a selected resolution, not immobility of every constituent.

Structure can also exist at several analytical levels. A local structure may concern the arrangement of a small number of actors or resources. A higher-order structure may concern patterns among relations, institutions, or categories. Structures can be nested, overlapping, or partially incompatible. The same economic subject may simultaneously occupy a workplace hierarchy, a household division of care, a credit relation, a legal status, a platform ranking system, and an ecological dependency. No single structure necessarily exhausts the subject's economic position.

For GRE, structure becomes especially important when it shapes how an intervention propagates. The same allocation can have different effects under different structures because access, conversion, visibility, bargaining, and recirculation differ. A cash transfer received within a predatory debt relation may partly flow to creditors. A research grant enters a university structure that conditions hiring, procurement, intellectual-property ownership, publication, and career recognition. Access to compute can generate different capacities depending on whether technical knowledge, electricity, data, institutional permission, and collaborative networks are available. Structure therefore mediates the relation between an initial resource and the later configuration it helps produce.

Structure also helps distinguish a merely repeated occurrence from a stabilized pattern. Repetition alone can result from coincidence or independent causes. A structural claim is stronger: it proposes that the recurrence reflects an organization of relations, positions, rules, or constraints that makes certain patterns more likely, durable, or reproducible. Such claims require evidence appropriate to the domain. GRE should not infer structure from visual regularity alone; qualitative mechanisms,

institutional rules, historical evidence, statistical relationships, network organization, formal models, or combinations of evidence may be needed.

Importantly, structure can itself be an outcome of prior generation. Infrastructure, property regimes, professional categories, organizational routines, standards, market conventions, and technical architectures are historically produced. Once established, they can condition later behavior and appear to subsequent actors as part of the environment. This temporal layering is central to GRE because generated structures can become conditions of future generation. The analytical movement is therefore recursive: processes generate structures; structures condition later processes; later processes may reproduce, erode, or transform those structures.

Structure should consequently be treated as relative to both scale and time. A relation that looks transient at one temporal scale may contribute to a stable pattern at another. A structure that appears fixed during a short intervention study may be historically recent. A national institution can function as background in a firm-level analysis while becoming the primary object in a comparative institutional study. GRE's minimal concept of structure supports these shifts without requiring that one level be declared ontologically fundamental.

3.3.3 Constraint

Constraint concerns the conditioning of possible transformation. A constraint limits, channels, raises the cost of, delays, redirects, or otherwise modifies which changes are available to a configuration under specified conditions. This definition is intentionally broader than prohibition. Constraints can be hard or soft, formal or informal, material or symbolic, local or distributed, immediate or historically accumulated. They can reduce some possibilities while enabling others by stabilizing expectations, protecting boundaries, supplying standards, or coordinating action.

The enabling dimension is important. A legal rule constrains conduct while also making contracts, organizations, ownership claims, or collective action more reliable. A technical standard restricts admissible designs while enabling interoperability. A professional norm narrows acceptable practice while supporting trust. A budget constraint restricts expenditure while helping define feasible planning. Physical infrastructure limits movement to available routes while making high-volume movement possible along those routes. GRE therefore treats constraint as a transformation of an option space rather than as a synonym for oppression or deprivation.

Constraints differ in the mechanisms through which they operate. A material constraint may arise from energy, time, geography, bodily capacity, or resource availability. An institutional constraint may arise from law, organizational authority, eligibility criteria, property rights, or administrative procedure. A relational constraint may arise from dependence on another actor, obligations, network position, reputation, or bargaining asymmetry. A cognitive or epistemic constraint may arise from limited knowledge, inaccessible information, uncertainty, interpretive categories, or attention. A technological constraint may be embedded in interfaces, protocols, platforms, or computational architectures. These forms can interact, and the same observed limitation can often be generated through several different mechanisms.

Constraint is therefore relational in a weak but important sense: a condition con-

strains only relative to some possible transformation of a specified configuration. The absence of advanced compute does not constrain a task that requires none. A licensing rule may constrain an unlicensed entrant while enabling established professionals to coordinate around a recognized standard. A language barrier can constrain access in one institution and become irrelevant in another with translation infrastructure. The researcher must specify whose possibilities are conditioned, which possibilities are at issue, and through what mechanism the conditioning occurs.

Constraints can also be inherited. Present actors confront conditions generated by earlier processes that they did not choose: debt structures, infrastructures, ecological degradation, historical exclusions, educational systems, legal categories, standards, and accumulated concentrations of capital or knowledge. Such inherited constraints can be highly durable even when no current actor intends their continuation. GRE's concern with generation therefore includes the production and transmission of constraints across time.

At the same time, constraints are often transformable. Actors can acquire resources that relax a constraint, organize collectively to alter a rule, invent technologies that change material limits, reinterpret categories, create new infrastructures, or exit relations that previously restricted them. An intervention can also exchange one constraint for another. Credit can relax a liquidity constraint while introducing repayment obligations. Digital platforms can reduce search costs while increasing dependency on ranking systems or data infrastructures. Automation can relax labor bottlenecks while creating new capital, compute, energy, or skill dependencies. Analysis should therefore trace transformations of the constraint structure rather than classify interventions simply as constraint-reducing.

GRE also distinguishes constraint from deterministic closure. A constraint can make a transition improbable without making it impossible, and it can make a transition formally possible while rendering it practically inaccessible. Conversely, the absence of a known constraint does not imply that a possibility will be realized. Capacities, orientations, coordination, chance, and additional conditions also matter. This distinction will later be important for economic power: asymmetry can influence option spaces and the conditions under which choices are made without reducing action to mechanical determination.

3.3.4 Difference

Difference supplies the discriminations through which change, structure, and constraint can be described. In its minimal GRE sense, a difference is a non-equivalence, contrast, distinction, gradient, or differentiation that is relevant to a specified analysis. The primitive does not assume that every observable variation is economically meaningful. A difference becomes analytically consequential when it participates in identification, interaction, selection, valuation, constraint, or subsequent generation.

This distinction between variation and consequential difference is central. Two actors can differ in height without that difference affecting a particular credit relation. They can differ in legal status in a way that radically alters eligibility, bargaining, mobility, or vulnerability. Two firms can differ in size without that difference determining market power in one industry, while in another industry scale can transform

access to data, compute, distribution, or finance. GRE therefore asks how a difference enters the relational configuration and what later effects follow from its recognition or operation.

Difference can be prior to a relation, produced through a relation, or amplified by a relation. Participants may enter an exchange with different resources or capabilities. The exchange may itself create new differentiation through learning, reputation, debt, ownership, or access. Repeated interactions can amplify an initially small difference through cumulative advantage or self-reinforcement. Conversely, institutions can reduce the economic consequences of a difference through insurance, universal provision, accessibility design, anti-discrimination rules, redistribution, or shared infrastructure. The economic significance lies in the generative trajectory of the difference, not merely in its presence.

Difference also participates in the constitution of categories. Economic systems routinely classify workers, firms, borrowers, residents, consumers, citizens, dependents, owners, professionals, risks, assets, and forms of labor. Such classifications make some differences institutionally salient while suppressing others. A category can convert a continuous variation into a discrete administrative distinction, or combine heterogeneous cases under one label. Once institutionalized, the classification can affect access, rights, prices, obligations, visibility, and self-understanding. Representational differences can thereby become causally effective within economic life.

The primitive must remain distinct from inequality. Inequality is a more specific relation involving unequal quantities, positions, opportunities, burdens, capabilities, recognition, or powers. Difference is logically weaker. Heterogeneity can be economically valuable, neutral, complementary, conflictual, or unjust depending on how differences are organized and evaluated. GRE's later treatment of heterogeneous subjects depends on preserving this distinction; a plural economy need not aim at eliminating difference, while justice may require intervention when particular differences are converted into avoidable domination or exclusion.

Difference is also scale-relative. Two configurations can be equivalent for one analytical purpose and different for another. Two households may have the same income while differing in care burdens, health needs, legal status, housing security, social networks, or exposure to environmental risk. Two firms may have identical revenue while differing in ownership, dependence on a platform, ecological footprint, or accumulated knowledge. An economic representation always selects which differences to preserve. GRE therefore treats the choice of relevant difference as part of the epistemic architecture of inquiry rather than as a transparent property of the world.

This point prevents the primitive from becoming an unlimited invitation to complexity. A research design cannot preserve every difference. The analytical task is to justify which distinctions matter to the proposed generative mechanism and to test whether omitted differences undermine the explanation. Difference thus supports pluralism while remaining disciplined by the local research question.

3.3.5 Interaction among the Four Primitives

The analytical value of the primitive structure lies primarily in interaction among its terms. Change, structure, constraint, and difference should rarely be interpreted as

independent explanatory variables. Each modifies the meaning and operation of the others. A difference can alter a transition; repeated transitions can stabilize a structure; a structure can convert some differences into effective constraints; a constraint can preserve a structure by narrowing available transitions; and structural change can create new differences and remove old ones.

Consider a simple economic sequence. Two actors begin with a difference in access to finance. An institutional structure determines which forms of collateral are recognized. That structure constrains borrowing possibilities differently across the actors. The resulting difference in investment capacity alters later income, asset ownership, reputation, and access to finance. Repetition can stabilize a configuration in which the original difference is amplified and incorporated into a more durable structure. The example does not require the researcher to declare wealth, creditworthiness, institutions, or even the actors themselves to be ontological primitives. It can begin from transformations, patterned organization, conditioned possibilities, and consequential distinctions, then introduce richer objects as the analysis becomes empirically specific.

The same primitive structure can describe generative expansion. Shared infrastructure may reduce a constraint on participation. Increased participation can create new differences in specialization and knowledge. Those differences can support a more complex division of labor. The emerging structure can generate additional resources, standards, and coordination capacities, which further relax some constraints while creating new ones. Generativity therefore need not mean monotonic liberation from constraint. New capabilities often depend on newly stabilized structures whose operation introduces obligations, dependencies, standards, or maintenance requirements.

The interaction among primitives also permits recursive analysis. A structure can constrain change, while changes can transform the structure. A difference can be produced by a constraint, while the resulting difference can later modify the constraint through political organization, market power, technological innovation, or institutional recognition. Constraint structures can become objects of economic investment; differences can become commodities, credentials, rankings, or legal statuses; structures can be deliberately designed; and change itself can be governed through procedures that determine how rules may be revised.

This recursion provides a bridge to the stronger GRE question concerning transformation of effective rules of change. At an initial analytical level, a researcher may ask how a configuration changes under a specified structure and set of constraints. At a second level, the inquiry can ask how those structures and constraints themselves change. At a third level, the procedures or mechanisms through which structures and constraints are transformed may become objects of inquiry. The primitive vocabulary can therefore support increasingly reflexive analysis without assuming that a single immutable law governs every level.

A useful discipline follows from this interaction: explanations should specify which primitive role a concept is playing at a given moment. The same institution can be treated as structure when its internal organization matters, as constraint when it conditions an actor's options, as difference when membership distinguishes eligible from ineligible actors, and as an object of change when reforms alter its

operation. These descriptions are compatible because they answer different analytical questions. Confusion arises when movement among them occurs without being stated.

The primitive framework is therefore better understood as a grammar than as a taxonomy. It organizes questions about transformation without assigning each empirical object to one permanent category. This flexibility is important for economic inquiry because the same phenomenon can change analytical status across scale and time. Money can be a resource in one analysis, a relation of credit in another, an institutional structure in a third, a symbolic representation in a fourth, and a constraint through liquidity requirements in a fifth. The primitives do not replace these richer categories; they clarify how such categories can be introduced without assuming their universality in advance.

3.3.6 Emergence of Stable Configurations

GRE requires relatively stable objects because economic inquiry cannot proceed by treating every moment as ontologically unique. Contracts, firms, households, states, currencies, property rights, professions, platforms, resources, and subjects must often be tracked across time. The primitive framework therefore needs an account of how stability can become analytically legitimate without turning stability into primordial substance. The concept of *stable configuration* supplies that bridge.

A stable configuration is a patterned organization whose continuity is sufficient for a specified analytical purpose across a relevant interval, scale, or set of transformations. Stability can arise through several mechanisms: material durability, repeated interaction, institutional recognition, legal enforcement, habit, technical standards, ecological reproduction, feedback, coordinated expectations, memory, documentation, or continual maintenance. These mechanisms need not produce permanence. They produce enough persistence or recurrence for the configuration to function as an identifiable object within the inquiry.

The phrase *sufficient for a specified analytical purpose* is crucial. A corporation can be treated as the same legal entity across changes in personnel and assets, while an organizational ethnography may treat those same changes as constitutive transformations. A currency can remain nominally the same while inflation alters its purchasing power and institutional reforms alter its governance. A household can persist administratively while membership changes. Entityhood is therefore resolution-dependent. GRE treats an entity as analytically real where the stability of a configuration supports explanation, measurement, interpretation, intervention, or coordination at the chosen scale.

Relations can stabilize in the same way. A relation need not be continuously active in order to persist. A debt relation remains operative between payments; a property relation persists while the owner is absent; a professional relation can survive periods without interaction; an institutional hierarchy can remain in force outside moments of explicit command. Persistence can depend on documents, expectations, enforcement, memory, infrastructure, or recognized roles. A stable relation is therefore more than repeated contact, yet it need not be a metaphysically independent object.

Stable configurations can also acquire causal and generative efficacy. Once a classification is institutionalized, it can govern eligibility. Once a platform becomes infrastructure, it can condition market access. Once a professional credential stabilizes, it can shape labor-market sorting. Once a norm becomes widely expected, deviations can become costly even without formal enforcement. An emergent configuration can thus become part of the structure and constraint environment faced by later actors. Ontological emergence and generative recursion meet at this point: what was produced through earlier processes becomes a condition of later processes.

Stability should also be distinguished from desirability, efficiency, and equilibrium. A configuration can persist because exit is costly, alternatives are suppressed, coordination failure prevents change, or power reproduces the relevant conditions. Another configuration can be beneficial yet fragile because its maintenance depends on scarce resources or voluntary cooperation. GRE therefore treats persistence as an empirical property requiring explanation rather than as evidence of optimality.

The emergence of stable configurations gives GRE a principled basis for introducing richer objects in the next section. Entities, subjects, relations, resources, values, fields, institutions, and symbolic objects can be treated as first-class economic objects when their organization is sufficiently stabilized and their distinctions matter to the research problem. Their status remains historically and analytically conditioned. Stability licenses local objecthood; it does not establish final ontology.

3.3.7 Ontological Suspension

Ontological suspension is the discipline that keeps this primitive framework from becoming a dogmatic metaphysics. It means withholding claims about the ultimate constitution of economic reality when stronger ontological commitments are unnecessary for the local inquiry. Suspension permits the researcher to use entities, relations, processes, fields, networks, states, events, or other representations where they are analytically productive while keeping open the possibility that another representation may reveal different aspects of the same empirical configuration.

Suspension differs from ontological denial. GRE does not claim that entities are unreal because they are relationally constituted, that relations are unreal because they are represented through models, or that institutions are mere descriptions because they depend on recognition. A bank account, legal status, debt, organization, or technical standard can have robust economic consequences. Ontological suspension concerns the level of metaphysical assertion attached to those consequences. The researcher can treat an object as real and causally relevant within an inquiry without claiming that its current representation exhausts what the object is.

This position also differs from unrestricted constructivism. Economic objects can resist interpretation, produce unexpected effects, and impose material constraints regardless of the researcher's preferred description. A bridge has load limits; an ecosystem can be degraded; a debt contract can be enforced; a platform can deny access; a person can become exhausted. Ontological suspension does not dissolve these realities into discourse. It requires the analyst to distinguish the empirical resistance of a configuration from the categories used to describe it.

The discipline is especially important when formal methods are used. A graph

can represent relations among nodes, a state space can represent possible configurations, a field can represent distributed conditions, and a simulation can explore consequences of specified rules. Each representation can be rigorous within its assumptions. None acquires metaphysical authority merely from mathematical precision. GRE therefore asks what distinctions the representation preserves, what it suppresses, which mechanisms it assumes, and whether alternative representations change the substantive conclusion.

Ontological suspension also supports interdisciplinary communication. Economics, law, sociology, history, ecology, computer science, and philosophy can represent the same situation through different objects. A platform worker can appear as a labor supplier, contractual party, legal claimant, network node, data-generating user, organizational participant, or historically situated subject. These representations can conflict in specific claims while remaining jointly informative. GRE should compare their explanatory consequences before treating one vocabulary as universally privileged.

Finally, suspension creates a condition for theory revision. If entities, relations, and categories were fixed as final primitives, evidence that their boundaries change would threaten the coherence of the framework. A suspended ontology permits categories to be reconstructed when historical change reveals their limits. This revisability is particularly important to a programme concerned with the generation of new economic objects, technologies, institutions, and forms of subjecthood.

3.3.8 Multiple Realizations and Ontological Plurality

A minimal primitive structure also allows economically meaningful objects to have multiple realizations. The same functional or institutional role can be sustained through different material, organizational, legal, or relational configurations. Payment systems can be realized through cash, bank deposits, cards, mobile platforms, or other infrastructures. Collective production can be organized through firms, cooperatives, public institutions, households, commons, or loosely coordinated networks. Credentialing can be performed by universities, professional bodies, states, platforms, or community institutions. What counts as the same economic object therefore depends partly on the level at which equivalence is being claimed.

Multiple realization should not be confused with identity. Two configurations can perform similar functions while differing in power relations, vulnerability, ecological cost, accessibility, governance, or downstream generativity. A public payment infrastructure and a proprietary platform may both enable transactions while generating different dependencies and data relations. Two educational systems may produce comparable test scores while differing in social networks, institutional recognition, stress, curiosity, or future opportunity. GRE consequently treats functional equivalence as one possible relation among configurations rather than as proof that their broader economic consequences are equivalent.

The converse problem also occurs: similar manifestations can arise from different generative structures. Two workers can report the same income while one depends on a stable employment relation and the other on volatile platform work. Two firms can display the same output while one relies on durable local capabilities and the

other on fragile external supply chains. Two communities can exhibit similar consumption while differing in debt burdens, ecological dependencies, public infrastructure, or informal care. Observable similarity therefore does not guarantee generative similarity.

Ontological plurality follows from these possibilities. GRE can permit several ontologies or representational schemes to coexist when they preserve different distinctions relevant to the research question. An entity-centered model may be adequate for one task, a network representation for another, a process account for a third, and a field-like description for a fourth. Plurality is disciplined by explanatory and evidential adequacy rather than by an assumption that every representation is equally useful.

This pluralism has limits. Representations can contradict evidence, conceal relevant mechanisms, or impose categories that systematically misdescribe the subjects they classify. A plurality of possible descriptions does not eliminate standards of criticism. GRE should ask whether a representation preserves the differences relevant to the claim, whether its boundaries are justified, whether its entities remain stable enough for the inference being made, and whether alternative representations produce materially different conclusions. Ontological plurality therefore increases the burden of comparison rather than removing it.

Multiple realization also matters normatively. Policies often target administratively standardized objects such as households, firms, jobs, schools, or regions. If those categories have heterogeneous realizations, identical interventions can generate unequal effects. A household with the same measured income can face different care obligations; a firm of the same size can possess different network dependencies; a school with similar resources can operate within different linguistic, social, or infrastructural conditions. GRE's later analysis of heterogeneous subjects and values depends on recognizing that categorical sameness can coexist with generatively consequential difference.

The primitive structure developed in this section therefore establishes a deliberately modest ontological foundation for the programme. Change identifies transformation without presupposing a fixed bearer. Structure identifies patterned organization without requiring stasis. Constraint identifies the conditioning of possible transformation without implying deterministic closure. Difference identifies relevant non-equivalence without equating difference with inequality. Their interaction can generate relatively stable configurations that become legitimate objects of economic inquiry at specified scales and times. Ontological suspension prevents these objects from hardening prematurely into universal primitives, while multiple realization and ontological plurality preserve the possibility that comparable economic functions can be sustained through different configurations and that similar observations can arise from different generative histories.

This architecture is intentionally incomplete. It supplies the minimal conceptual conditions under which richer objects can be introduced; it does not yet specify which objects GRE should study. The next section can therefore move from primitive structure to the heterogeneous economic objects that become available once relative stability, analytical scale, and ontological suspension have been established.

3.4 Objects of GRE Inquiry

The primitive structure developed in Section 3.3 allows GRE to introduce richer objects without treating their present boundaries as metaphysically final. The role of this section is to specify the principal classes of objects that GRE may take as economically relevant once relative stability, analytical scale, and ontological suspension have been established. Its objective is taxonomic rather than exhaustive: to identify a working repertoire of objects through which relational and generative economic processes can be investigated. The discussion proceeds from emergent entities and subjects to relations, resources and capacities, value, conditions and constraints, fields, temporal objects, institutions, and symbolic or representational objects. Its method is constitutive and pluralist. Each category is defined by the analytical work it can perform, while overlap among categories remains permissible where an empirical configuration supports several descriptions.

An *object of inquiry* in GRE is therefore an analytically stabilized referent around which a research question, body of evidence, mechanism claim, comparison, or intervention can be organized. Objecthood in this sense is local to an inquiry. A firm may be treated as an entity when the question concerns ownership or output, as a relational configuration when the question concerns authority and contracting, as an institutionally recognized subject when the question concerns legal responsibility, and as a trajectory when the question concerns organizational transformation. These descriptions are compatible when they preserve different economically consequential distinctions. GRE does not require a single vocabulary to carry every explanatory burden.

The admissibility of an object depends on several disciplines. Its boundary should be sufficiently explicit for the claim being made. Its persistence should be adequate to the temporal resolution of the inquiry. The evidence used to characterize it should correspond to the dimensions under discussion. Its role in a mechanism should be distinguished from the representation through which that role is inferred. Finally, the analyst should remain attentive to whether the object itself changes through the processes being studied. A category useful at the beginning of an inquiry can require revision if its constitutive relations, internal heterogeneity, or practical meaning change during the relevant history.

The categories below are therefore best understood as a research grammar. They help determine what GRE can study without implying that economic reality is naturally partitioned into ten mutually exclusive classes. Many of the most important GRE questions arise precisely where an object moves across categories: a resource becomes a capability, a repeated relation stabilizes into an institution, a symbolic classification becomes a material constraint, an event redirects a trajectory, or a distributed field of conditions contributes to the emergence of a new economic subject. The taxonomy is designed to preserve those transformations rather than eliminate them through premature classification.

3.4.1 Emergent Economic Entities

Economic analysis routinely refers to persons, households, firms, states, markets, sectors, technologies, assets, platforms, infrastructures, and other entities. GRE retains these objects while treating their entityhood as historically and analytically conditioned. An emergent economic entity is a relatively stabilized configuration that can be tracked as a distinguishable unit because some combination of boundary, continuity, recognition, organization, or causal coherence persists across the interval relevant to the inquiry.

Relative stability is central. A corporation can remain the same legal entity while employees, ownership shares, technologies, contracts, products, and internal authority change. A household can remain administratively recognizable while membership, dependency relations, income sources, and care obligations vary. A market can persist as a named domain while its technologies, participants, rules, and geographic reach are transformed. GRE can treat each as an entity when the continuity is sufficient for the local question, while preserving the possibility that another question requires decomposition of the apparent unit.

Entity boundaries can arise through several mechanisms. Law creates juridical boundaries around corporations, contracts, property, and public authorities. Accounting creates reporting boundaries around organizations and transactions. Technical architectures distinguish users, devices, accounts, services, and platforms. Social recognition can stabilize occupations, communities, or organizational identities. Material organization can generate boundaries through infrastructure, geography, or ecological dependence. These boundaries differ in durability and authority. A legal boundary may remain stable while operational relations cross it extensively; an informal organization may have no independent legal personality while displaying strong internal continuity.

The economic significance of entityhood therefore depends partly on what the boundary permits the entity to do. Recognition can make ownership, contracting, taxation, liability, borrowing, representation, or participation possible. Entity formation can pool resources, concentrate decision rights, create collective capabilities, or separate responsibility. It can also obscure internal asymmetries by presenting a heterogeneous configuration as a single actor. Treating a firm, household, state, or community as one unit can be analytically efficient while suppressing differences in who decides, who bears risk, who receives value, and who remains unrepresented.

Entity emergence can itself become an object of explanation. A group of workers can become an organization; a technical project can become a firm; a loose exchange environment can become a recognized market; a digital protocol can acquire institutional governance; a collective practice can become a sectoral standard. GRE is interested in the conditions through which such configurations become sufficiently stable, recognized, resourced, and reproduced to acquire economic consequences as entities. The transition from diffuse activity to recognized entity can alter access to finance, law, infrastructure, legitimacy, and bargaining power.

Entities can also dissolve, fragment, merge, or migrate across classifications. Insolvency can dissolve a firm while parts of its productive capacity survive elsewhere. A public service can be privatized while its infrastructure remains materially continu-

ous. A platform can reclassify workers without changing the practical dependence through which labor is organized. These cases show why GRE treats entity identity as a question of maintained distinctions rather than a self-evident fact.

The category of emergent economic entity consequently supplies a practical unit of analysis while keeping three questions open: which relations stabilize the entity, which boundaries make the entity economically actionable, and which transformations would make the existing entity description inadequate. These questions connect entity analysis to the remaining object classes rather than isolating entities from them.

3.4.2 Subjects and Subject Positions

Subjects form a distinct class because economic participation involves more than the persistence of an entity. A subject occupies positions from which action, claim-making, evaluation, vulnerability, responsibility, recognition, or experience becomes economically consequential. GRE therefore distinguishes the existence of an entity from the constitution of a subject position. A corporation can be a juridical subject for some purposes without possessing human experience; a person can exist as a biological and social individual while being denied effective recognition as a worker, claimant, owner, borrower, resident, or political participant.

A *subject position* is a relationally and institutionally organized location from which rights, expectations, obligations, opportunities, exposures, or forms of agency become available. Employment status, citizenship, tenancy, creditor status, professional accreditation, platform membership, consumer classification, and eligibility for public support are examples of positions that configure economic possibilities. Such positions are often produced jointly by law, organizational rules, records, classifications, infrastructures, and recognition by other actors.

Subject positions can therefore change without the underlying person or organization disappearing. A worker can move from employee to contractor; a resident can gain or lose eligibility for a service; a borrower can be reclassified by a credit system; a community can become formally recognized as an eligible governance unit; a software agent can be delegated limited transactional authority. Each change modifies what the subject can do, what others may demand from it, and which relations become economically available.

GRE is especially interested in the generative consequences of these positions. A position can enable access to income, credit, education, information, legal remedies, social networks, or institutional voice. It can also create dependency, surveillance, liability, exclusion, or constrained exit. Because positions mediate later capacities, subject formation is not merely a descriptive question about identity. It can become part of the economic mechanism through which future options are generated or foreclosed.

This perspective also preserves the difference between subjecthood and agency. A subject can be strongly constrained while remaining economically consequential. Children, persons under guardianship, refugees, patients, dependents, or algorithmically classified users can occupy economically important positions even where their formal decision authority is limited. Conversely, an actor with substantial op-

erational agency can remain weakly recognized within a legal or moral order. GRE should therefore specify which dimension of subjecthood matters to the inquiry: capacity to act, capacity to experience, standing to claim, institutional recognition, representation, accountability, or exposure to consequences.

Heterogeneity within subject categories is equally important. Administrative categories such as household, worker, consumer, student, patient, migrant, or firm can contain subjects with markedly different capacities and dependencies. Treating category membership as sufficient description can obscure differences in language, disability, care obligations, wealth, access to networks, legal status, technical literacy, or exposure to institutional power. A GRE analysis can preserve the usefulness of the category while examining how its practical realization varies among subjects.

Subject positions can also be collectively constituted. A union, cooperative, community association, indigenous polity, professional body, or informal collective can acquire forms of representation and bargaining capacity that are unavailable to isolated members. Collective subjecthood can reorganize the field of negotiation, create shared resources, and alter the conversion of individual grievances into actionable claims. The relevant object is then neither a simple aggregate of persons nor a timeless collective substance. It is a stabilized configuration of representation, recognition, organization, and capacity.

The category will later support GRE's more detailed inquiry into human and artificial economic subjects. At the constitutional level, the key point is narrower: subjecthood is an economic object whenever the positions from which actors participate, experience consequences, make claims, or become governable are themselves generated, maintained, or transformed through economic relations.

3.4.3 Relations and Relational Configurations

Relations are central objects of GRE because economic consequences frequently depend on how actors, resources, institutions, and conditions are connected. A relation can involve exchange, authority, dependence, care, credit, ownership, recognition, information, obligation, trust, competition, cooperation, representation, access, or other structured forms of connection. GRE treats the relation itself as analytically available when its persistence, terms, or consequences matter to the research question.

Relations vary in their constitution. Some are formally specified through contracts, law, accounting, organizational rules, or technical protocols. Others depend on repeated practice, trust, custom, shared expectations, social proximity, or tacit coordination. Some are symmetric in a relevant dimension; others distribute authority, information, risk, or exit options asymmetrically. A relation can remain formally unchanged while its practical content shifts because one party's outside options, dependence, knowledge, or institutional protection changes.

Dyadic representation is useful for many questions, yet GRE also recognizes relational configurations that cannot be adequately decomposed into independent pairs. Supply chains, families, teams, communities, standards ecosystems, financial systems, platform markets, and public infrastructures often involve higher-order or multilayer dependencies. The significance of one tie can depend on the presence of

several others. A credit relation, for example, can depend on legal enforceability, informational infrastructure, collateral arrangements, reputational systems, and monetary institutions. A labor relation can depend on household reproduction, immigration status, local labor demand, professional credentials, and collective bargaining institutions.

A *relational configuration* therefore refers to an organized set of relations whose joint structure has economically consequential properties. Concentration, brokerage, segregation, reciprocity, redundancy, hierarchy, mutual dependence, and network closure can arise at the configuration level. These properties may affect bargaining power, diffusion, resilience, access, vulnerability, and capacity formation even when no single relation carries the full explanation.

GRE also distinguishes relations that connect already stabilized objects from relations that contribute to the constitution of those objects. A contract between two established firms may primarily coordinate exchange. Repeated recognition relations can help constitute a professional status. Care relations can contribute to the maintenance of persons' capabilities. Membership relations can constitute an organization. Legal relations can create ownership or corporate personality. The analytical question is therefore whether the relation is external to the identity relevant for the model, partly constitutive of it, or generative of a new stabilized object.

Relations can persist through material and symbolic infrastructures. A debt relation may be maintained through records and enforcement institutions; a platform relation through accounts, interfaces, ranking systems, and data; a professional relation through credentials and reputational networks. These mediating objects matter because they can change the relation without changing its nominal category. Digitization, automation, or legal reform can intensify monitoring, alter bargaining positions, reduce transaction costs, or enable new forms of exclusion within an apparently familiar relationship.

Relation formation and relation removal are themselves economically consequential events. Access to a mentor, lender, market, transport system, care network, professional community, or knowledge infrastructure can transform later opportunity. Loss of a relation can destroy capability even when material possessions remain unchanged. GRE therefore studies relational portfolios and configurations alongside stocks of individually held resources.

This category supplies the most direct bridge between the programme's relational commitment and ordinary economic inquiry. GRE does not require every explanation to be relation-first. It requires the analyst to make relation-dependent mechanisms visible where they materially alter economic outcomes, value trajectories, subject positions, or future generative conditions.

3.4.4 Resources and Capacities

Resources and capacities are distinct objects because possession or access does not by itself determine what an economic subject can do. A resource is something that can be mobilized, accessed, consumed, transferred, invested, preserved, or combined within an economic process. A capacity concerns an ability or practical possibility to act, produce, learn, adapt, participate, maintain, transform, or generate further pos-

sibilities. The relation between the two is mediated by context, institutions, skills, relations, infrastructure, bodily conditions, ecological conditions, and other conversion factors.

Resources can be material, financial, informational, institutional, social, technical, ecological, or symbolic. Land, equipment, money, time, data, legal rights, public infrastructure, credentials, reputation, access to a network, and environmental quality can each function as resources under appropriate conditions. Their resource character is relational because usefulness depends on what a subject can access and convert within a particular configuration. A database inaccessible to a community, a credential unrecognized by employers, or capital without complementary infrastructure can have limited practical value despite nominal possession.

Capacities likewise occur at several levels. Individuals can possess capacities for work, learning, judgment, mobility, communication, care, and political participation. Organizations can possess capacities for production, coordination, innovation, maintenance, adaptation, compliance, or collective learning. Communities can possess capacities for mutual support, governance, cultural reproduction, ecological stewardship, and collective action. Infrastructures can support capacities by making transport, communication, payment, identification, or knowledge access possible across many subjects.

GRE gives special attention to *generative capacity*: the ability of a configuration to produce or support further economically consequential possibilities. Education can generate later learning capacity; institutional trust can reduce coordination costs and enable cooperation; a research infrastructure can generate future knowledge; public health can preserve productive and participatory capacity; ecological regeneration can sustain future material possibility. Generative capacity is therefore temporally extended and often distributed across relations rather than located wholly inside a single actor.

The distinction between resource and capacity also clarifies why equal allocation can produce unequal outcomes. Subjects receiving identical monetary transfers can face different housing markets, care obligations, health conditions, legal statuses, network access, or local infrastructure. The same nominal resource can therefore generate different effective possibilities. Conversely, subjects with different resource bundles can sometimes realize comparable capabilities through different conversion arrangements. GRE is interested in the relational conditions that mediate these transformations.

Resources and capacities can also be depleted, captured, transferred, or rendered obsolete. Skill can lose market value after technological change; social capital can erode through displacement; ecological capacity can be exhausted; institutional capacity can decay through underinvestment; a public infrastructure can become inaccessible through privatization or pricing. These processes matter even when short-run output or consumption remains stable because they alter the future space of action.

Collective and relational capacities deserve separate attention. Some capacities exist only through coordination among several subjects. A payment system, scientific community, emergency-response network, common resource regime, or democratic

institution cannot be reduced to the sum of individual skills. Their capability depends on maintained relations, standards, trust, interoperability, authority, and shared infrastructures. Disruption of those relations can destroy a collective capacity while leaving individual resources physically intact.

GRE therefore treats resources and capacities as related but non-equivalent economic objects. Resource analysis asks what is available and under whose control. Capacity analysis asks what actions or transformations become practically possible. Generative analysis adds a further temporal question: how does the use, distribution, or transformation of present resources and capacities alter the production of later capacities?

3.4.5 Value and Forms of Value

Value is an object of GRE inquiry whenever economic relations create, recognize, transform, circulate, convert, preserve, capture, dissipate, or contest something treated as valuable. The category includes monetary price while extending beyond price to forms of value whose realization depends on use, relation, recognition, institutional standing, ecological condition, cultural meaning, capability, or future generativity. GRE therefore studies both valued objects and the processes through which value becomes intelligible, actionable, and convertible.

Forms of value should remain differentiated. Market value can be expressed through exchange prices under specified institutional conditions. Use value concerns usefulness relative to purposes and users. Social and relational value can depend on participation, belonging, trust, recognition, reciprocity, or the quality of continuing relations. Cultural and symbolic value can depend on meaning, status, heritage, identity, or collective recognition. Ecological value can concern the maintenance of living systems and material conditions that support present and future activity. Generative value concerns the production or return of capacities, resources, relations, knowledge, infrastructures, or other conditions that enable further generation.

These forms can interact without becoming automatically commensurable. A forest can carry market value as timber, ecological value as habitat and water regulation, cultural value for a community, and generative value through the capacities it sustains over time. A university can generate wages and patents while also producing credentials, knowledge, networks, civic capacity, and symbolic standing. A care relation can involve paid labor, emotional significance, capability maintenance, and institutional responsibility. GRE's task is to track these dimensions with enough separation to avoid converting plurality into a single metric before the research question justifies such conversion.

Valuation is therefore as important as value. Institutions, markets, professional communities, households, algorithms, legal systems, and cultural practices establish procedures through which some properties become visible and comparable. Accounting standards recognize certain assets and liabilities; credit systems assign risk categories; rankings convert heterogeneous characteristics into ordered representations; markets translate bids and offers into prices; communities maintain values that remain outside formal exchange. These valuation processes can affect the objects being

valued by changing access, incentives, recognition, or behavior.

Value conversion creates a particularly important object of inquiry. Economic processes frequently transform one form of value into another: knowledge into income, reputation into access, public infrastructure into private profit, ecological resources into commodities, care into labor-market participation, or symbolic recognition into political and economic influence. Conversion interfaces distribute power because actors differ in their ability to authorize, measure, appropriate, or resist conversion. The same relation can generate value for several parties while allowing only some of that value to be captured or monetized.

Value can also propagate beyond the initial transaction. Education provided to one person can contribute to household well-being, organizational capability, future teaching, or community knowledge. A technological standard can create value for complementary producers. A public transport investment can alter labor-market access and land values. These effects need not be reducible to externalities in a narrow sense; GRE can examine the pathways through which value becomes distributed across relational configurations and time.

Normative value requires additional care. Something can be economically valued without being normatively desirable, and a normatively important condition can remain weakly priced or administratively invisible. Profitability, efficiency, social importance, justice, and generativity are separate evaluative dimensions. Later normative sections of the programme can specify how such dimensions are assessed. At the object level, GRE preserves their distinction so that descriptive value processes do not silently determine normative conclusions.

Value thus enters GRE as a heterogeneous and dynamic object. The central questions concern which form of value is at issue, who recognizes it, through which relations it is produced or realized, how it moves or converts, who can capture it, what is lost in conversion, and how present valuations alter future generative conditions.

3.4.6 Conditions and Constraints

Economic action unfolds within conditions that shape which transitions are feasible, costly, legitimate, intelligible, or sustainable. GRE treats these conditions as objects when their distribution or transformation materially affects economic possibility. A *constraint* is a condition that restricts, redirects, or differentially prices possible action; an enabling condition expands or stabilizes practical possibility. The same configuration can perform both roles for different subjects, actions, or timescales.

Conditions can be material, ecological, institutional, legal, technical, social, epistemic, temporal, or spatial. Transport infrastructure affects geographic access; legal status conditions eligibility and enforceability; technical standards condition interoperability; language affects participation in institutions and markets; ecological limits shape production possibilities; time scarcity constrains care and learning; data access conditions computational capability; public safety affects mobility and investment. These conditions often operate before any explicit transaction occurs.

Constraints vary in strength. Some prohibit action through law or physical impossibility. Others increase cost, uncertainty, delay, or risk. Still others operate probabilis-

tically by making some pathways easier to reproduce than others. A weak broadband connection, lack of childcare, inaccessible documentation, reputational stigma, or absence of collateral may not formally prohibit participation, yet each can substantially reduce practical access. GRE therefore studies the topology of feasible action rather than equating freedom with formal permission alone.

Constraints can also be relationally generated. Bargaining dependence can restrict exit; debt can condition future income allocation; platform design can constrain visibility; organizational hierarchy can restrict decision rights; social obligations can direct resource use; network position can limit access to information or opportunities. These constraints arise through relations and can persist even where no single actor consciously designs them.

Enabling conditions deserve equal analytical standing. Public infrastructure, trust, open standards, education, legal protection, care systems, stable ecological conditions, and interoperable institutions can make action possible across broad populations. Their economic contribution may be difficult to assign to individual transactions because they operate as background capacities. GRE can bring such enabling structures into view by asking which later activities depend on their continued reproduction.

Conditions can become endogenous to the processes they condition. Industrial activity can degrade ecological conditions; investment can improve infrastructure; repeated discrimination can reshape expectations and network access; successful coordination can build trust; institutional reform can alter transaction costs and enforcement. A condition that is treated as fixed in one local model can therefore become an outcome in a wider temporal or system boundary.

This category is especially important for intervention analysis. Policies frequently act by changing conditions rather than directly producing final outcomes. A guarantee changes perceived risk; a public option changes outside alternatives; a legal recognition changes standing; a subsidy changes relative cost; an information system changes observability. GRE can study these interventions by tracing how modified conditions alter relations, capacities, subject positions, and later trajectories.

Conditions and constraints thus provide the connective tissue between current configuration and future possibility. Treating them as first-class objects allows GRE to examine why identical resources or formal rights can generate different practical outcomes across subjects and contexts.

3.4.7 Fields and Distributed Structures

Some economic conditions are best represented as distributed structures rather than as possessions or pairwise relations. GRE uses the term *field* cautiously for configurations in which opportunities, pressures, meanings, incentives, risks, or capacities vary across a domain and affect actors partly through their position within that distribution. The field concept is an analytical resource rather than a commitment that social reality literally instantiates a physical field.

A distributed structure can be spatial. Land prices, transport access, pollution exposure, labor demand, public services, broadband quality, and ecological condi-

tions vary across geographic space. It can also be institutional or social. Prestige, professional opportunity, credit access, political influence, or informational visibility can vary across positions in a social or organizational configuration. Digital environments add further domains in which ranking, recommendation, search visibility, platform rules, and data access are unevenly distributed.

Field-like representation is useful when the relevant condition cannot be assigned cleanly to a single actor or relation. A local labor market exerts pressures that emerge from many employers, workers, institutions, transport networks, regulations, and expectations. A scientific field distributes prestige and attention through journals, institutions, funding systems, peer networks, and disciplinary categories. A financial environment shapes borrowing conditions through monetary policy, risk assessment, regulation, liquidity, and market expectations. No isolated tie carries the entire condition.

GRE can therefore study how distributed structures affect the formation and transformation of local relations. A person entering a region with abundant public transport and dense employment opportunities faces a different opportunity structure from an otherwise similar person in a poorly connected region. A small firm operating within an interoperable technical ecosystem faces different generative possibilities from one locked into a proprietary infrastructure. A researcher positioned in a highly visible institutional environment encounters different pathways for recognition and collaboration.

Fields can also be produced by accumulated local actions. Residential sorting can generate spatial concentrations; repeated investment can create technological clusters; platform participation can generate data advantages; institutional prestige can become self-reinforcing through hiring, funding, and citation. The distributed condition then feeds back into later local decisions. GRE is especially interested in these recursive situations because a field generated by past relations becomes a condition for future relation formation.

Boundaries of a field require explicit justification. The relevant domain may be a neighborhood, labor market, profession, platform ecosystem, jurisdiction, linguistic community, supply network, or ecological region. Different boundaries can reveal different gradients and dependencies. The researcher should therefore state what is distributed, across which domain, how position is measured, and which mechanism links the distributed structure to observed outcomes.

Field representations also help avoid attributing every effect to intentional action by identifiable actors. Unequal opportunity can arise through distributed historical structures even when no single current actor controls the whole configuration. At the same time, distributed structure does not imply absence of power. Some actors may possess disproportionate capacity to shape the field through infrastructure ownership, rule setting, investment, standardization, or control of classification systems.

Fields and distributed structures therefore enter GRE as meso- and macro-level objects that connect local relations with wider conditions. They prepare the transition to the next section's analysis of levels and scales by showing that the same economic process can be experienced locally while depending on structures distributed across a much larger domain.

3.4.8 Processes, Events, and Trajectories

GRE requires temporal objects because generation is inherently concerned with how present configurations produce later conditions. Processes, events, and trajectories provide three complementary ways of organizing temporal analysis. A process is an extended pattern of transformation or reproduction; an event is a temporally localized occurrence that changes or reveals a configuration; a trajectory is an ordered history through a sequence of states, positions, relations, or regimes.

Processes can include accumulation, learning, institutionalization, technological diffusion, ecological degradation, care, maintenance, financialization, organizational growth, migration, professionalization, or the reproduction of inequality. Their identity depends on a pattern that persists through time even though the participating entities and local actions can change. Process analysis asks which mechanisms sustain the pattern, what inputs and relations it requires, and under which conditions its direction or intensity changes.

Events are analytically useful when temporally concentrated occurrences reorganize later possibilities. A bankruptcy, legal judgment, policy reform, infrastructure failure, technological release, merger, protest, disaster, discovery, or institutional recognition can redirect relations and expectations. The significance of an event is relational to its surrounding history. The same formal event can have different effects depending on preparedness, institutional capacity, network structure, or prior accumulation.

Trajectories preserve ordered history. Two subjects can arrive at similar present outcomes through different paths that leave different capacities, obligations, networks, expectations, or vulnerabilities. Equal current income can follow stable professional advancement, volatile gig work, inherited wealth, debt-financed education, or recent displacement. A cross-sectional measure can therefore conceal generatively important histories. GRE uses trajectory analysis to ask how sequences of relations and events shape present and future possibility.

Path dependence can arise through several mechanisms. Earlier choices can create switching costs, complementary investments, habits, classifications, reputational effects, or network structures that condition later choices. Institutional arrangements can make some transitions progressively easier and others harder. Learning can create cumulative capability. Trauma or depletion can reduce future adaptability. These mechanisms differ, so trajectory dependence should be specified rather than invoked as a generic explanation.

Temporal objects also allow GRE to distinguish maintenance from change. A stable institution or capacity may require continuous process. Public infrastructure must be repaired; professional competence maintained; ecosystems regenerated; trust reproduced; data updated; organizations staffed. A snapshot can therefore make a dynamically maintained condition appear static. Process analysis reveals the labor, resources, relations, and constraints required for persistence.

The timescale of a trajectory matters. A policy can improve short-run consumption while weakening long-run fiscal capacity; a technology can raise output while generating ecological or skill dependencies; a cost-cutting strategy can increase current profit while degrading organizational knowledge. GRE consequently studies tra-

jectories across timescales rather than treating the immediate effect as a sufficient description of economic consequence.

Processes, events, and trajectories can themselves interact. An event can initiate a process; a process can accumulate conditions that make an event consequential; a trajectory can cross a threshold that changes the process governing subsequent evolution. These temporal objects therefore provide the language needed to connect current intervention with future generative structure.

3.4.9 Institutions and Social Facts

Institutions and social facts are objects of GRE because economic possibilities are stabilized through rules, roles, classifications, expectations, conventions, recognized statuses, and recurring practices that exceed isolated transactions. Institutions organize who may act, under what authority, through which procedures, with which forms of recognition, and under which expectations of continuity. Social facts include collectively sustained realities whose economic consequences depend on shared recognition, repeated practice, or institutional support.

An institution should be distinguished from an organization. An organization is a relatively bounded collective entity; an institution is a stabilized pattern of rules, roles, norms, or practices that can operate across many organizations. A university is an organization, while credentialing practices, academic tenure, disciplinary review, or degree recognition are institutional arrangements. A bank is an organization, while money, deposit insurance, accounting standards, or secured lending involve wider institutions. The distinction matters because organizational change can occur within persistent institutions, and institutional change can reorganize many organizations simultaneously.

Institutions stabilize expectations. Contract law affects the expected consequences of agreement; property regimes organize control and transfer; professional licensing structures entry; welfare systems define eligibility; labor law configures employment relations; standards coordinate interoperability. This stabilization can reduce uncertainty and make complex cooperation possible. It can also preserve historically produced asymmetries by assigning differential rights, burdens, recognition, or access.

Social facts can become economically real through collective recognition and practical enforcement. Currency, credentials, corporate status, property claims, rankings, occupational categories, and reputations depend partly on recognition while producing material consequences. Their socially constituted character does not weaken their reality. A person denied a credential, account, license, or legal status can face direct material exclusion even though the relevant object exists through institutional and representational practices.

GRE is interested in how institutions are generated and reproduced. Repetition can stabilize conventions; law can formalize existing practices; administrative categories can create new subject positions; technical infrastructures can embed rules into routine action; organizations can reproduce institutions through hiring, reporting, and compliance. Institutional persistence therefore requires material, symbolic, and relational supports that can themselves become objects of economic analysis.

Institutions also transform the value and meaning of other objects. A dwelling becomes mortgageable property under specific legal and financial institutions. Data become tradable or restricted through regulatory and contractual regimes. A skill becomes economically valuable when recognized by employers or credentialing systems. A relationship becomes taxable, insurable, or legally protected when institutional categories recognize it. Institutions thus participate in converting material and social differences into economically actionable distinctions.

Institutional change can produce generative effects that extend far beyond the immediate rule modification. A new legal status can enable contracting, borrowing, inheritance, representation, or access to public support. A new technical standard can create markets for complementary products. A revised accounting rule can alter investment behavior. Because institutions condition many later relations simultaneously, their generative reach can be large even when the initiating intervention appears administrative.

The institutional object category therefore links GRE's analysis of stable social reality with its interest in historical transformation. Institutions provide continuity while remaining generated, maintained, contested, and revisable. Their durability makes them analytically powerful; their historical production prevents their present form from being treated as timeless.

3.4.10 Symbolic and Representational Objects

Economic life increasingly depends on symbolic and representational objects: prices, money, accounts, contracts, rankings, scores, categories, models, forecasts, identities, records, credentials, tokens, indices, dashboards, and algorithmic classifications. GRE treats such objects as economically consequential when representations mediate access, coordinate action, allocate attention, stabilize expectations, or alter the behavior of the subjects represented.

A representation should be distinguished from its referent. A credit score is not identical to a borrower's full financial condition; a ranking is not identical to institutional quality; a market price is not identical to every form of value; a model is not identical to the system modeled. The distinction matters because economic action often responds to the representation. A lender can deny credit because of a score, investors can respond to a rating, students can choose universities through rankings, managers can reorganize work around performance indicators, and public agencies can allocate resources through administrative categories.

Representations can therefore become performative or generative. Once a category is used for allocation, subjects may adapt behavior to satisfy it. Once a metric determines funding, organizations may reorganize activity around the metric. Once a risk model affects pricing, the resulting prices can alter the behavior on which future risk estimates are based. Representation enters the causal structure because institutions and actors use it to make decisions.

Symbolic objects also permit coordination across distance and scale. Money represents transferable claims; contracts encode obligations; accounting records organize complex organizations; technical standards encode compatibility; credentials communicate institutional recognition; databases preserve histories that can be acted

upon by subjects who never directly observed the original events. These symbolic infrastructures expand economic coordination while creating dependencies on classification, record integrity, interpretability, and institutional trust.

The production of representations is therefore itself an economic process. Data must be collected, categories designed, models trained, records maintained, standards negotiated, and interpretations authorized. These activities require labor, infrastructure, expertise, and institutional power. Actors controlling representation systems can shape which differences become visible and which forms of value become actionable. In data-intensive economies, control over classificatory and representational infrastructure can become a major source of economic power.

Representations also have error structures. Measurement can be noisy; categories can be incomplete; models can be misspecified; historical records can be biased; proxies can drift as behavior changes. A representation can remain administratively stable while becoming less adequate to the underlying configuration. GRE therefore treats representational validity as historically revisable. The question is not only whether a representation was accurate when introduced, but whether the relations between indicator, referent, and institutional use remain sufficiently stable for current decisions.

Symbolic objects can move across contexts and acquire new effects. A credential issued for educational recognition can become a labor-market filter. A social-media metric can become an advertising asset. A legal category can become a database field used in automated decision systems. A scientific indicator can become a policy target. Such movements can alter the meaning of the representation and the incentives surrounding it.

GRE's interest in symbolic and representational objects is consequently broader than a study of information. It concerns the economic relations through which representations are created, authorized, circulated, interpreted, converted into decisions, and recursively connected to the realities they describe. The distinction between relation and representation remains central: a representation can reveal a relation, simplify it, distort it, or participate in generating a new one.

The ten object classes developed in this section provide GRE with a plural repertoire for empirical and theoretical inquiry. Emergent entities supply relatively stable units; subjects and subject positions identify locations of participation, standing, experience, and exposure; relations and relational configurations make interdependence explicit; resources and capacities distinguish what is available from what can practically be done; forms of value identify heterogeneous objects of production, recognition, conversion, and evaluation; conditions and constraints organize feasible possibility; fields capture distributed structures; processes, events, and trajectories preserve temporal organization; institutions and social facts explain stabilized collective realities; and symbolic or representational objects make visible the classificatory infrastructures through which economic action is coordinated.

These categories should remain permeable. A corporation can simultaneously be an entity, a juridical subject, an institutional configuration, a bundle of capacities, a node in relational fields, and a trajectory. Money can be a resource, an institutionally stabilized social fact, a symbolic object, and a medium through which value is repre-

sented and converted. A platform can be an organization, technical infrastructure, field, relation-generating environment, classificatory system, and economic subject under different legal arrangements. GRE gains explanatory power from selecting the representation that preserves the distinctions relevant to the local question, while comparing alternative representations when conclusions depend on that choice.

Object selection is therefore inseparable from scale. An object stable at one level can decompose into heterogeneous relations at another; a relation local to one scale can appear as a distributed field at another; an event for one subject can be part of a long institutional process at a wider temporal resolution. The next section turns explicitly to these levels and scales of inquiry, establishing how GRE can move among individual, organizational, collective, institutional, ecological, and transnational domains without assuming that the same objects retain identical boundaries across them.

3.5 Levels and Scales of GRE Inquiry

The objects identified in the preceding section become analytically meaningful only relative to a level and scale of inquiry. A household can be treated as an economic subject in one analysis, as a field of interpersonal relations in another, as a node in a credit or welfare network in a third, and as part of a larger demographic, ecological, or transnational configuration in a fourth. Generative Relational Economics therefore requires an explicit account of scale selection. The role of this section is to specify the principal levels at which GRE inquiry can be organized and to clarify how movement among levels affects what counts as an entity, relation, condition, mechanism, and consequence. Its objective is neither to impose a fixed micro–meso–macro hierarchy nor to deny the usefulness of scalar distinctions. It is to make scale an explicit analytical choice whose adequacy depends on the research question, the generative mechanism under study, and the evidential resolution available to the researcher.

Scale in GRE has several dimensions. A *spatial scale* concerns the geographic or material extent of a configuration. A *temporal scale* concerns the duration over which formation, persistence, transformation, or consequence is observed. An *organizational scale* concerns the level at which coordinated action is stabilized, from interpersonal relations to firms, states, transnational institutions, or distributed infrastructures. A *juridical scale* concerns the reach of rights, duties, jurisdictions, and recognized authority. An *ecological scale* concerns the material and living systems within which economic activity is embedded. An *analytical scale* concerns the resolution at which a researcher constructs objects and causal or generative claims. These dimensions can align, but they often diverge.

The distinction between *level* and *scale* is useful even when their boundaries remain context-dependent. A level identifies a position within a layered description, such as person, organization, institution, or transnational system. Scale identifies the extent or resolution of the phenomenon being observed. An organizational process can have a local spatial scale but a long temporal scale; an interpersonal relation can be embedded in a global platform infrastructure; a juridical rule can operate nationally while being produced through transnational negotiation. GRE therefore

treats levels as analytical locations within an inquiry and scales as dimensions of extent, duration, or resolution. Neither should be assumed to map onto a single natural hierarchy.

This section proceeds across six recurrent domains of analysis—individual and interpersonal, organizational, community and collective, institutional and juridical, ecological and more-than-human, and inter-system and transnational—before turning to two cross-cutting issues: scale-relative entityhood and cross-scale generative effects. The method is constitutive rather than classificatory in a rigid sense. The purpose is to define a usable architecture for GRE research while preserving the possibility that empirical cases require different or additional levels.

3.5.1 Individual and Interpersonal Scales

Individual and interpersonal scales concern persons, households, dyads, small groups, and recurrent relations whose immediate organization is accessible at the level of situated interaction. At this scale, GRE can study how economic capacities, constraints, expectations, obligations, identities, and values are generated through relations among concrete subjects. The focus is wider than individual choice in isolation. Choice remains important, but the inquiry asks how the conditions under which choices become available, intelligible, affordable, legitimate, or sustainable are relationally formed.

An individual can be analyzed as an economic subject with resources, preferences, capabilities, legal standing, knowledge, vulnerabilities, and temporal commitments. Yet these attributes frequently depend on relations that exceed the individual. Income can depend on employment relations; credit access can depend on institutional classification and social history; capability can depend on care, education, infrastructure, or recognition; preference formation can depend on social learning and available categories of action. GRE therefore treats individual-level observations as legitimate without treating the individual as analytically self-sufficient.

Interpersonal relations can themselves generate economic effects. Trust can reduce monitoring costs and make cooperation feasible. Care can maintain or expand another person's practical capacities. Advice can alter information, confidence, or opportunity. Repeated exchange can create expectations of reciprocity. Family relations can redistribute resources across time and persons. Friendship and professional ties can provide access to information, employment, finance, or institutional navigation. These effects can be valuable without being fully priced, and they can generate dependency or unequal obligation as well as support.

Households illustrate the importance of distinguishing the administrative recipient from the relational field. A transfer formally delivered to one household member can alter bargaining power, care allocation, educational investment, consumption, savings, mobility, or future exit options for several people. A wage increase can change household time allocation and dependency patterns. Debt undertaken by one member can constrain future resources of others. The relevant unit therefore depends on the mechanism being studied rather than on the administrative unit through which a programme or transaction is recorded.

Temporal scale is especially important at the interpersonal level. Some effects are

immediate, such as payment, consumption, or access. Others accumulate through repeated interaction. Trust, skill, reputation, dependency, and caregiving capacity are often generated through histories rather than single encounters. A relation that appears beneficial over one month can create vulnerability over several years; a costly educational investment can generate capabilities whose effects become visible much later. GRE inquiry should therefore specify the time horizon over which an interpersonal relation is being evaluated.

The individual and interpersonal scale also reveals the difference between formal equality and relational position. Two persons may hold the same legal right while facing different exit costs, knowledge, network access, or dependence. Equal monetary transfers can have different generative effects because subjects occupy different relational configurations. This does not imply that every analysis must reconstruct the full social history of each person. It means that the scale of analysis should be broad enough to capture the relations necessary for the specific generative claim.

At this level, evidence can include interviews, ethnography, surveys, administrative records, experiments, transaction histories, diaries, social-network data, or mixed-method designs. The appropriate evidence depends on whether the claim concerns subjective meaning, observed behavior, resource flow, causal effect, relational structure, or long-horizon change. Individual-scale data do not automatically support interpersonal or institutional claims, just as aggregate data can conceal mechanisms operating through concrete relations.

The individual and interpersonal scale is therefore a legitimate entry point rather than a privileged foundation. GRE can begin with persons and direct relations when that resolution is adequate, while remaining prepared to enlarge the analytical boundary when the observed capacities, constraints, or trajectories depend on organizational, institutional, ecological, or transnational structures.

3.5.2 Organizational Scales

Organizational scales concern coordinated configurations that stabilize roles, procedures, decision rights, resource pools, routines, information flows, and boundaries of participation. Firms, public agencies, universities, hospitals, cooperatives, nongovernmental organizations, platforms, laboratories, and project teams can all become objects at this scale. The relevant question is not simply whether an organization exists as a legally recognized entity. GRE asks how organizational arrangements generate capacities and constraints for participants and how those arrangements reproduce or transform their own conditions of operation.

Organizations can pool resources that individuals cannot mobilize alone. They can create specialized roles, accumulate knowledge, establish infrastructure, coordinate long production processes, and distribute risk. They can also concentrate decision authority, create informational asymmetries, and determine access to opportunities. An organization therefore appears simultaneously as an emergent entity and as a relational architecture through which people, technologies, rules, and resources become coordinated.

Organizational boundaries are analytically important because many contemporary production processes extend beyond formal employment or ownership. A plat-

form can rely on independent contractors, users, complementors, cloud providers, advertisers, moderators, data-labeling workers, and public infrastructure. A manufacturing firm can depend on suppliers distributed across jurisdictions. A university can rely on temporary researchers, publishers, funders, accreditation systems, and digital services. The legal boundary of the organization is one relevant boundary, but it may not coincide with the generative boundary of the economic process.

GRE can therefore distinguish between organizational membership and organizational dependence. A person may depend economically on an organization without being an employee. A community may bear environmental or infrastructural consequences of organizational activity without participating in governance. A supplier may become technologically locked into a dominant buyer. A public institution may depend on proprietary software whose provider sits outside its formal hierarchy. These relations affect the organization's generative reach and the distribution of benefits, risks, and future options.

Organizational scale also makes internal heterogeneity visible. Departments, teams, occupational groups, and technical systems can operate under different incentives and temporalities. A firm can appear coherent at the market level while containing conflicts over investment, labor conditions, safety, innovation, and accounting. An organization can therefore be treated as a unit for one research question and decomposed into internal relational configurations for another. The adequacy of aggregation depends on which mechanisms matter to the inquiry.

Organizational learning is one important generative process. Routines, archives, training systems, informal norms, and technological infrastructures can preserve knowledge beyond individual tenure. Conversely, turnover, outsourcing, or fragmentation can dissipate capabilities even when short-term financial indicators improve. Investment in organizational capacity can therefore generate future possibilities that are not visible in current output, while extraction from organizational knowledge or trust can reduce later adaptability.

Governance within organizations is similarly generative. Decision procedures determine whose information enters deliberation, which risks become visible, how conflict is resolved, and who can revise rules. Participation can create knowledge and legitimacy; concentrated authority can accelerate decisions in some contexts while suppressing local information in others. GRE does not presume one organizational form to be normatively superior across cases. It studies how specific governance architectures shape the production, distribution, and transformation of future capacities.

Organizational scale thus mediates between interpersonal relations and wider institutional structures. Organizations translate law, markets, technologies, and cultural expectations into local procedures, while their actions can reshape sectors, communities, standards, and political economies. Their analysis requires attention both inward to internal relational architecture and outward to the fields in which they operate.

3.5.3 Community and Collective Scales

Community and collective scales concern forms of coordination and shared dependence that do not necessarily coincide with formal organizational boundaries. Neighborhoods, professional communities, scientific fields, cultural groups, commons, mutual-aid networks, open-source communities, social movements, informal markets, and distributed publics can exhibit patterns of collective action without constituting a single organization. GRE includes these formations because economically consequential capacities can emerge through repeated participation, shared norms, common infrastructures, and distributed recognition.

A community can generate resources that are difficult to assign to individual producers. Shared knowledge, reputation systems, linguistic conventions, safety expectations, informal credit, professional standards, and norms of reciprocity can enable action across many participants. Their value often depends on continued collective reproduction. If participation declines, trust erodes, common infrastructure deteriorates, or knowledge ceases to circulate, the resource itself can weaken even when no discrete asset has been destroyed.

Collective scale also matters for the formation of economic subjects. Membership in a professional, cultural, or local community can provide categories through which people understand opportunities and obligations. Collective narratives can shape expectations about work, entrepreneurship, education, debt, care, or acceptable risk. These processes need not imply homogeneous values. Communities can contain disagreement, hierarchy, exclusion, and multiple overlapping memberships. GRE therefore treats collective identity as an empirical configuration rather than an assumption of unity.

Commons provide a particularly useful illustration. A resource can be collectively used and governed through rules that define access, contribution, monitoring, sanction, and adaptation. The relevant economic object is then neither only the resource nor only the individual user. It includes the relation among resource conditions, user practices, governance arrangements, and external pressures. Changes in any of these can alter the viability of the collective system.

Digital communities extend these issues beyond geographic proximity. Open-source projects, online knowledge communities, creator networks, and platform-mediated groups can generate software, information, cultural value, reputation, and social support through dispersed participation. Their infrastructures can nevertheless remain privately owned or technically centralized. A community can therefore be distributed at the level of participation while depending on concentrated control at the infrastructural level. This asymmetry becomes visible only when multiple scales are analyzed together.

Collective action can also produce public or quasi-public capacities. Community organizing may improve bargaining power; professional associations may establish standards; neighborhood networks may coordinate disaster response; scientific communities may produce shared methods and repositories. These capacities can benefit participants unevenly and can create boundaries around membership or recognition. GRE can study both the generative contribution of collective organization and the distribution of access to what is collectively generated.

The temporal scale of communities often exceeds individual participation. Institutions of memory, ritual, documentation, mentorship, and repeated practice can transmit norms and capacities across cohorts. At the same time, a community can transform rapidly under migration, technological change, political conflict, or economic restructuring. Analyses that treat collective structure as fixed can miss the processes through which membership, meaning, and governance are continually reproduced.

Community and collective scales therefore provide a middle range in which distributed relations acquire partial stability without necessarily becoming formal organizations. They are especially important for GRE because generation frequently occurs through participation that is economically consequential yet only partially represented in contracts, prices, or administrative categories.

3.5.4 Institutional and Juridical Scales

Institutional and juridical scales concern relatively stabilized systems of rules, recognized roles, procedures, classifications, rights, duties, jurisdictions, and authorized decisions. At this scale, GRE studies how economic possibility is structured through the formal and informal arrangements that determine what can be owned, exchanged, licensed, enforced, recognized, taxed, subsidized, inherited, represented, or contested. Institutions are not merely background conditions. They actively generate categories of action and subject positions.

Law provides one especially explicit architecture of economic possibility. Corporate law makes certain collective entities legally actionable. Property law organizes claims over resources. Contract law structures enforceable commitments. Labor law defines employment relations and protections. Bankruptcy law redistributes consequences of failure. Immigration law can shape access to labor markets and public support. Intellectual-property law conditions the circulation and appropriation of knowledge. These arrangements alter incentives, but they also constitute the legal identities and relations through which economic action proceeds.

Juridical scale should not be reduced to national legislation. Municipal regulations, administrative agencies, courts, professional licensing bodies, treaty regimes, private arbitration systems, technical standards, and organizational rules can each exercise authority over different domains. Jurisdictions overlap, and actors can move or strategically position activity among them. GRE therefore asks which authority is operative for the relation under study and how jurisdictional boundaries affect the distribution of rights, risks, and generative opportunities.

Institutional categories can have constitutive effects. Eligibility rules determine who counts as a beneficiary. Accounting standards determine which assets and liabilities become visible. Educational credentials authorize access to professions. Credit classifications influence borrowing conditions. Statistical categories shape policy populations. Once institutionalized, such classifications can alter behavior and resource flows, thereby contributing to the reality they purport to describe.

Institutional scale also introduces temporal depth. Rules inherit prior conflicts and compromises; administrative routines accumulate; precedents stabilize expectations; legal categories outlive the conditions under which they were formed. Economic actors adapt to these structures, and repeated adaptation can create constituencies

that support their continuation. Institutional persistence can therefore be generated through feedback among rules, investments, expectations, and organized interests.

Change at this scale can be discontinuous. A legal recognition, regulatory decision, court judgment, or policy reform can rapidly transform the feasible set of actions for many actors. Yet implementation remains relational. Formal change can produce uneven effects when local administrative capacity, information, infrastructure, or social recognition differs. GRE consequently distinguishes institutional rule change from the distributed processes through which a rule becomes effective in practice.

Institutional and juridical scales also mediate normative questions. Rights, procedural protections, and public obligations can constrain economically efficient arrangements for reasons of justice, dignity, or political legitimacy. Conversely, legal authority can stabilize extractive or exclusionary relations. GRE does not infer normative validity from institutional existence. It treats institutions as economically generative structures whose consequences and justification require separate evaluation.

This scale is indispensable whenever the relevant causal or generative mechanism depends on recognized authority. A transaction between two persons may appear interpersonal, yet its enforceability, tax treatment, property consequences, and admissible terms can be institutionally constituted. The juridical environment therefore enters GRE inquiry whenever it materially changes what relations can exist and what they can generate.

3.5.5 Ecological and More-than-Human Scales

Ecological and more-than-human scales concern the living, material, energetic, climatic, and technological systems through which economic activity becomes possible and consequential. GRE includes these scales because economic relations are embedded in conditions that are neither produced solely by human exchange nor adequately represented as passive inputs. Soil fertility, water systems, biodiversity, atmospheric conditions, energy infrastructures, animal populations, computational systems, and built environments can shape and be transformed by economic processes.

Ecological scale complicates conventional boundaries around the economic unit. A factory can be analyzed as an organization, but its production may depend on watersheds, energy grids, mineral extraction, transport corridors, and waste sinks distributed across large regions. Agricultural production can depend on pollination, soil microbiomes, climate patterns, seed systems, and water availability. The relevant generative configuration can therefore extend far beyond the spatial boundary of the producing organization.

Temporal scale becomes especially consequential here. Ecological regeneration, depletion, contamination, and climate effects can unfold over decades or generations. Short accounting periods can therefore classify an activity as productive while externalizing degradation of the conditions that make later production possible. GRE can address this mismatch by treating ecological conditions as part of the generative system rather than only as exogenous constraints encountered by economic actors.

More-than-human inquiry also raises questions about agency and subjecthood.

GRE need not resolve a general metaphysics of non-human agency in order to study how animals, ecosystems, technical systems, or artificial agents participate causally in economic configurations. A river can constrain settlement and transport; a disease vector can alter labor and health systems; an algorithm can allocate visibility or credit; an automated system can modify production decisions. The analytical status of these participants should be specified relative to the claim being made rather than predetermined by a universal hierarchy of subjects.

Technological systems illustrate the overlap between ecological and organizational scales. Energy networks, communication infrastructures, logistics systems, and machine-learning platforms have material footprints, operational dependencies, maintenance requirements, and failure modes. Their economic effects emerge through coupled human and technical relations. Treating technology as a neutral tool can obscure how technical architecture redistributes practical capacities and how its maintenance depends on resource extraction, labor, standards, and institutional support.

Ecological relations also generate value that can resist simple monetization. A wetland can support flood protection, habitat, cultural practice, recreation, and future ecological resilience. Assigning a price to one service can assist a particular decision while leaving other forms of value unrepresented. GRE therefore permits multiple valuation registers at ecological scales and requires transparency about which dimensions are included in a given economic representation.

More-than-human scales also expand the population affected by economic decisions. Future people, non-human organisms, and ecosystems can bear consequences without participating in present transactions. This creates a temporal and representational problem: current subjects make decisions under institutions that may weakly represent distant or non-speaking affected parties. GRE can study the mechanisms through which those absences become economically consequential without assuming that a single metric resolves the normative problem.

Ecological and more-than-human scales thus prevent the research boundary from stopping where conventional organizational or market boundaries stop. They make visible the material conditions, distributed dependencies, and long-duration transformations through which present economic generation can either sustain or erode future possibility.

3.5.6 Inter-System and Transnational Scales

Inter-system and transnational scales concern relations that cross organizational fields, institutional orders, jurisdictions, sectors, infrastructures, or national boundaries. Contemporary economic processes frequently operate through such crossings. Finance, migration, supply chains, digital platforms, scientific collaboration, humanitarian assistance, trade, energy systems, taxation, and data governance can connect actors governed by different rules and situated within different value structures. GRE therefore requires a scale at which interactions among systems become objects in their own right.

A transnational supply chain illustrates the problem. Production may involve design in one jurisdiction, components from several others, assembly elsewhere,

finance through global institutions, shipping through international logistics, and consumption in distant markets. Labor rights, environmental rules, currencies, tax regimes, and political risks differ across locations. The economic relation cannot be understood fully through the bilateral transaction between buyer and seller because value generation and vulnerability are distributed across the chain.

Inter-system analysis is broader than geographic internationalization. Health systems can interact with labor markets; education systems with migration regimes; financial systems with housing; scientific systems with intellectual-property institutions; humanitarian systems with border governance. Each system can maintain its own classifications, objectives, and evaluative criteria. Their coupling can create gaps, contradictions, or conversion points through which subjects gain or lose access.

Conversion across systems is therefore a central object. A qualification recognized in one jurisdiction may not convert into professional standing elsewhere. Financial capital can cross borders more easily than labor. Data can be generated in one legal environment and processed in another. Carbon emissions can be produced locally while their climatic effects are globally distributed. Humanitarian categories can determine access to assistance but interact imperfectly with immigration categories. GRE can study these interfaces as generative sites where differences among systems produce new capacities or constraints.

Transnational scale also changes the distribution of governance capacity. Some actors can choose jurisdiction, route investment, relocate data, restructure ownership, or negotiate directly with states. Others remain territorially or institutionally fixed. Mobility itself therefore becomes an economic capability. The ability to cross boundaries can alter bargaining power even when formal rules are equal within each jurisdiction.

Distributed infrastructures further complicate territorial analysis. Payment networks, cloud computing, communications, shipping, and digital identity systems can operate across many jurisdictions while being controlled by a limited number of organizations or standards bodies. Failure or policy change at one infrastructural node can propagate across distant systems. The relevant scale is then neither purely national nor simply global; it follows the architecture through which dependence and coordination are organized.

Transnational processes also operate across heterogeneous temporalities. Trade agreements, infrastructure investments, migration histories, debt contracts, and climate commitments can bind actors over long periods. Short-term political cycles may interact with long-term obligations. GRE can therefore examine how institutional time horizons become coupled and how present decisions distribute future adjustment costs across places and populations.

Inter-system and transnational scales are consequently necessary whenever the generative relation crosses the boundary of the system in which the initial action is recorded. They direct attention to interfaces, conversions, jurisdictional differences, infrastructural dependencies, and the unequal capacity to move among systems.

3.5.7 Scale-Relative Entityhood

The preceding scales reveal a central constitutional principle of GRE: entityhood is often scale-relative. A configuration that functions as a coherent entity at one analytical level can become a field of heterogeneous relations at another. A household can be a unit in a national survey and a contested relational configuration in an ethnographic study. A corporation can be a market actor in industrial analysis and a network of departments, contracts, algorithms, workers, and investors in organizational analysis. A state can be treated as an actor in international negotiation and decomposed into agencies, courts, political coalitions, infrastructures, and administrative practices in institutional analysis.

Scale-relative entityhood does not imply that entities are unreal. It specifies the conditions under which treating a configuration as an entity is analytically productive. Relative stability, boundary persistence, coordinated action, recognized identity, and causal integration can justify entity-level analysis. The same configuration can nevertheless be decomposed when internal structure becomes relevant to the question. Ontological suspension therefore supports practical realism: the analyst can work with entities while remaining open to changing the level of resolution.

Aggregation is one mechanism through which entities appear. Individual transactions can produce market-level regularities; organizational decisions can produce sectoral patterns; local ecological changes can accumulate into regional effects. Yet aggregation alone does not guarantee that the higher-level object has independent explanatory value. GRE asks whether higher-level patterns feed back into lower-level behavior, constrain possible transitions, or stabilize classifications and expectations. When they do, the higher-level configuration can become causally or generatively relevant in its own right.

Decomposition likewise requires care. Explaining an organization through individuals alone can omit rules, infrastructures, and emergent coordination. Explaining a legal order through statutes alone can omit administrative practice and social recognition. Explaining a market through transactions alone can omit standards, network effects, and institutional conditions. Reduction to a finer scale can therefore lose structure just as aggregation can conceal heterogeneity.

The choice of scale also affects attribution. If a worker acquires a skill, the generative contribution may involve individual effort, teachers, organizational training, public education, family support, digital infrastructure, and prior scientific knowledge. Different scales reveal different contributors. GRE should therefore match attribution to the level of the claim and avoid converting a multi-scale generative process into a single-agent narrative without justification.

Scale-relative entityhood also matters for normative evaluation. Benefits and harms can reverse appearance across scales. A firm-level efficiency gain can impose community-level unemployment; a household-level coping strategy can reproduce gendered burdens; a national growth policy can create ecological costs elsewhere; a local conservation rule can restrict livelihoods while sustaining long-run regional resilience. Evaluation should therefore state the population, temporal horizon, and scale to which a conclusion applies.

Remark 3.1 (Scale-relative entityhood)*.* Treating a configuration as an entity is a mod-

eling and evidential commitment justified by the local inquiry. It does not require the same configuration to remain indivisible, homogeneous, or equally salient at other scales.

This principle gives GRE a disciplined way to move among levels without declaring one level ultimately fundamental. The research question determines the initial resolution, while empirical anomalies, mechanism evidence, or downstream effects can require expansion or decomposition of the analytical boundary.

3.5.8 Cross-Scale Generative Effects

Cross-scale generative effects occur when processes organized at one level alter capacities, constraints, structures, or possibilities at another. These effects are central to GRE because economic generation often propagates beyond the scale at which an intervention, transaction, or decision is initially observed. A scholarship allocated to one person can affect a household, professional network, organization, or future community. A local technological innovation can reshape industry standards. A national regulation can reorganize firm behavior and interpersonal opportunities. A transnational platform rule can alter the visibility and income of individual creators.

Cross-scale effects can move upward through accumulation, coordination, diffusion, or institutionalization. Repeated individual behavior can create market conventions. Local experiments can become organizational routines. Collective practices can become recognized standards. Distributed demand can support an industry. Social expectations can become politically salient and eventually codified. The relevant mechanism should be specified rather than assumed from the observation that lower-level and higher-level change occur together.

Effects can also move downward. Institutional classifications shape individual eligibility; organizational rules structure team behavior; market concentration alters bargaining conditions; national monetary policy changes borrowing costs; ecological degradation constrains household livelihoods. Higher-level patterns can therefore become conditions of lower-level action even when they originated historically from distributed processes.

Horizontal propagation across scales is equally important. A change in one sector can alter another through labor, finance, infrastructure, or regulation. A technological standard adopted by one industry can create complementary markets elsewhere. A health crisis can transform education, transport, employment, and care. These processes are not captured adequately by a single vertical hierarchy because the relevant systems can be partially autonomous yet strongly coupled.

Cross-scale generation can also involve delayed effects. Investment in early childhood can influence educational trajectories years later; infrastructure can shape settlement and productivity over decades; ecological damage can accumulate before crossing thresholds; institutional reforms can alter expectations gradually. A local analysis may therefore be accurate within its immediate horizon while incomplete for longer generative consequences.

Feedback among scales creates additional complexity. An organizational policy can alter worker behavior; aggregated behavior can change organizational perfor-

mance; performance can lead to a revised policy. A legal reform can change market practices; those practices can generate new political coalitions; the coalitions can reshape subsequent law. In such cases, scale is part of the mechanism because causal influence circulates among levels rather than traveling in one direction.

Cross-scale effects also create attribution difficulties. When value or harm propagates across several levels, assigning the outcome to the initial actor alone can overstate individual contribution, while attributing it only to structure can erase situated agency. GRE therefore treats generative attribution as potentially distributed. The relevant task is to identify the relations through which capacities or constraints were produced and the points at which different actors or structures materially altered the trajectory.

Measurement should reflect this distributed character. Data collected at one scale can miss effects at another. Firm-level productivity data may not reveal household care burdens; household income data may not reveal ecological depletion; national statistics may not capture transnational tax shifting; platform-level engagement metrics may not capture community-level cultural effects. Multi-level designs, linked data, comparative cases, qualitative tracing, and simulation can each contribute where appropriate, provided the relation between evidence and claim remains explicit.

Cross-scale analysis finally has a governance implication. Interventions aimed at one level can generate consequences elsewhere, so institutional responsibility may need to follow generative reach rather than administrative jurisdiction alone. This does not imply unlimited responsibility for every remote consequence. It creates a research question about which downstream effects are sufficiently connected, foreseeable, material, or governable to enter evaluation and design.

The architecture established in this section therefore gives GRE a way to specify where an inquiry begins, how far its analytical boundary extends, and when movement among scales becomes necessary. Individual, organizational, collective, institutional, ecological, and transnational levels are recurrent sites of inquiry rather than a closed hierarchy. Entityhood remains relative to analytical scale, and generative effects can propagate upward, downward, horizontally, and across time. With these levels clarified, the next task is to state the characteristic questions through which a GRE inquiry can interrogate a concrete economic situation.

3.6 Illustrative Questions in Generative Relational Economics

The preceding sections have specified the disciplinary identity, problem-space, methodological primitives, objects, and scales of Generative Relational Economics. Those elements define a field of possible inquiry, but they remain abstract until translated into questions that can organize empirical, historical, formal, interpretive, and normative research. The role of this section is therefore illustrative. It identifies recurrent question-forms that make the distinctive concerns of GRE operational without turning them into a mandatory sequence or a closed checklist. The objective is to show how a researcher can move from a conventional economic problem toward

a generative-relational formulation by asking what relations constitute the situation, what is generated through them, how value and capacity travel, where asymmetries are converted into power, and how present arrangements alter later conditions of possibility.

These questions are intentionally broader than particular methods. A question concerning value propagation might be studied through administrative data, interviews, network analysis, accounting records, historical archives, ethnography, simulation, or some combination of these. A question concerning subject formation may require interpretive evidence that differs from the evidence required to identify a resource flow. GRE therefore treats the question-form as analytically prior to method selection. Methods are chosen according to the object, scale, mechanism, and evidential problem rather than according to a presumption that one technique defines the field.

The questions are also non-exclusive. A single research project may begin with one and encounter several others. An analysis of a training subsidy may ask who formally receives the subsidy, which household or organizational relations mediate its use, what capacities are generated, how those capacities propagate through employment networks, which forms of value are realized or lost, and whether the programme changes the future bargaining position of workers. The value of the GRE perspective lies partly in making these connections available for investigation while preserving distinctions among them.

The twelve question families below should consequently be read as an open repertoire. They do not exhaust GRE inquiry, and they do not imply that every project must answer all twelve. Their function is to reveal characteristic directions of attention: constitution, displacement beyond the administrative recipient, generation, propagation, conversion, recirculation, capacity transformation, subject formation, power formation, orientation, foreclosure, and recursive transformation of the conditions of change.

3.6.1 Which Relations Constitute the Economic Situation?

A GRE inquiry can begin by asking which relations make the observed economic situation possible and intelligible. The question directs attention away from treating visible entities as analytically self-sufficient. A worker, firm, household, platform, loan, public service, or market transaction enters an already organized field of legal, infrastructural, contractual, social, technical, ecological, and symbolic relations. Some of these relations are proximate and observable; others operate as background conditions. The task is to identify which of them materially affect the phenomenon under investigation.

This question is selective rather than totalizing. GRE does not require reconstruction of every relation surrounding an object. The relevant relations are those whose inclusion changes explanation, evaluation, or intervention. A study of household energy insecurity, for example, may need to include income, housing quality, tenancy status, energy pricing, family composition, climate exposure, and access to public support. The entire history of the household is unnecessary unless some part of that history affects the mechanism under study. Relational analysis becomes useful when

it improves the adequacy of the inquiry rather than when it simply multiplies context.

The question also encourages distinctions among kinds of relation. A legal relation of entitlement differs from an interpersonal relation of trust; a supply relation differs from an ownership relation; a technical dependency differs from a political authorization; an ecological dependency differs from a contractual obligation. Several may intersect in one case without being reducible to one another. Mapping constitution therefore requires enough conceptual resolution to preserve the mechanism carried by each relation.

Relational constitution can also be asymmetric. One party may depend on another without reciprocal dependence of the same magnitude or kind. A small supplier can depend heavily on a dominant buyer whose dependence on that supplier is negligible. A migrant worker can depend on an employer for income, legal sponsorship, housing, or information. A municipality can depend on a private platform for an infrastructure it does not control. Asking which relations constitute the situation therefore prepares later analysis of bargaining position, exit, capture, and power.

The practical result is a boundary decision. Once the constitutive relations have been identified, the researcher can justify why some actors, institutions, infrastructures, temporal histories, or ecological conditions are inside the analytical frame and others remain outside it. The boundary remains revisable as evidence accumulates. GRE thus treats relational mapping as a disciplined way to construct the object of inquiry rather than as a demand for unlimited contextual description.

3.6.2 What Changes beyond the Administrative Recipient?

Economic programmes and transactions are frequently recorded through an administrative recipient: the person receiving a transfer, the firm receiving a subsidy, the borrower named on a loan, the patient receiving a service, or the organization holding a grant. GRE asks what changes beyond that formally designated unit. The question matters because economic effects often propagate through relations that administrative data do not treat as recipients.

A cash transfer received by one person may alter household consumption, bargaining power, care responsibilities, debt repayment, education, mobility, or support to relatives. A grant to a small firm can affect employees, suppliers, clients, landlords, local tax revenue, or competing firms. A scholarship can transform not only the student's education but household expectations, future remittances, professional networks, and the aspirations of younger family members. The administrative recipient remains an important object, but it does not automatically define the boundary of effect.

This question is not equivalent to measuring conventional spillovers alone. GRE is interested in the relational pathways through which effects move. Two programmes with similar average indirect effects can operate through different mechanisms. One may propagate through knowledge sharing, another through household redistribution, another through changes in bargaining position, and another through infrastructure created for the initial recipient. Identifying the pathway helps distinguish incidental correlation from generated consequence.

The question also exposes burdens that move beyond the recipient. A policy that expands employment for one group can transfer unpaid care to another group. Debt relief for a firm can preserve jobs while imposing losses on pension funds or public budgets. Digital convenience for consumers can shift risk and time costs onto gig workers. The analysis therefore follows both enabling and constraining consequences beyond the administrative unit.

A useful GRE design can make this boundary extension explicit at the outset. The researcher can specify the formal recipient, identify connected subjects and systems likely to be affected, determine which effects are theoretically relevant, and select evidence capable of observing those pathways. The resulting analysis does not reject administrative categories; it treats them as one layer within a wider relational field.

3.6.3 What Is Generated through an Economic Relation?

A central GRE question asks what an economic relation produces beyond its immediate exchange or recorded output. The relevant generated objects can include income, knowledge, capability, trust, dependency, reputation, infrastructure, organizational routine, institutional legitimacy, ecological burden, expectations, data, symbolic standing, or new relations. Generation concerns the production of later conditions and possibilities, not merely the transfer of an already existing object from one holder to another.

Consider employment. A wage relation transfers income in exchange for labor, but it can also generate skill, professional identity, social networks, credentials, routines, health effects, dependence, bargaining experience, or exclusion from alternative opportunities. Which of these effects matters depends on the research question. A GRE analysis does not assume that every employment relation generates the same bundle. It asks which outputs are produced in this case, through which mechanisms, for whom, and with what temporal persistence.

The distinction between output and generation is especially useful where the immediate output is easy to measure but longer-term transformation is economically important. A training programme can produce a certificate immediately while generating later confidence, network access, occupational mobility, or employer recognition. A public library can provide books and space while generating study routines, weak ties, civic participation, or access to digital services. An open technical standard can coordinate present interoperability while generating an ecosystem of future complementary production.

Generated effects can be intended or unintended. Organizations can deliberately build capability, loyalty, or infrastructure, while other consequences emerge from repeated interaction without centralized design. Some generated effects become visible only retrospectively. GRE therefore distinguishes the existence of a generated consequence from claims about intention. The question concerns the causal or constitutive production of a later condition, not whether an actor planned that condition.

Generation can also be negative in practical or normative terms. A predatory credit relation may generate debt dependency and reduced future exit options. Repeated precarity may generate risk aversion or the erosion of professional capacity. An extractive production process may generate ecological degradation that constrains later

economic activity. The category of generation is therefore descriptive before it is evaluative. Evaluation requires additional criteria concerning whose capacities, values, or futures are affected.

3.6.4 How Does Value Propagate?

Value produced or realized in one relation can travel through a wider configuration. GRE asks how that propagation occurs, which pathways carry it, where it amplifies or decays, and who becomes able to use or capture it. The question begins from the observation that valuable effects rarely remain confined to the site at which they first appear.

Knowledge provides a clear example. A skill acquired by one worker can improve team performance, be taught to colleagues, contribute to organizational routines, support innovation, or become embodied in a product used elsewhere. Public infrastructure can raise the productivity of many firms and households. Trust accumulated through repeated cooperation can reduce coordination costs for later projects. A scientific result can enable downstream technologies, standards, or educational materials. The original site of value generation and the later sites of value realization can therefore be separated in space, time, and institutional ownership.

Propagation has a topology. Some value moves through direct exchange; some through imitation, learning, standards, networks, public goods, reputation, or price changes. Some pathways require institutional authorization. A professional qualification becomes valuable partly because employers and regulators recognize it. A digital protocol becomes valuable as adoption expands. A neighborhood amenity can propagate into land prices through property markets. Mapping the pathway helps determine whether value is widely distributed, locally concentrated, or captured at a bottleneck.

Propagation can also be blocked. Intellectual-property restrictions, incompatible standards, discriminatory networks, lack of infrastructure, language barriers, licensing rules, organizational secrecy, or geographic isolation can prevent generated value from reaching potential users. A GRE analysis can therefore investigate not only how value travels but which relations determine its transmissibility.

This question does not require that heterogeneous forms of value be collapsed into a common unit. Monetary gains, capability expansion, ecological support, recognition, and relational trust can propagate through different mechanisms and may require different measurements. The analytical task is first to identify the form of value and its pathway. Comparison or aggregation comes later, if the research purpose justifies it.

3.6.5 How Does Value Convert across Forms?

Economic life contains interfaces at which one form of value becomes convertible into another. GRE asks how those conversions occur, which institutions authorize them, whose valuations determine the rate or terms of conversion, and what is lost or created in the process. Conversion is analytically distinct from propagation. Propagation concerns movement of value through a relational configuration; conversion

concerns a change in the form through which value is recognized or realized.

Education can be converted into credentials, credentials into employment access, employment into income, income into housing security, and housing security into educational opportunity for another generation. Reputation can become credit access. Cultural attention can become advertising revenue. Publicly produced knowledge can become private intellectual property. Ecological capacity can be converted into commodity production, while financial resources can sometimes be converted into restoration or conservation capacity. Each conversion requires a specific institutional and relational interface.

Conversion interfaces are often sites of asymmetry. Actors differ in their ability to define categories, certify equivalence, set prices, control access, or refuse conversion. A platform may convert user attention into advertising income while users lack a comparable mechanism for realizing the monetary value of their data. A credentialing institution can translate learning into recognized status. A financial system can translate property into collateral and collateral into borrowing capacity, thereby privileging subjects who already possess assets recognizable by that system.

Conversion can be lossy. Meaning, context, ecological complexity, or relational quality can disappear when translated into a scalar metric. Conversely, conversion can create new practical possibilities by making heterogeneous resources interoperable. Monetization can enable exchange across distance; standardized credentials can enable mobility; technical standards can connect previously incompatible systems. GRE therefore treats conversion neither as inherently exploitative nor as inherently beneficial. Its consequences depend on the forms involved, the terms of translation, and the distribution of authority over the interface.

Research can make these interfaces explicit. Instead of asking only how much value exists, it can ask which forms are recognized, which remain invisible, who can perform conversion, what conversion costs arise, who captures the resulting surplus, and whether repeated conversion changes the source form itself. Such questions are especially important when policy seeks to make previously unrecognized value legible to markets or administrative systems.

3.6.6 What Recirculates, Dissipates, or Is Extracted?

Generated resources and value can return to the relations that produced them, spread elsewhere, decay, or be extracted by actors positioned to capture them. GRE therefore asks what recirculates, what dissipates, and what leaves the generative configuration. This question focuses on reproduction through time. A relation can remain productive only if enough of the conditions supporting it are replenished, repaired, or renewed.

Recirculation occurs when generated value or capacity contributes to the maintenance or expansion of the relations that produced it. A cooperative can reinvest surplus in shared infrastructure. A university can use research income to support laboratories and training that enable later research. A community enterprise can return part of its income to local services and networks. Trust generated through successful cooperation can make later cooperation easier. Recirculation can therefore create self-reinforcing dynamics without implying that the resulting configuration is

socially desirable.

Dissipation concerns loss through time, friction, obsolescence, leakage, neglect, or ecological degradation. Skills can decay when unused; infrastructure can deteriorate without maintenance; trust can erode; institutional knowledge can disappear through turnover; ecological capacity can be depleted; attention can fragment. Some dissipation is unavoidable, while some reflects institutional choices about maintenance and renewal. An analysis focused only on gross production can miss the cost of replacing dissipated conditions.

Extraction occurs when generated value or capacity is appropriated in ways that weaken the configuration from which it arises or concentrate its benefits elsewhere. Rent extraction from a local economy, uncompensated appropriation of community knowledge, financial distributions that undermine productive investment, or platform capture of user-generated value can all become candidates for investigation. The concept requires mechanism evidence. The fact that one actor gains more than another does not by itself establish extraction; the analysis must identify the relation through which value is captured and the effect on the generative configuration.

Recirculation, dissipation, and extraction can coexist. A profitable firm can reinvest some surplus, distribute some to workers or suppliers, lose some through depreciation, and transfer some to distant owners. A public programme can generate local capacity while trained workers later migrate. The question is therefore compositional: what proportion or form of generated value follows each pathway, and how do those pathways alter future capability?

3.6.7 How Are Future Capacities Transformed?

GRE places particular emphasis on the transformation of future capacity. An economic arrangement matters not only because of what it produces now but because it changes what subjects and systems can do later. This question links present allocation and relation to the future space of feasible action.

Capacity transformation can occur through learning, infrastructure, health, care, institutional reform, ecological change, debt, technological dependency, network formation, or depletion. A loan can expand productive capacity by financing equipment, while repayment obligations can constrain future cash flow. Employment can build skill and reputation while narrowing alternative career paths. A subsidy can help an industry acquire capabilities that persist after the subsidy ends. Environmental degradation can generate present income while reducing the future productive capacity of an ecosystem.

The temporal profile matters. Some interventions impose immediate costs in order to generate later capacity. Others create immediate gains by drawing down capacities that become scarce only later. A short evaluation window can therefore reverse the apparent ranking of alternatives. GRE does not prescribe one universal horizon, but it requires the horizon to be explicit and adequate to the mechanism claimed.

Capacity is also subject-specific and relational. The same infrastructure can expand the capacity of one group while reducing another's control over land or resources. A technology can increase organizational capacity while deskilling particu-

lar workers. A regulatory change can expand consumer choice while increasing compliance burdens for small producers. Asking whose future capacity changes prevents aggregate improvement from automatically standing in for distributed capability.

The question also creates an interface with uncertainty. Future capacities cannot always be observed directly at the time of intervention. Researchers may need intermediate indicators, historical comparison, simulation, qualitative evidence, or repeated observation. GRE therefore treats claims about future generativity as evidentially demanding. The more distant the claimed effect, the more explicit the mechanism and uncertainty should become.

3.6.8 How Are Economic Subjects Generated and Stabilized?

Economic analysis often begins with subjects already defined as workers, consumers, owners, borrowers, firms, entrepreneurs, citizens, beneficiaries, or investors. GRE asks how such positions are generated, recognized, stabilized, and transformed. The question concerns practical economic subjecthood rather than a final theory of personhood.

Subject positions can be produced through legal categories, contracts, organizational roles, technologies, data systems, professional standards, markets, and social expectations. A person becomes a borrower not simply by possessing an individual preference for credit but through eligibility rules, identity documentation, scoring systems, collateral conventions, and lender recognition. A platform worker occupies a subject position shaped by contract classification, algorithmic management, customer ratings, payment infrastructure, and labor regulation. A firm becomes an investable object through legal incorporation, accounting practices, governance arrangements, and financial representation.

Stabilization requires continuity. Roles persist because institutions recognize them, records maintain them, counterparties respond to them, and subjects often organize their own expectations around them. This continuity can enable planning and rights while also producing path dependence. A classification that initially facilitates coordination can later restrict access or define subjects in ways that no longer fit their circumstances.

Economic subjects can also be generated through participation. Repeated saving can produce a recognized credit history; apprenticeship can produce professional identity; membership in a cooperative can develop capacities for collective decision-making; long-term unemployment can alter institutional classification and self-expectation. Subject formation is therefore partly an economic process because access to resources, roles, and relations can reshape practical identity and future action.

The question becomes especially important under technological change. Artificial agents, automated systems, platforms, and hybrid human-machine arrangements can perform functions previously associated with human economic subjects. GRE can ask which dimensions of subjecthood are relevant in each domain: productive agency, control over resources, capacity to enter recognized relations, continuity across time, liability, representation, or normative standing. These dimensions need not coincide, and functional capability does not settle moral or legal status.

3.6.9 How Does Asymmetry Become Economic Power?

Differences in resources, knowledge, capability, network position, or technical capacity are ubiquitous. GRE asks when such asymmetries become economic power. The question prevents a simple equation between difference and domination. Power arises when asymmetry is connected to relations through which one actor can shape another's feasible actions, terms of participation, exposure to risk, access to resources, or future capacities.

A firm with superior technology does not automatically hold power over every other actor. Power emerges when that capability is linked to ownership, market position, contractual authority, infrastructure control, legal privilege, dependency, standard-setting, or capture of a bottleneck. Likewise, information asymmetry becomes power when one party can use informational advantage to determine terms, classify others, restrict alternatives, or impose costs that the other party cannot readily avoid.

Exit and dependence are therefore central. A relation can be formally voluntary while one side faces much higher exit costs. Workers may be able to leave an employer in principle but lose legal sponsorship, health insurance, housing, or accumulated benefits. Users may be free to leave a platform but face network effects, data lock-in, or loss of professional visibility. Suppliers may be free to reject a dominant buyer while lacking alternative markets. Power analysis asks how these relational conditions transform nominal options into practical constraints.

Power can also be infrastructural and impersonal. No single actor may intentionally dominate others, yet standards, algorithms, payment systems, zoning rules, or inherited property structures can distribute capacities asymmetrically. GRE can therefore examine power embedded in relational architectures as well as direct command. Identifying power does not require attributing malicious intention; it requires showing how a configuration systematically shapes the options or capacities of differently positioned subjects.

The question naturally leads to generative consequences. Power can reproduce itself by generating the resources, information, legitimacy, or dependency that sustain the original asymmetry. It can also erode its own conditions when extraction undermines cooperation or when concentrated authority produces institutional resistance. GRE therefore studies power not only as a present relation but as a potentially self-reinforcing or self-transforming generative configuration.

3.6.10 What Orients the Direction of Generation?

Generation has direction because economic systems selectively develop some possibilities while leaving others unrealized. GRE asks what orients that selection. Markets, institutions, professional communities, public policy, cultural expectations, metrics, aesthetic judgments, scientific questions, organizational goals, and individual aspirations can all influence which objects receive attention and investment.

The question is broader than incentive analysis while remaining compatible with it. Prices and expected returns orient activity, but so do legal mandates, research agendas, rankings, reputational systems, narratives of desirable futures, and perceptions

of what is interesting or feasible. A research organization can direct resources toward questions regarded as scientifically significant even when immediate commercial returns are uncertain. A city can prioritize mobility, housing, tourism, or environmental restoration according to institutional and political judgments that structure later investment.

Orientation can operate before explicit choice by shaping salience. Subjects do not evaluate every imaginable possibility. They encounter a selected field of options made visible by institutions, technologies, language, education, and social experience. Recommendation systems, professional curricula, funding categories, procurement rules, and media attention can influence which possibilities become thinkable or practically available. GRE can therefore study the production of the option field as well as selection within it.

Orientation is also heterogeneous. Different subjects can pursue incompatible forms of value or imagine different desirable futures. Economic coordination then involves negotiation, conflict, coexistence, or institutional procedures for selecting among directions. The presence of plural orientations means that generativity alone cannot supply a normative criterion. A system can be highly generative while producing futures that some affected subjects reject.

Research on orientation can ask who participates in defining goals, which signals are amplified, which possibilities are rendered invisible, what feedback modifies priorities, and how orientation changes after new capacities or knowledge emerge. These questions prepare the more systematic treatment of orientation later in Chapter 3 while showing why the direction of generation is already an economic question.

3.6.11 Under What Conditions Does Generation Produce Foreclosure?

Generation can expand future possibility, but it can also close alternatives. GRE therefore asks under what conditions the production of one pathway forecloses others. Foreclosure can arise through irreversible investment, ecological depletion, institutional lock-in, debt, standardization, network effects, path-dependent learning, spatial development, or the concentration of control over key resources.

A technology can create new capabilities while making older infrastructures uneconomic to maintain. An urban development project can generate housing and commercial value while eliminating community uses of land that cannot easily be reconstructed. A standardized platform can enable broad interoperability while reducing space for alternative technical architectures. Specialized education can generate high competence in one domain while increasing the cost of changing fields later. These examples show why generation and foreclosure can occur together.

Foreclosure is not identical to constraint. Every realized choice excludes some alternatives simply because resources and time are finite. The analytical question concerns consequential closure of future possibilities, especially where the closure becomes difficult to reverse or is imposed unevenly across subjects. The degree of reversibility, distribution of exit costs, and availability of alternative pathways therefore become relevant indicators.

Some foreclosure can be justified or desirable. Safety regulation intentionally elim-

inates dangerous production methods; environmental rules can close destructive extraction pathways; technical standards can reduce costly incompatibility. GRE does not treat openness as an unconditional good. It asks which possibilities are being closed, for whom, by what authority, with what reversibility, and in pursuit of which values.

The question is particularly important for policy evaluation. An intervention can appear successful according to immediate outcomes while narrowing later adaptability. Conversely, a policy that preserves optionality can look inefficient in a short horizon because it maintains redundant capacity or multiple institutional pathways. GRE can therefore include future option structure as part of economic evaluation when the case warrants it.

3.6.12 How Do Relational Structures Transform Their Own Conditions of Change?

The final illustrative question concerns recursive transformation. Economic relations can generate outcomes that alter the mechanisms through which later change occurs. A market can produce firms that reshape regulation; a platform can generate network effects that change entry conditions; a labor arrangement can produce new worker organizations; a financial innovation can change the infrastructure through which future credit is allocated. The object of inquiry is therefore not only change within a structure but change in the conditions that organize subsequent change.

This question requires careful separation among levels of transformation. A system can move from one state to another while its basic rules remain stable. Parameters can change while the form of the mechanism remains intact. Institutions can revise rules while preserving their authority structure. More strongly, actors, categories, boundaries, or mechanisms can be reconstituted so that the previous model of change no longer describes the later situation adequately. GRE is especially interested in the transition among these cases because historical economic development often involves several simultaneously.

Recursive transformation can be deliberate. Legislators can redesign institutions, firms can alter governance, communities can create new property arrangements, and regulators can modify market rules in response to observed outcomes. It can also emerge without centralized design as repeated practices create new conventions, standards, expectations, or dependencies. In either case, the researcher should identify the pathway through which earlier relations modify later generative conditions.

Reflexivity intensifies the problem. Economic subjects can observe models, policies, forecasts, and classifications and respond to them. A credit score changes behavior because actors know that the score affects access. A policy target can reorganize organizational reporting. A market forecast can affect expectations and transactions. Representation can therefore enter the causal field it describes. GRE treats such reflexive loops as empirically investigable rather than as a reason to abandon formal or causal analysis.

The evidential standard should remain demanding. Claims that a system has transformed its own rules can easily become rhetorical if the relevant rule, boundary, or mechanism is left unspecified. A strong analysis identifies what changed, which

earlier relations contributed to that change, how the new arrangement differs operationally from the previous one, and what consequences follow for later possibilities. The concept is useful precisely when it distinguishes ordinary state change from transformation in the organization of change itself.

Taken together, these twelve question families define a characteristic style of GRE inquiry without establishing a closed doctrine. They invite researchers to move beyond the immediate recipient, transaction, or output when doing so materially improves explanation; to track generation, propagation, conversion, and recirculation across heterogeneous relations; to examine future capacities, subject formation, power, orientation, and foreclosure; and to remain alert to recursive changes in the conditions of change. A project can enter this problem-space through any one of these questions and combine them according to the object and evidence at hand.

The next section converts this repertoire of questions into a more explicit analytical sequence. It distinguishes allocation, relational mediation, generation, propagation, conversion, recirculation, extraction, structural transformation, and changes in generative conditions. That sequence is not intended as a universal causal chain. Its role is to provide GRE with a reusable perspective for deciding which stages of an economic process require attention in a particular inquiry.

3.7 The Distinctive Analytical Perspective of GRE

The preceding sections have specified the problem-space, primitive structure, admissible objects, scales, and illustrative questions of Generative Relational Economics (GRE). The role of the present section is to state more explicitly the analytical perspective that organizes those elements into a characteristic mode of economic inquiry. Its objective is to describe a sequence of analytical moves through which an allocation, transaction, policy, institution, or other economic event can be followed beyond its immediate recipient and immediate output into the relations, generated capacities, value pathways, structural changes, and altered conditions of future change that it helps produce. The sequence is presented as a research grammar rather than a universal causal law. A concrete study may enter at any point, omit stages that are irrelevant, distinguish several parallel pathways, or discover feedbacks that make the ordering recursive. The analytical value of the sequence lies in keeping distinct processes that conventional evaluation can easily compress into a single outcome measure.

The perspective begins from allocation because allocation remains a central economic operation. Resources, rights, attention, credit, land, labor, data, infrastructure, authority, and institutional recognition are distributed through decisions and arrangements that place something somewhere under particular terms. GRE treats that placement as an initial intervention into a relational configuration. The allocation changes access, bargaining positions, expectations, dependencies, opportunities for coordination, and sometimes the identities or capacities of the participants. Those changes can generate new resources and forms of value, which may propagate through a wider configuration, convert across forms, recirculate into the relations that produced them, dissipate, or become subject to extraction. Repeated or

sufficiently consequential processes can alter institutional and relational structure, transform the conditions that enable future generation, and in some cases change the effective rule through which subsequent transformations occur.

This perspective therefore extends the temporal and relational horizon of economic analysis without prescribing one metric of success. Monetary return, productivity, capability, recognition, ecological capacity, knowledge, trust, security, autonomy, and other forms of value can remain heterogeneous. GRE asks how they are generated and connected before deciding whether comparison, aggregation, or normative judgment is warranted. It also keeps mechanism claims separate from moral evaluation. A self-reinforcing process can be economically powerful while normatively objectionable; a process that dissipates one form of value can generate another; a structural transformation can expand some future possibilities while foreclosing others. The following subsections develop the ten analytical moments in this perspective.

3.7.1 Allocation as an Initial Intervention

Allocation is the analytical point of departure because many economic processes become administratively visible at the moment when a resource, entitlement, burden, opportunity, or authority is assigned. Public budgets allocate funds to programmes. Firms allocate capital and labor. Banks allocate credit. Households allocate time and care. Platforms allocate visibility. Legal institutions allocate rights and liabilities. Educational institutions allocate credentials and access. These operations remain central to GRE, yet GRE reads them as interventions into already structured relations rather than as terminal distributions among self-contained recipients.

An allocation changes more than possession. Receiving credit can alter a firm's bargaining position with suppliers, its ability to hire, its exposure to debt service, and the confidence of other financiers. A housing subsidy can change household security, neighborhood demand, landlord expectations, and local land values. Allocation of research funding can change laboratory composition, collaboration networks, training capacity, and the future distribution of expertise. Even an apparently simple transfer enters a field of existing institutions, expectations, power relations, and conversion mechanisms.

The analytical unit is therefore the allocation-in-context. A useful GRE study specifies what is allocated, under which institutional conditions, to whom or to which configuration, at what time, with what duration, and through which rights or obligations. It also identifies the baseline relations into which the allocation enters. These relations determine what the allocation can become. The same monetary amount can have different generative effects when recipients possess different infrastructure, debt burdens, social recognition, legal status, network access, or ecological conditions.

Allocation can also concern non-scarce or symbolically abundant objects. Attention, rankings, reputational signals, software, information, and institutional recognition can be allocated through procedures that differ from the allocation of rival material goods. Their economic significance often arises from the relations that make them consequential. A search ranking matters because users, advertisers, platforms,

and firms respond to it. A credential matters because institutions recognize it. A dataset matters because actors possess complementary computational and organizational capacities. GRE therefore treats allocation as a broad intervention category whose meaning depends on the relational conditions of use.

Starting from allocation preserves continuity with established economic analysis while widening the subsequent inquiry. The initial question remains who receives what, under which conditions. GRE then asks what relations are activated or reconfigured by that placement, what becomes possible because of it, and which downstream effects remain outside the administrative boundary of the allocation itself.

3.7.2 Relational Mediation

An allocation acquires practical significance through relational mediation. Resources rarely produce identical effects independently of the relations through which subjects can use, interpret, exchange, protect, combine, or transform them. Relational mediation names the set of pathways through which an initial intervention becomes economically operative. These pathways can include contractual relations, kinship and care relations, organizational routines, infrastructures, legal recognition, technical standards, reputational systems, financial arrangements, ecological dependencies, and informal networks of trust or exclusion.

Mediation can enable use. A loan becomes productive when a borrower can purchase equipment, hire workers, obtain permits, reach customers, and sustain repayment. A public dataset becomes generative when users have the skills, computational infrastructure, legal permission, and institutional incentives required to employ it. A school meal programme can affect educational participation through household budgets, health, attendance routines, and parental expectations. The intervention therefore passes through a configuration of relations whose structure conditions the realized effect.

Mediation can also redirect or neutralize an intervention. A subsidy intended for tenants can be partly captured through rent increases. A wage increase can produce limited household security when debt obligations absorb the gain. New infrastructure can intensify land speculation and displace the population whose mobility it was intended to improve. These outcomes do not imply that the allocation itself is analytically irrelevant. They show that its effect is co-produced by the relations through which it travels.

GRE therefore distinguishes administrative recipient from relational incidence. The person or organization named in a programme may be only one node in a larger set of affected relations. Suppliers, creditors, family members, competitors, property owners, workers, public institutions, ecosystems, or future participants can experience consequential effects. The boundary of relevant incidence should follow the mechanism under investigation rather than the accounting category alone.

Relational mediation also includes interpretation. Economic subjects respond to signals through historically and institutionally formed meanings. A tax incentive can be interpreted as temporary or durable. A guarantee can change perceived risk. A government purchase can signal future market demand. A platform rule can alter expectations about visibility and participation. Such interpretive mediation affects

behavior without requiring that every actor hold the same belief.

The analytical task is to identify which relations materially condition the pathway from intervention to effect. GRE does not require exhaustive mapping of an entire social world. It requires enough relational specification to explain why the intervention produced the observed or anticipated consequences and why those consequences differ across subjects, sites, or periods.

3.7.3 Generation

Relational mediation can produce new capacities, resources, meanings, institutions, practices, identities, expectations, and forms of value. GRE uses *generation* for this productive moment. Generation concerns the emergence or augmentation of economically relevant possibilities through a relation or configuration. The generated object may be material, symbolic, institutional, ecological, epistemic, or relational. Its significance lies in the fact that later action becomes possible, easier, harder, or differently organized because the configuration has changed.

Production and generation overlap in many cases, yet their analytical emphases differ. Production commonly directs attention toward an output: goods, services, income, knowledge, or measurable performance. Generative analysis asks what further capacities and conditions are created in producing, using, distributing, or maintaining those outputs. A training programme produces instruction and credentials; it can also generate professional networks, self-confidence, recognized status, organizational routines, and future learning capacity. A transport project produces mobility services; it can generate new patterns of settlement, commercial access, land valuation, and ecological pressure. A cooperative produces goods or services while potentially generating shared governance capability and durable norms of reciprocity.

Generation can occur without an intended designer. Repeated market exchange can generate conventions. Repeated platform participation can generate data and reputational histories. Shared exposure to risk can generate mutual-aid institutions. Competitive pressure can generate organizational routines or technological standards. Conversely, deliberate interventions can fail to generate the capacities they target because the necessary relational conditions are absent.

Generated outcomes are frequently distributed unevenly. A technology can generate organizational productivity while reducing the bargaining power or skill development of particular workers. A financial instrument can generate liquidity for one group while creating systemic exposure elsewhere. Public infrastructure can generate collective access while simultaneously generating private land rents. The generative question therefore includes the location and distribution of newly created capacities and constraints.

A GRE analysis should identify the mechanism through which generation occurs. The presence of a later capacity after an intervention does not establish that the intervention generated it. Competing pathways, background trends, selection effects, and independent causes remain relevant. Historical, qualitative, quantitative, comparative, causal, formal, and computational methods can each contribute depending on the problem. Generative language becomes analytically useful when it sharpens mechanism and temporal structure rather than merely redescribing change.

Generation also includes the production of constraints. Debt can generate purchasing capacity and repayment obligations. Digital infrastructure can generate access and dependency. Standardization can generate interoperability and exclusion of incompatible practices. Institutional recognition can generate rights and categories that narrow alternative forms of identity. GRE therefore treats generativity as directionally open: what is generated may expand, stabilize, redirect, or constrain future possibility.

3.7.4 Propagation

Generated effects can move beyond the relations in which they first appear. Propagation concerns the transmission, diffusion, amplification, attenuation, or replication of resources, capacities, constraints, meanings, and forms of value through a wider relational configuration. It extends the analysis from local generation to the pathways through which generated effects become consequential elsewhere.

Propagation can occur through exchange, learning, imitation, network contact, infrastructure, standards, prices, legal precedent, organizational replication, migration, ecological flows, media, or technical interoperability. A skill acquired within one workplace may spread through labor mobility. A protocol developed by one organization may become an industry standard. A reputation produced in one network may affect credit access in another. An innovation can diffuse through suppliers and competitors. Pollution can propagate across ecological and jurisdictional boundaries.

The structure of the pathway matters. Dense networks can accelerate some forms of diffusion while creating redundancy. Centralized networks can enable rapid dissemination while producing bottlenecks or concentrated control. Institutional filters can privilege particular carriers and suppress others. Spatial distance can be reduced by digital infrastructure for information while remaining decisive for housing, care, logistics, or ecological impact. A GRE account therefore asks through which relations the effect propagates and how topology, access, and institutional authority condition that movement.

Propagation is also selective. An intervention that generates knowledge may propagate technical information more easily than tacit practice. Monetary gains may cross organizational boundaries through payments while trust remains locally embedded. Recognition can travel across institutions only when credentials or reputational signals are mutually accepted. Ecological damage can propagate physically even when financial liability does not. The form of what moves and the medium through which it moves should therefore be distinguished.

Amplification and attenuation are important possibilities. A small innovation can become economically large when network effects, complementary investment, or standardization amplify adoption. A substantial local intervention can dissipate as effects pass through weak or incompatible connections. The magnitude observed at the origin gives limited information about the magnitude realized elsewhere.

GRE also considers the distribution of access to propagation pathways. Actors positioned at interfaces, platforms, logistics hubs, standards bodies, financial intermediaries, or institutional gateways can influence what travels and under which terms. Propagation can therefore become a source of power as well as a mechanism of dif-

fusion. The relevant inquiry concerns the relational architecture through which generated effects acquire reach.

3.7.5 Conversion

Propagation frequently encounters interfaces at which one form of resource or value is translated into another. Conversion concerns these transformations among forms. Income can become education, housing security, political access, or health. Knowledge can become credentials, intellectual property, technical standards, or market advantage. Attention can become advertising revenue. Reputation can become creditworthiness. Land can become collateral. Ecological capacity can become commodity output, while financial resources can sometimes become restoration capacity.

Conversion differs from movement within a single form. A payment transferred between accounts remains monetary propagation. A credential used to obtain employment converts recognized educational achievement into labor-market access. A public research result licensed into proprietary technology passes through an institutional conversion interface that changes the rights and forms through which its value can be realized. The distinction helps identify where commensuration, authorization, pricing, certification, or institutional recognition becomes necessary.

Conversion interfaces are rarely neutral. Actors differ in their ability to define categories, establish equivalence, set prices, issue credentials, certify quality, recognize claims, or deny access. A bank decides which assets count as acceptable collateral. A university determines which learning qualifies for a degree. A platform determines which forms of attention can be monetized and by whom. A legal system determines which interests can become enforceable rights. Control over conversion can therefore become a source of economic power.

Conversions can be partial or lossy. Rich forms of knowledge can be reduced to a credential or score. Ecological complexity can be translated into a carbon metric. Care can be monetized without preserving every relational quality attached to unpaid care. Standardization may sacrifice contextual detail while enabling interoperability across institutions. GRE therefore keeps the source form and converted form analytically distinguishable and asks what information, capacity, meaning, or control is gained or lost in translation.

Conversion can also generate additional value. A technical standard can make separate systems interoperable. A recognized qualification can enable geographic mobility. Monetization can permit resources to be exchanged across otherwise disconnected contexts. Legal incorporation can allow a collective project to contract, borrow, or hold assets. The normative significance of conversion depends on the terms, distribution, reversibility, and consequences of the transformation rather than on conversion as such.

Because heterogeneous values may resist full commensuration, GRE does not assume a universal conversion metric. Some forms may be partially convertible, institutionally incomparable, or normatively protected from exchange. The analytical task is to identify the interface, the actors who govern it, the terms under which conversion occurs, and the effects of repeated conversion on both the source and destination forms.

3.7.6 Recirculation

Generated and converted value can return to the relations and capacities that helped produce it. Recirculation concerns this return and the possibility that an economic configuration reproduces or expands its own generative conditions through the value it creates. Recirculation provides a bridge from one-time effects to recurrent economic dynamics.

A firm may reinvest earnings in productive equipment, worker training, research, or supplier development. A cooperative may return surplus to shared infrastructure. A university may use research income to support laboratories and students who enable later research. A community institution may reinvest revenue in local services and networks. Trust produced through successful collaboration can reduce the cost of subsequent collaboration. In each case, an output contributes to the maintenance or enlargement of a condition that supports later generation.

Recirculation is broader than financial reinvestment. Knowledge can return through teaching and mentorship. Institutional capacity can return through improved procedures. Ecological value can return through restoration. Recognition can return through strengthened membership and participation. Data generated by users can be used to improve a service that then attracts further users. The relevant object is the pathway by which generated value reconnects to a generative configuration.

The rate, distribution, and governance of return matter. An organization can generate large value while returning little to the workers, communities, infrastructures, or ecosystems that sustain it. Another can deliberately allocate returns to maintain those conditions. The existence of some recirculation does not by itself establish sufficiency or justice. A system can remain self-reinforcing while distributing benefits unequally or depleting unmeasured conditions outside its accounting boundary.

Recirculation can create positive feedback. Additional capability increases later generation, which supplies further resources for capability formation. Such loops can support cumulative development, institutional persistence, or technological lock-in. Their effects depend on the underlying configuration. A virtuous cycle for one group can become an exclusionary barrier for another when access to the loop is restricted. Self-reinforcement is therefore a dynamical property to be analyzed separately from normative desirability.

GRE uses recirculation to ask whether generated value contributes to the reproduction of the capacities and relations on which future generation depends. This question is especially important where conventional accounts register output or profit while leaving maintenance, care, learning, ecological renewal, and institutional reproduction analytically peripheral.

3.7.7 Dissipation and Extraction

Generated value does not necessarily return to its generative configuration. Some of it dissipates through depreciation, obsolescence, friction, neglect, entropy, institutional turnover, loss of trust, or ecological degradation. Some is extracted by actors positioned to appropriate value without proportionately sustaining the conditions

from which it arises. GRE treats dissipation and extraction as distinct pathways because their mechanisms and policy implications differ.

Dissipation can occur without an appropriating beneficiary. Infrastructure decays when maintenance is deferred. Skills weaken when unused. Organizational memory disappears through turnover. Trust erodes after repeated coordination failures. Ecological capacity can decline through cumulative pressure. Data lose relevance. Knowledge becomes obsolete. These processes imply that the maintenance of a generative configuration often requires recurrent inputs rather than a one-time investment.

Extraction involves a relational mechanism of capture. Rent can be appropriated because ownership or control over a bottleneck allows an actor to claim part of the value generated elsewhere. A platform can capture value from user activity through control of infrastructure and monetization interfaces. A financial arrangement can transfer returns away from productive reinvestment. A firm can rely on public education, care work, or ecological capacity while externalizing part of the cost of reproducing those conditions. The analytical claim requires evidence of the pathway through which value is captured and of its relation to the generative configuration.

Unequal distribution alone does not establish extraction. A participant can receive a large return because it supplies scarce capital, bears risk, contributes specialized knowledge, or performs coordination. GRE therefore asks what relation supports the claim, what alternative arrangements are feasible, whether the captured value weakens or sustains the source configuration, and how bargaining power and institutional rights shape the terms of appropriation.

Dissipation and extraction can interact. Deferred maintenance can make an organization dependent on external financing, which can increase opportunities for future extraction. Extractive arrangements can reduce resources available for training or ecological renewal, accelerating dissipation. Conversely, some forms of external appropriation can finance infrastructure that improves the source configuration. Mechanism and temporal sequence matter more than categorical labeling.

The analytical purpose is to account for where generated value goes. A process that appears productive at one accounting boundary may look fragile once maintenance requirements, externalized costs, and captured returns are traced over time. This wider accounting remains plural: GRE need not translate every dissipated or extracted form into money in order to analyze its economic significance.

3.7.8 Structural Transformation

Repeated allocations, mediations, generation, propagation, conversion, recirculation, dissipation, and extraction can alter the relational structure within which later economic action occurs. Structural transformation concerns changes in relatively persistent configurations of access, authority, dependency, coordination, classification, ownership, infrastructure, and institutional recognition. The analytical horizon therefore moves from flows through a structure to changes in the structure itself.

A credit programme can gradually create new financial histories that alter who is considered bankable. Platform adoption can reorganize market access and bar-

gaining relationships. Public infrastructure can change settlement patterns and land values. Repeated outsourcing can transform organizational boundaries and labor relations. An educational expansion can change occupational competition and credential requirements. Long-term extraction can concentrate ownership sufficiently to reshape political and market power. These effects persist because the relations through which later actors operate have changed.

Structural transformation can be cumulative. Small changes in network access, standards, expectations, or institutional categories may become mutually reinforcing. Once a technical standard reaches broad adoption, complementary investments increase switching costs. Once a legal category becomes embedded in administrative systems, data structures, and organizational routines, later decisions may reproduce it. Such persistence does not imply irreversibility, yet reversal can require interventions different in kind from those that produced the initial change.

Structure is scale-relative. A transformation that appears structural for a household may be local from the perspective of a national economy. A regulatory change can be structural for an industry while leaving broader institutional arrangements intact. GRE therefore specifies the scale and boundary at which structural transformation is claimed. The term should signal a change in the organization of relations relevant to the inquiry rather than function as a synonym for any large effect.

Structural transformation can redistribute generative capacity. New infrastructure can enable some actors to participate while making others dependent on centralized systems. Consolidation can create investment capacity and reduce diversity of organizational forms. A new property regime can make resources legible and tradable while displacing customary claims. GRE asks how the changed structure reorganizes the possibilities available to different subjects and which later pathways become easier, harder, visible, or inaccessible.

At this stage, the analytical perspective begins to become recursive. Structures mediate later allocations and generation, while those processes can further transform structure. The economy is therefore approached as historically layered: present relations carry residues of earlier allocations, conversions, institutions, conflicts, and generative cycles.

3.7.9 Transformation of Generative Conditions

Structural change becomes especially significant when it alters the conditions that make later generation possible. Generative conditions include capacities, infrastructures, ecological resources, legal permissions, institutional trust, knowledge bases, standards, networks, interpretive categories, and other background arrangements through which new economic possibilities can emerge. Transformation of generative conditions concerns changes in this enabling and constraining environment.

The distinction between generated output and generative condition is temporal and relational. A research project can produce a paper as an output while training researchers who become a condition for later inquiry. A transportation system can provide current mobility while also changing the accessibility structure through which future firms and households choose locations. A legal reform can resolve a present dispute while changing the institutional expectations that shape later con-

tracting. Restoration can generate present employment and rebuild ecological capacity that supports future livelihoods.

Conditions can become more or less diverse. An economy can accumulate specialized capabilities that deepen productive potential within one technological trajectory while reducing adaptability to alternative trajectories. Standardization can create broad interoperability while narrowing variation. Concentrated infrastructure can generate scale economies while increasing dependency on a small number of providers. GRE therefore examines the composition of generative capacity, including redundancy, diversity, reversibility, and dependence.

Generative conditions are distributed. The capacity to innovate may depend on public education, care systems, research institutions, finance, standards, migration regimes, energy infrastructure, social trust, and ecological stability. No single actor needs to own these conditions for them to shape economic possibility. This distributed character makes attribution and governance difficult: benefits may be privatized while maintenance costs remain collective, or collective institutions may fail to recognize contributions occurring outside formal accounting systems.

Changes in generative conditions can also alter who counts as an economic subject. Digital identity systems can enable participation for some subjects and exclude others. New organizational forms can recognize collective actors. Artificial systems can acquire delegated decision capacities that change the distribution of agency in markets and institutions. Educational and technical infrastructures can transform the capacities through which persons become able to participate in particular forms of production or exchange. These questions prepare the more focused treatment of economic subjecthood in the following section, while the present subsection keeps attention on the background conditions through which such subject positions become possible.

The GRE perspective therefore evaluates interventions partly by their effects on future generativity. Immediate welfare or output remains important, yet an intervention can also be assessed by whether it expands, concentrates, diversifies, depletes, or forecloses the conditions from which later value and action can emerge. Such evaluation requires an explicit temporal horizon and awareness that future uses cannot be fully specified in advance.

3.7.10 Transformation of the Effective Rule of Change

The deepest analytical extension concerns situations in which economic processes transform the effective rule through which subsequent change occurs. A structural configuration can change while the basic mechanisms governing adjustment remain similar. In other cases, the mechanisms themselves are reorganized: new institutions redefine permissible transactions, technologies create new categories of action, collective learning changes how actors respond, platforms redesign market matching, legal reforms alter rights and enforcement, or artificial systems introduce new forms of automated selection and adaptation. GRE treats such cases as transformations of the effective rule of change.

The phrase *effective rule* is deliberately modest. It does not imply that an economy possesses one literal master equation. It refers to the locally relevant mechanisms, in-

stitutional procedures, response functions, selection environments, and constraints through which changes in the studied configuration are produced. Different methods can represent these rules differently. A historian may reconstruct them through institutional sequences, an economist through behavioral or equilibrium relations, a network analyst through evolving topology, an ethnographer through changing practices, and a computational model through explicit update procedures.

Rule transformation occurs when later dynamics cannot be adequately described by holding those mechanisms fixed. A market governed by bilateral bargaining can become a platform-mediated market in which ranking algorithms and platform rules shape matching and price formation. A monetary system can acquire new instruments that change transmission mechanisms. A labor process can move from human supervision to algorithmic allocation, altering how performance is measured and how workers adapt. A regulatory reform can change the criteria through which organizations become eligible, compliant, or sanctionable. The later system is connected historically to the earlier one while operating through modified mechanisms.

Rule transformation is especially important under reflexivity. Economic subjects learn, anticipate policies, reinterpret categories, and adapt to models used to govern them. Institutions respond to observed behavior. Firms redesign strategies when competitors imitate them. Regulators revise rules when existing rules generate unintended effects. The object of analysis can therefore react to the representations and interventions applied to it. A stable rule may remain a useful local approximation, yet GRE keeps open the possibility that repeated interaction changes the mechanisms on which the approximation depended.

The transformation of effective rules also raises a governance problem. Interventions can influence more than outcomes within a given system; they can shape the procedures through which future outcomes will be produced. A procurement rule can determine which organizational forms survive long enough to compete later. A data standard can define what becomes measurable and therefore governable. Intellectual-property rules can influence the future distribution of innovation incentives and knowledge access. Educational assessment can alter what institutions teach and what learners treat as valuable. These interventions operate partly at the level of the future change process itself.

This final analytical moment does not make every economic change a case of rule transformation. The claim requires evidence that the mechanisms generating later transitions have materially changed. Maintaining this threshold preserves the distinction among movement within a structure, transformation of structure, transformation of generative conditions, and transformation of the effective rule of change.

Taken together, the ten moments of the GRE perspective provide a layered way to follow economic action through time and relation. Allocation identifies an initial placement of resources, rights, burdens, or attention. Relational mediation specifies the configuration through which that placement becomes operative. Generation identifies newly produced capacities, constraints, values, subjects, or possibilities. Propagation follows their movement; conversion follows changes of form; recirculation follows return to generative configurations; dissipation and extraction account for loss and capture. Structural transformation asks how persistent relations are reorganized. Transformation of generative conditions asks how the capacity for later gen-

eration changes. Transformation of the effective rule of change asks whether the mechanisms producing future transitions have themselves been altered.

The sequence remains a heuristic research architecture. Empirical cases can contain loops, branching pathways, simultaneous processes, and multiple scales whose temporal order is only partially recoverable. GRE's distinctive perspective lies in making these layers available for explicit inquiry while preserving the possibility that a narrower established economic analysis may be sufficient for a particular question. The next section turns from this analytical architecture to one of its most consequential objects: the economic subject itself, whose identity, recognition, capacities, and persistence can be treated as historically and relationally generated rather than analytically fixed in advance.

3.8 GRE and the Economic Subject

Generative Relational Economics (GRE) requires a conception of the economic subject that is sufficiently stable for analysis and sufficiently open to account for historical transformation. The role of this section is to specify that conception after the preceding sections have established GRE's objects, scales, problem families, and distinctive analytical sequence. Its objective is to explain how persons, organizations, artificial systems, and other configurations can occupy economically consequential subject positions without assuming that subjecthood is a timeless property given prior to economic relations. The discussion proceeds through eight connected problems: the movement from given agents to relationally situated subjects; institutional recognition; relational persistence; the coexistence of human and artificial economic subjects; heterogeneity among subjects; capability asymmetry and ontological distinction; participation under conditions in which productive necessity may decline; and subject formation itself as an economic process. The method is constitutive rather than taxonomic. GRE does not attempt to settle the metaphysics of personhood, consciousness, or agency. It specifies a working analytical conception of subjecthood adequate to economic inquiry while preserving ontological suspension and explicit normative separation.

Within this framework, an *economic subject* is a relatively stabilized locus of economically consequential participation that can be identified within a relational configuration. Such participation may include choosing, claiming, producing, consuming, owning, borrowing, contracting, coordinating, representing, interpreting, allocating, governing, bearing risk, receiving recognition, or being made answerable for an economic event. Different forms of subjecthood need not contain the same capacities. A human worker, a household, a corporation, a public agency, and an automated trading system can occupy very different kinds of economic subject position. Their inclusion within a common analytical vocabulary records their participation in economic relations; it does not establish metaphysical, experiential, juridical, or moral equivalence among them.

This distinction is especially important because economic theory often gains tractability by beginning with an already individuated agent. GRE can use such models when the research question warrants them, yet its broader programme keeps

open the prior question of how the agent became recognizable, durable, capable, and economically situated. The economic subject can therefore be treated both as a participant in economic dynamics and as a possible product of those dynamics. Wage relations, property regimes, credit systems, organizational membership, legal classifications, technical infrastructures, educational institutions, platforms, and systems of representation can all help constitute which subjects exist for an economic process, what they can do, how they are recognized, and which futures become available to them.

3.8.1 From Given Agent to Relationally Situated Subject

A large class of economic models begins with agents whose identities, preferences, feasible actions, and relevant resources are specified before the modeled interaction begins. This abstraction can be highly productive. It makes possible clear analysis of choice, exchange, strategic interaction, allocation, and equilibrium. GRE retains these analytical resources while adding a complementary question: under which relations did the modeled agent become the kind of subject for whom those preferences, capacities, resources, and feasible actions are available?

The move from a given agent to a relationally situated subject changes the analytical starting point. A worker enters a labor market with skills formed through education, family relations, health, language, migration status, credentialing, and previous employment. A firm enters a market through legal incorporation, ownership arrangements, financing, supplier relations, infrastructure, standards, and accumulated organizational routines. A consumer appears in a platform economy through accounts, payment systems, identity verification, recommendation systems, device access, and categories through which demand is represented. In each case, the subject remains a meaningful analytical unit, while its capacities and boundaries are understood as relationally conditioned.

Relational situatedness does not imply that a subject is reducible to its relations. GRE requires enough analytical independence to speak about a subject's actions, interests, experiences, holdings, or capabilities when those categories are warranted. The point is that such independence is historically and institutionally achieved to varying degrees. A property owner can act independently with respect to an asset because institutions stabilize ownership claims. A worker can negotiate because labor law, organizational rules, scarce skills, collective representation, or outside options provide a position from which negotiation is possible. A household can plan because some flows of income, care, residence, and obligation persist through time. Subjecthood therefore contains a relation between relative individuation and continuing dependence.

This approach also prevents agency from being treated as a single scalar quantity. A subject may possess substantial agency in one relation and little in another. A highly skilled employee may exercise considerable control over technical decisions while possessing limited bargaining power over employment conditions. A small firm may choose its product design while remaining strongly constrained by a dominant platform or creditor. A government agency may have formal authority but limited informational or implementation capacity. GRE therefore asks which dimensions of

agency are operative, through which relations, and at which scale.

Relational situatedness further allows preferences and objectives to be historically formed without assuming that they are infinitely malleable. Education, advertising, professional communities, organizational cultures, social norms, technologies, and repeated interactions can affect what subjects attend to, expect, desire, or regard as feasible. A research programme can study these processes without denying that subjects also exhibit persistence, reflection, resistance, and internally organized commitments. GRE's analytical interest lies in the conditions through which orientation is formed and revised, a problem developed more directly in the following section on the orientation of generation.

The relationally situated subject therefore supplies an intermediate analytical position. It is more structured than an undifferentiated relational field because it permits attribution of action, capacity, burden, and value to relatively stabilized participants. It is more historically open than a permanently given agent because its boundaries, capacities, orientations, and recognized positions can themselves become objects of inquiry. This duality is central to GRE's treatment of subjecthood.

3.8.2 Subjecthood and Institutional Recognition

Economic subjecthood depends partly on recognition. Institutions specify who can open an account, hold property, enter a contract, receive a payment, owe a tax, register a company, claim a benefit, represent an organization, access a market, or be counted within an administrative category. Recognition converts a potential participant into a legible participant for a particular institutional process. The resulting subject position can carry rights, obligations, expectations, records, and pathways for future action.

Recognition is distributed across institutions rather than concentrated in a single act. Legal systems recognize persons, organizations, property titles, and contractual capacities. Firms recognize employees, managers, vendors, customers, and authorized representatives. Financial institutions recognize account holders, borrowers, guarantors, and beneficial owners through their own procedures. Platforms recognize users, creators, advertisers, sellers, developers, and automated processes through technical accounts and permissions. Public programmes recognize beneficiaries through eligibility categories. Statistical systems recognize populations through classifications that subsequently shape policy and resource allocation.

These forms of recognition need not coincide. A participant can be economically active while remaining weakly represented in administrative data. A person can be recognized by one institution and excluded by another. An organization can exist juridically while possessing limited practical capacity to act. A platform account can exercise extensive economic functions while the relevant legal obligations remain assigned to a human or organizational principal. GRE therefore treats recognition as relation-specific. It asks who or what recognizes the subject, for which purpose, under which criteria, and with which consequences.

Institutional recognition can also generate capacities. Registration can permit access to banking, procurement, insurance, or legal enforcement. A professional credential can authorize entry into a labor market. A credit history can create or restrict

borrowing possibilities. A platform reputation can affect visibility and transaction opportunities. Recognition is therefore more than descriptive classification. Under some conditions it becomes a productive resource whose possession changes future possibilities.

The converse process is economically consequential as well. Misrecognition, weak recognition, or exclusion from relevant categories can constrain participation even when material capacity exists. A skill that lacks accepted certification may command less value. Informal work can remain economically important while receiving limited legal protection or statistical visibility. Care activities can sustain productive systems while remaining weakly represented in monetary accounts. GRE can analyze these situations by separating material contribution, institutional recognition, representational visibility, and normative valuation rather than treating them as a single dimension.

Recognition also creates subject positions that may reshape conduct. A person classified as debtor, beneficiary, employee, high-risk customer, eligible applicant, or verified creator encounters a different opportunity structure and may respond to the expectations associated with that position. The category becomes economically generative when it affects access, incentives, treatment by others, or self-understanding. The same mechanism applies to organizations. Classification as a regulated institution, nonprofit entity, startup, contractor, or systemically significant actor can alter available strategies and obligations.

GRE therefore treats institutional recognition as one mechanism through which economic subjecthood becomes stabilized. It remains distinct from ultimate personhood or moral status. Institutional categories can be revised, contested, strategically used, or shown to be inadequate. Their analytical importance lies in the fact that economies operate through such acts of recognition, and those acts participate in generating the subjects that economic analysis subsequently encounters.

3.8.3 Subjecthood and Relational Persistence

Recognition at one moment is insufficient for many economic processes. Credit, employment, ownership, reputation, insurance, investment, planning, responsibility, and cooperation depend on some capacity to identify a subject across time. GRE therefore treats relational persistence as another condition of economic subjecthood. Persistence means that a configuration can remain sufficiently identifiable across a sequence of interactions for expectations, records, obligations, capacities, and value to accumulate around it.

Persistence does not require immutability. A corporation can change employees, owners, strategies, and assets while remaining recognizable as the same juridical organization for relevant purposes. A household can change membership while retaining continuing obligations and resources. A person can change occupation, preferences, health, wealth, and social position while maintaining biographical and institutional continuity. An artificial system can be updated or retrained while an operational identity, account, mandate, or deployment context persists. Subjecthood therefore depends on criteria of continuity that vary by domain.

Different institutions stabilize continuity through different devices. Names, iden-

tifiers, contracts, registries, records, credentials, accounts, signatures, organizational charts, audit trails, reputational histories, and technical logs can all support persistence. These devices allow past interactions to influence present treatment. They make possible credit histories, employment records, accumulated reputation, continuing ownership, delegated authority, and accountability. In this sense, memory is partly institutionalized in economic relations.

Persistence has generative consequences because accumulated history changes future opportunities. Trust can deepen through repeated cooperation. Debt can compound. Reputation can open or close markets. Skills can accumulate through practice. Organizational routines can increase coordination capacity. A history of exclusion can constrain later access even when formal rules change. Economic subjecthood therefore has a temporal dimension: the subject is often a carrier of selectively preserved history.

The preservation is always partial. Institutions decide which past events remain legible and which disappear. Credit systems preserve some payment histories while ignoring many contextual circumstances. Employment records preserve formal roles while omitting informal contribution. Platform metrics preserve selected traces of participation. Historical records may be unequally available across groups and organizations. GRE therefore treats persistence as an epistemic and institutional construction as well as a temporal fact. The subject that appears stable to an analyst may be stabilized by selective recording.

Relational persistence can also fail. Organizations dissolve, identities become contested, records disappear, contractual relations end, platforms remove accounts, or political and technological transformations invalidate previous classifications. Such failures can release subjects from prior constraints, erase accumulated value, disrupt responsibility, or create opportunities for reconstitution. Subject dissolution is therefore part of the economic analysis of subjecthood rather than a mere exception to stable identity.

This temporal view enables GRE to analyze subject formation without assuming a permanent core that economic relations simply reveal. A subject can become more or less coherent, legible, capable, autonomous, or constrained through time. The relevant question is which mechanisms sustain continuity, what they preserve, what they suppress, and how persistence alters the subject's future generative possibilities.

3.8.4 Human and Artificial Economic Subjects

The increasing delegation of economically consequential tasks to artificial systems makes the category of economic subject more complex. Software already performs functions such as ranking, pricing, matching, forecasting, bidding, recommending, filtering, scheduling, allocating attention, and executing transactions under specified conditions. More capable artificial systems can also participate in extended sequences of planning, communication, and decision support. GRE requires a vocabulary that can analyze such participation without presuming that functional capability settles questions of consciousness, personhood, moral standing, or legal status.

A useful distinction is between *human subjecthood* and *artificial operational subjecthood*. Human economic subjects are embodied, vulnerable, temporally finite par-

ticipants whose economic lives are connected to experience, welfare, social membership, care, rights, and material dependence. Artificial operational subjects can occupy functionally stabilized positions in economic processes when systems are authorized, configured, or institutionally treated as loci through which actions are selected and executed. Their economic relevance can be substantial even when ultimate responsibility, ownership, or legal personality remains assigned elsewhere.

Operational subjecthood can arise through delegation. An organization may authorize a software system to execute trades within limits, set prices, route logistics, select advertisements, or communicate with customers. The system then becomes a proximate locus of economically consequential action. The relevant GRE questions concern the relations that enable this delegated position: who defines the objective, who supplies data, who controls deployment, who bears losses, who can override the system, how actions are attributed, and how generated value returns to the surrounding organization.

This approach avoids a binary choice between treating artificial systems as mere passive tools and treating them as equivalents of human persons. The appropriate analytical status can vary with the inquiry. For a study of market microstructure, an automated trading agent may be a meaningful economic subject because its decisions affect prices and counterparties. For a study of moral injury, welfare, or distributive justice, the same system may be better analyzed as infrastructure or delegated mechanism while the human and organizational subjects bearing consequences remain central. Subject classification is therefore question-relative.

Artificial systems can also become components of hybrid subjects. A professional using advanced decision support may acquire capacities unavailable to either the human or the system considered independently. A firm can reorganize around automated coordination. A scientific team can distribute cognitive work across researchers, instruments, databases, and models. A platform can combine algorithms, human moderators, sellers, and users into an operational configuration. GRE can treat such configurations as composite subjects when the composite exhibits sufficient persistence, coordination, and causal relevance for the local question.

The distribution of agency within hybrid configurations is a separate problem from identifying the composite. Delegation can obscure responsibility when an outcome is attributed to “the algorithm” despite organizational choices concerning data, objectives, thresholds, deployment, monitoring, and recourse. Conversely, attributing every artificial action directly to one human decision-maker can ignore emergent behavior, organizational fragmentation, and the practical autonomy created by scale and speed. GRE therefore encourages mechanism-specific attribution across the relations that produce the action.

The coexistence of human and artificial economic subjects also changes the ecology of capability. Artificial systems can amplify the productive and cognitive capacity of some human or organizational subjects more than others. Access to compute, proprietary data, infrastructure, legal expertise, capital, and distribution can determine who benefits from artificial capability. The economic significance of artificial subjecthood consequently lies not only in what a system can do, but in how its capability is situated within ownership, institutional recognition, delegation, and return structures.

3.8.5 Heterogeneous Subjects

GRE treats heterogeneity among economic subjects as a constitutive feature of inquiry rather than a residual deviation from a representative agent. Subjects can differ in material needs, bodily vulnerability, temporal horizon, information, attention, cognitive style, social recognition, bargaining position, legal status, technological access, organizational scale, ecological dependence, and forms of value they regard as significant. These differences shape both immediate economic behavior and the generative consequences of economic relations.

Heterogeneity matters even when subjects receive formally identical resources. A monetary transfer can have different effects depending on debt, housing security, health, care obligations, local prices, social networks, or access to complementary services. The same information can be useful to one subject and unusable to another because complementary knowledge or infrastructure differs. The same employment opportunity can expand freedom for one person and intensify constraint for another because mobility, care responsibilities, or legal status differ. GRE therefore asks how an intervention interacts with subject-specific and relation-specific conditions.

Heterogeneity also concerns value. Subjects can evaluate the same outcome through different normative, cultural, professional, ecological, or experiential frameworks. A land-use change may appear as increased asset value to one actor, loss of livelihood to another, ecological degradation to a third, and disruption of cultural continuity to a fourth. Economic analysis can sometimes translate these differences into a common measure for a specific decision. GRE does not assume in advance that every relevant value admits such conversion without remainder.

Subjects also differ in their capacity to make their valuations institutionally consequential. Some can purchase expertise, influence standards, control platforms, set contractual terms, or withdraw resources. Others possess weak bargaining power or limited representational access. Heterogeneity therefore interacts with asymmetry. A plural economy does not merely contain different preferences; it contains differently empowered subjects whose ability to stabilize their preferred classifications, metrics, and conversion rules can vary substantially.

Artificial and organizational subjects add further dimensions of heterogeneity. A corporation can persist for durations and command resources unavailable to an individual. An automated system can process information at a speed and scale that differs from human cognition. A public institution can exercise authority through rules rather than exchange. A household coordinates care and consumption through relations that are only partially contractual. Treating these subjects as analytically identical would conceal the mechanisms through which they act.

GRE's response is methodological pluralism at the level of subject modeling. Some questions can use utility functions, representative agents, or homogeneous populations. Others require types, distributions, networks, institutional categories, narratives, or qualitative reconstruction. The choice should follow the mechanism and scale of interest. Heterogeneity becomes analytically important when differences among subjects alter generation, propagation, conversion, bargaining, recognition, or exposure to risk.

This perspective also protects against interpreting difference as deficiency. A sub-

ject whose capacities do not match the requirements of a particular market or institution may still possess substantial capabilities that the institution does not recognize or reward. Economic subjecthood is therefore partly relational to the evaluative and infrastructural environment. The same person or organization can appear highly capable in one configuration and weakly capable in another. GRE analyzes that relational fit rather than converting every difference into a single hierarchy of subject quality.

3.8.6 Capability Asymmetry and Ontological Distinction

Economic subjects can differ enormously in capability. A multinational firm and an individual consumer do not command comparable resources. A state and a household occupy different institutional positions. A specialized artificial system can outperform a human participant on a bounded computational task while lacking many features that organize human economic life. GRE therefore separates capability comparison from ontological classification and from normative status.

Capability is multidimensional. It can concern computation, memory, prediction, physical action, social coordination, capital access, legal authority, mobility, learning, creativity, endurance, attention, bargaining, or the capacity to absorb loss. A subject can be strong on one dimension and weak on another. Aggregate labels such as “more capable” therefore require explicit specification of the relevant capability domain and the task or environment in which it is measured.

The distinction becomes especially important in human–artificial comparison. Superior performance by an artificial system on prediction, optimization, search, coding, or information processing demonstrates a capability difference in the specified domain. It does not by itself establish equivalence in embodiment, vulnerability, experience, social membership, moral standing, legal personality, or other ontological and normative dimensions. Conversely, inferior productive performance by a human subject does not imply diminished moral status or a weaker claim to social participation. Productive capability and normative worth belong to different analytical registers.

GRE therefore resists deriving subject status directly from productivity. Economies routinely assign value to capacities that are historically contingent: strength in one technological regime, literacy in another, credentialed expertise in another, computational skill in another. Technological change can rapidly alter which capacities command market value. If recognition or participation were tied directly to currently scarce productive capabilities, changes in technology could destabilize subject status in ethically and politically consequential ways. GRE treats that possibility as an object of economic analysis rather than as a normative conclusion supplied by productivity itself.

Capability asymmetry also generates power when it affects the terms under which others can participate. A platform with superior information and scale can shape market access. A creditor with greater liquidity can impose conditions on a constrained borrower. An organization equipped with advanced artificial systems can negotiate, monitor, or produce at a level unavailable to smaller actors. The relevant issue is the conversion of capability difference into durable relational advantage. Not

every asymmetry becomes power, and the mechanism of conversion requires specification.

Institutional design can amplify or moderate capability asymmetry. Standards, interoperability, public infrastructure, collective bargaining, competition rules, education, access to compute, liability arrangements, and rights of appeal can change how capability differences affect participation. GRE's interest lies in the resulting generative structure: which subjects gain new capacities, which become dependent, which forms of value are captured, and whether the asymmetry reproduces itself through control over the conditions of future generation.

The separation among capability, ontology, and normativity thus performs several analytical functions. It permits precise comparison where comparison is meaningful. It prevents performance metrics from silently becoming theories of personhood. It allows economic analysis to study artificial subjects without assuming human equivalence. It also preserves a space in which questions of justice, rights, dignity, or welfare can be evaluated through appropriate normative arguments rather than inferred from market productivity.

3.8.7 Subjective Participation beyond Productive Necessity

Technological development raises a further question for the constitution of the economic subject: how is participation organized when a subject's contribution is no longer required for a particular productive task? Automation has long displaced and transformed tasks, while new technologies have also created new occupations, complementary roles, and forms of demand. GRE does not assume a predetermined endpoint of this process. It identifies a structural problem that becomes more visible as productive capability can be supplied by machines or highly concentrated organizations: economic participation and social subjecthood may become less tightly coupled to productive necessity.

Historically, many economic institutions connect income, recognition, schedule, social interaction, insurance, status, training, and future opportunity to employment or productive contribution. When a task disappears, the loss can therefore extend beyond wages. A subject can lose routines, networks, bargaining position, identity, institutional recognition, and pathways for capability development. Analyses that record only the change in output or income can miss this wider transformation of subject position.

GRE uses the idea of *subjective participation* to name participation through which a person or collective can remain an active locus of choice, recognition, relation, contribution, and value formation within economic life. Productive work can be one important form of such participation, but the category is broader. Care, learning, civic contribution, cultural production, scientific inquiry, community activity, consumption, stewardship, and relational maintenance can all organize economically consequential participation even when their market valuation is limited or indirect.

The economic question is therefore partly institutional. If productive necessity declines for some subjects, which mechanisms connect them to resources, capabilities, recognition, and opportunities for meaningful participation? Several institutional arrangements are conceivable, and GRE need not select among them at the level of

disciplinary constitution. The research programme can instead examine how different arrangements affect autonomy, dependence, value generation, social recognition, bargaining power, capability development, and the distribution of future possibilities.

This problem also applies within organizations. An employee whose routine tasks are automated can become more capable when artificial tools release time for judgment, learning, care, design, or coordination. The same technological change can instead narrow the employee's role to monitoring a system controlled elsewhere. The distinction depends on ownership, training, discretion, workflow design, evaluation, and bargaining relations. Automation therefore transforms subjecthood through the surrounding institutional field rather than through task substitution alone.

Artificial systems intensify the question because they can participate in economic processes without requiring the same conditions for welfare, livelihood, social membership, or embodied reproduction as human subjects. A production system organized solely around output can therefore allocate increasingly large shares of economically consequential activity to artificial or organizational subjects while human participation becomes administratively residual. Whether and how institutions respond is a normative and political question; the economic analysis concerns the relations through which such a configuration affects value, demand, bargaining, recognition, capability, and social reproduction.

GRE thus separates the right to analyze productive contribution from the broader question of subject participation. It does not assume that economic inclusion must be earned through scarcity of labor, nor does it presume a specific institutional alternative. It asks how systems generate or foreclose forms of participation when technological and organizational change modifies the economic necessity of particular human capacities. The answer will depend on the orientation of generation, the subject of the following section.

3.8.8 Subject Formation as an Economic Process

The preceding subsections imply a final constitutional claim: subject formation is itself an economic process. Economic relations do more than coordinate already formed subjects. They participate in producing the capacities, identities, expectations, dependencies, temporal horizons, and recognized positions through which subjects subsequently act. GRE therefore includes subject formation within its field of inquiry whenever economic mechanisms materially contribute to that formation.

Labor markets provide a clear illustration. Education and credentialing prepare subjects for occupational categories; hiring procedures classify them; employment develops some skills while allowing others to decay; organizational hierarchies distribute authority; compensation affects outside options; performance metrics orient attention; career ladders shape expectations about the future. The resulting worker is neither created wholly by the labor market nor independent of it. Subject formation occurs through the interaction of economic, educational, familial, legal, cultural, technological, and biological processes.

Credit relations can similarly generate debtor subject positions. Access to credit expands purchasing or investment capacity while repayment schedules reorganize fu-

ture income. Credit histories affect later access. Default categories alter institutional treatment. Financial literacy, risk tolerance, and expectations can change through repeated borrowing. The economic subject that returns to a credit market is therefore historically modified by previous participation.

Platforms generate other subject forms through accounts, metrics, rankings, recommendation systems, monetization rules, and categories of permissible participation. A person can become a seller, creator, driver, host, advertiser, moderator, or rated customer through platform-specific infrastructures. These positions can create capabilities and income while also subjecting participants to new dependencies, forms of visibility, and evaluative systems. Artificial systems can likewise acquire operational subject positions through permissions, interfaces, memory, delegated objectives, and persistent identifiers.

Property institutions contribute to subject formation by stabilizing relations of control, responsibility, inheritance, exclusion, and expectation. Welfare institutions constitute beneficiary categories. Tax systems recognize households, firms, dependents, and taxable events. Corporate law stabilizes organizations that can persist beyond individual members. Monetary institutions constitute account holders and counterparties. Economic subjecthood therefore emerges repeatedly through institutional architectures that define who can do what, with which resources, under which records and obligations.

Subject formation also has recursive effects. Once a subject position is stabilized, subjects can act to preserve, reinterpret, contest, or transform the relations that formed them. Workers organize; firms lobby; consumers coordinate; professional groups set standards; communities create institutions; platform participants develop practices that alter platform design. Subject formation is therefore compatible with reflexivity. Generated subjects can become generators of subsequent institutional change.

This recursive structure connects subject analysis to GRE's broader concern with transformation of generative conditions. An economic system can generate subjects whose capacities and orientations reinforce the system. It can also generate subjects capable of questioning, modifying, or leaving it. Educational investment can create workers suited to an existing industrial structure while also producing knowledge that enables new industries. Financial systems can stabilize prevailing ownership while funding innovations that disrupt incumbent firms. Organizational routines can reproduce hierarchy while creating expertise that later supports institutional reform. The direction of subject formation is therefore neither mechanically reproductive nor inherently emancipatory.

For empirical work, treating subject formation as an economic process requires evidence appropriate to the mechanism. Administrative records can reveal changing classifications and access. Longitudinal data can track capability or income trajectories. Organizational records can show role transformation. Interviews and ethnography can recover changes in interpretation, identity, and perceived possibility. Experiments can identify bounded responses to institutional arrangements. Computational methods can trace large-scale patterns of classification or interaction. GRE does not privilege one method; it requires the method to match the dimension of subject formation being claimed.

The economic subject can now be located within the constitutional architecture of Chapter 3. GRE treats subjects as relatively stabilized participants whose capacities, recognition, persistence, and orientations are relationally conditioned and historically transformable. Human, organizational, and artificial subjects can all enter economic analysis while remaining ontologically and normatively distinct. Capability asymmetry can shape power without determining moral status. Participation can remain economically important even when particular productive contributions lose scarcity. Subject formation itself can be generated through economic relations and can recursively transform those relations in return.

This account also identifies the next constitutional problem. If economic relations help generate subjects, capacities, attention, and future possibilities, the direction of that generation cannot be treated as analytically empty. Economic systems select, reward, amplify, suppress, and stabilize different possibilities. Section 76 therefore turns from the constitution of subjects to the orientation of generation: the processes through which attention, curiosity, aesthetic judgment, epistemic priorities, institutional selection, and heterogeneous value structures influence what becomes economically generative.

3.9 GRE and the Orientation of Generation

Generative Relational Economics treats economic generation as more than the production of additional outputs from given inputs. Economic relations can enlarge, redirect, stabilize, or close future possibilities; they can generate capacities, questions, representations, institutions, expectations, forms of value, and modes of participation. Once generation is understood in this wider sense, a further analytical problem becomes unavoidable: generative processes are oriented. Among many possible objects of attention, questions, investments, designs, interpretations, and institutional trajectories, some become salient and others remain peripheral. The role of this section is to make that directional dimension explicit within the constitution of GRE. Its objective is to identify several mechanisms through which orientation is formed and economically consequential without reducing orientation to a single preference ordering or normative criterion. The discussion proceeds through attention and salience, curiosity and question formation, aesthetic judgment, epistemic orientation, institutional selection, and heterogeneous value structures before locating orientation itself as an economic and political problem. The method remains constitutive rather than exhaustive: these mechanisms identify admissible objects of GRE inquiry and can be combined differently across empirical domains.

Orientation occupies a position between possibility and realized generation. A field can contain several technically feasible innovations, several plausible interpretations of evidence, several ways of organizing care, several institutional reforms, or several investments capable of producing future value. Generativity alone does not determine which possibility receives resources, recognition, attention, or continued development. Selection occurs through subjects, organizations, infrastructures, norms, evaluative conventions, histories, and unequal capacities to make one possibility visible or actionable. GRE therefore asks not only what a relation can generate, but how its generative direction becomes selected, reinforced, contested, or revised.

This problem is distinct from saying that every economic process possesses a conscious purpose. Orientation can arise without centralized intention. Search rankings alter attention; funding rules privilege some questions; professional conventions stabilize standards of relevance; prices redirect investment; built environments make some actions easier than others; inherited categories determine what can be recorded; and repeated interaction can make one trajectory increasingly probable. Orientation can therefore be intentional, institutional, distributed, emergent, or mixed. What matters for GRE is the mechanism through which a space of possibilities becomes unevenly weighted and how that weighting changes subsequent generation.

3.9.1 Direction within Generative Processes

Generation becomes analytically directional whenever several possible continuations are available and the realized process favors some over others. A research group can investigate several questions but allocates effort to a subset. A firm can deploy capital across several technologies but selects particular projects. A city can support several mobility arrangements but builds infrastructure that makes some trajectories easier to reproduce. A household can convert additional income into consumption, education, savings, care, mobility, or debt reduction. In each case, resources enter a relational configuration whose later consequences depend partly on how possibilities are selected.

Direction should be distinguished from destination. A destination specifies an endpoint toward which activity is explicitly organized. Direction can be weaker and more distributed. It can consist in a persistent bias toward particular questions, objects, timescales, values, or forms of recognition even when no actor has specified a final state. An institution that rewards measurable short-term outputs may orient inquiry toward easily countable achievements without formally prohibiting long-horizon research. A credit system can orient firms toward revenue models compatible with repayment schedules without prescribing a specific product. A platform can orient cultural production through visibility metrics even when creators retain formal freedom over content. GRE is interested in these directional effects because they alter the future distribution of generative opportunity.

Orientation should also be distinguished from deterministic selection. A strong directional field can coexist with novelty, resistance, and contingency. Subjects can reinterpret incentives, institutions can be repurposed, and unexpected relations can open alternatives. The analytical claim is therefore probabilistic and structural: some configurations make particular generative pathways easier to enter, sustain, fund, legitimate, or recognize than others. The strength of orientation is an empirical question that can vary across scales and historical periods.

The concept also permits several levels of analysis. At the level of a subject, orientation can concern attention, aspiration, perceived possibility, or evaluative judgment. At the organizational level, it can concern strategy, metrics, hiring, budgeting, and project selection. At the institutional level, it can concern law, professional standards, eligibility rules, and classification systems. At the infrastructural level, it can concern access, interoperability, search, transportation, or computation. At the cultural level,

it can concern what appears admirable, credible, urgent, or worth pursuing. These levels can reinforce or conflict with one another.

Direction becomes especially consequential when orientation feeds back into the conditions of future choice. A selected research programme develops specialized instruments and expertise, making adjacent questions easier to investigate. An industry cluster attracts suppliers and workers, increasing the relative feasibility of further investment in the same domain. A classification adopted for administrative convenience can accumulate datasets organized around its categories, making alternative classifications harder to operationalize. What begins as selection among possibilities can therefore become a transformation of the possibility structure itself.

GRE treats this recursive effect as one reason to study orientation separately from immediate allocation. Allocation determines where resources initially go. Orientation concerns the relational processes that make some uses, interpretations, and continuations more likely to become generative. Their interaction can produce path dependence without requiring that the path was planned in advance. Orientation is thus a bridge between local selection and historical transformation.

3.9.2 Attention and Salience

Attention is a scarce and selective condition of economic participation. Subjects, organizations, and institutions encounter more signals, opportunities, demands, and possible actions than they can process with equal intensity. What enters attention can therefore influence what becomes available for evaluation and generation. GRE treats attention not simply as an internal cognitive resource but as relationally organized through environments, interfaces, institutions, social expectations, and distributions of visibility.

Salience is one mechanism through which this organization occurs. An object can become salient because it is perceptually striking, institutionally emphasized, repeatedly measured, socially endorsed, economically rewarded, emotionally charged, or strategically amplified. Salience need not indicate importance in any independent normative or causal sense. A highly visible indicator can dominate decision making while a less visible condition exerts larger long-term effects. Conversely, a previously neglected relation can become salient when a crisis, measurement innovation, public controversy, or new interpretive framework makes it perceptible as an economic problem.

The economic consequences of salience are therefore twofold. First, salience affects allocation of attention in the present. A firm monitors some indicators more closely than others; an investor notices some opportunities; a public agency prioritizes some risks; a consumer sees some products; a researcher encounters some literatures. Second, repeated attention can alter the object itself. Metrics invite optimization, visibility attracts resources, and recognized problems acquire organizations, professions, and infrastructures devoted to them. Attention can consequently become generative rather than merely observational.

Digital mediation intensifies this issue because ranking, recommendation, notification, and search systems actively order visibility. Their orientation effects may arise from commercial objectives, relevance models, engagement metrics, modera-

tion rules, personalization, or technical constraints. The resulting distribution of attention can affect demand, reputation, cultural production, political communication, and the formation of economic subjects. GRE need not assume that a platform fully controls these outcomes. It can instead ask which mechanisms structure exposure, how users respond, and how visibility feeds back into production and value.

Attention also interacts with inequality. Subjects differ in their capacity to command attention and in their ability to protect their own attention from external capture. Advertising budgets, institutional prestige, network centrality, media access, and control over interfaces can increase one actor's capacity to make objects salient to others. At the same time, workers, consumers, citizens, and researchers can face environments saturated with demands on attention. The distribution of attention therefore has both productive and power dimensions.

A GRE analysis should avoid equating attention with endorsement. A subject may attend to an object because it is threatening, unavoidable, controversial, or institutionally mandatory. Nor should measured engagement be treated as a complete representation of attention. Observable clicks, purchases, dwell time, or citations are partial indicators conditioned by the platform or institution through which they are recorded. The relation between salience, attention, interpretation, and later action requires empirical specification.

Attention becomes a problem of orientation when it changes which possibilities can enter generative processes. What remains persistently unseen may receive neither investment nor institutional articulation. What becomes hyper-salient can attract disproportionate resources and narrow alternative exploration. GRE therefore studies the production and distribution of salience as part of the economic organization of possibility.

3.9.3 Curiosity and Question Formation

Curiosity introduces a different form of orientation. Attention identifies what enters a field of concern; curiosity can transform an encountered difference, anomaly, absence, or possibility into an object of inquiry. This transformation matters economically because new questions can redirect research, entrepreneurial activity, public investment, education, and institutional experimentation before the value of an answer is known.

Question formation is generative in a stronger sense than information acquisition. A subject seeking a known datum operates within a pre-specified problem. A newly formulated question can reorganize the problem-space itself by distinguishing previously conflated phenomena, proposing a new comparison, or making an unrecognized relation investigable. The economic consequences can be substantial. Scientific questions create research programmes; engineering questions motivate design trajectories; policy questions define measurable problems; entrepreneurial questions organize searches for unmet needs or new combinations.

Curiosity should not be romanticized as an unconstrained internal virtue. Opportunities for curiosity are institutionally distributed. Time, income security, educational access, research infrastructure, mentorship, mobility, archival access, computational resources, and tolerance for failure all affect who can pursue uncertain questions. A

person may possess strong curiosity while lacking the relational conditions required to sustain inquiry. Conversely, organizations can create protected spaces in which exploratory questions become economically viable despite uncertain short-term returns.

Question formation is also socially mediated. A discipline defines which questions appear legitimate, mature, trivial, or impossible. A market communicates demand signals that make some problems commercially visible. Public institutions define categories of need. Communities preserve practical knowledge that can make different questions salient from those generated in professional research settings. Interdisciplinary contact can expose assumptions that remain invisible within a single field. Curiosity therefore emerges within histories of classification, authority, and encounter.

The economic orientation of curiosity becomes visible in the distribution of exploratory resources. Research grants, venture finance, procurement programmes, universities, laboratories, foundations, public challenges, and organizational slack all influence which uncertain inquiries can be sustained long enough to generate results. These mechanisms differ from ordinary exchange because expected value may be difficult to estimate ex ante. Selection often relies on judgments concerning plausibility, novelty, promise, social relevance, or strategic fit rather than on known outputs.

GRE can therefore analyze curiosity as a relational capacity with downstream economic effects. It can ask how an environment makes questions possible, how inquiry becomes sustained, how failed questions still generate capabilities or networks, and how exploratory activity alters the future set of feasible projects. It can also examine exclusion: whose questions receive recognition, which experiences become researchable problems, and which uncertainties remain institutionally invisible.

This perspective does not imply that more curiosity is always better. Unbounded exploration can consume resources, produce distraction, or impose risks on others. Some domains require reliability, maintenance, and disciplined exploitation of established knowledge. GRE's task is not to assign curiosity an intrinsic positive value, but to make visible the conditions under which question formation becomes economically generative and the trade-offs through which exploratory orientation is governed.

3.9.4 Aesthetic Judgment

Economic generation often proceeds under incomplete evidence. Researchers choose among conjectures before proof is available. Designers compare forms before market response is known. Investors assess emerging projects with limited histories. Engineers select architectures before every downstream consequence can be calculated. Public institutions imagine futures for which no complete dataset exists. In such settings, judgment frequently includes an aesthetic dimension: a sense that a problem, pattern, design, explanation, or possibility is elegant, coherent, beautiful, compelling, fertile, proportionate, or otherwise worthy of continued attention.

GRE treats aesthetic judgment as a possible orientation mechanism rather than as a universal or infallible faculty. The term refers here to evaluative responses that help rank possibilities when propositional evidence does not fully determine selec-

tion. Such judgments can concern mathematical elegance, conceptual simplicity, visual form, narrative coherence, spatial atmosphere, craftsmanship, symbolic resonance, or the perceived fertility of a question. Their content varies across practices and communities.

Aesthetic judgment can become economically consequential because it directs scarce exploratory resources. Scientists choose which problems feel deep or promising. Architects and planners create environments that shape movement and encounter. Consumers attach value to form and atmosphere. Organizations cultivate identities through design. Investors may respond to narrative and presentation alongside formal projections. Cultural industries depend directly on aesthetic differentiation. In each case, aesthetic orientation participates in the generation of value without being reducible to price.

The relational character of aesthetic judgment is important. Judgments are neither simply arbitrary private tastes nor automatically universal properties of objects. They are formed through histories of training, exposure, comparison, convention, embodiment, and social interaction. What appears elegant to a mathematician, trustworthy to a patient, refined to a consumer, or harmonious to a community can depend on learned repertoires and material environments. Institutions can therefore cultivate, standardize, or marginalize aesthetic criteria.

This relationality creates both generative possibility and power. Shared aesthetic repertoires can coordinate collaboration and make complex quality judgments possible without complete formalization. They can also become exclusionary when dominant groups define legitimate taste, professional style, or intellectual beauty. A funding committee's sense of what constitutes an "interesting" question, for example, may reproduce disciplinary histories that favor some objects and methods. Aesthetic judgment can thus influence resource allocation even when it is not formally acknowledged.

GRE should keep aesthetic judgment distinct from truth, welfare, and justice. An elegant theory can be empirically wrong. A beautiful design can be inaccessible or harmful. A compelling narrative can conceal exploitation. A technically awkward solution can nevertheless generate substantial social value. The analytical significance of aesthetic judgment lies in its role in orientation under uncertainty, not in a presumption that aesthetic approval validates the selected object.

Aesthetic orientation also interacts with serendipity. Encounters that were not sought for instrumental reasons can become generative when a subject experiences them as salient, intriguing, beautiful, strange, or worth pursuing. The generative consequence depends on both encounter and judgment. An environment rich in variation does not guarantee innovation; subjects and institutions must still recognize some differences as invitations to inquiry or creation. This suggests an economic problem of field design: how can environments sustain heterogeneous encounters and exploratory judgment without attempting to pre-engineer the exact novelty that should emerge?

Within GRE, aesthetic judgment therefore belongs to the analysis of orientation because it can influence which possibilities receive further attention, articulation, resources, and institutional support. Its mechanisms require contextual investigation,

and its normative status remains open to separate evaluation.

3.9.5 Epistemic Orientation

Economic generation is also directed by epistemic orientation: the standards, classifications, methods, evidential expectations, and interpretive habits through which subjects and institutions decide what can be known, what counts as relevant evidence, and which uncertainties deserve investigation. Epistemic orientation does not merely affect description after economic processes occur. It can shape which processes become actionable and therefore which futures are generated.

Measurement provides a direct example. Once an organization adopts a metric, activity can reorganize around what the metric makes visible. Data collection creates categories, time series, benchmarks, and comparison groups. These representations can improve coordination and accountability, but they also privilege some dimensions over others. A phenomenon that cannot be recorded within the existing schema can remain difficult to govern even when participants experience it as important. Epistemic orientation therefore influences institutional capacity through the design of observability.

Methods likewise orient inquiry. Randomized experiments, econometric identification, ethnography, archival reconstruction, simulation, network analysis, participatory research, and legal interpretation provide access to different dimensions of a problem. Their strengths are domain-specific. When one method becomes institutionally dominant, questions that fit its evidential architecture can become easier to legitimate and fund. GRE's methodological pluralism is partly a response to this orientation effect: the research problem should guide method selection rather than allowing an inherited method to define the only admissible problem.

Classification is another generative mechanism. Administrative categories determine eligibility, statistics, taxation, regulation, and rights. Market classifications affect comparability and exchange. Scientific classifications shape research populations. Professional categories define expertise. Once stabilized, classifications can influence behavior and identity, making the represented distinctions increasingly consequential. Epistemic orientation therefore links representation to ontology without collapsing the two: categories can help generate social effects even though the category remains analytically distinct from the object it represents.

Epistemic orientation has a temporal dimension. Institutions inherit archives, standards, vocabularies, and datasets from earlier periods. These resources make some historical comparisons possible while leaving other experiences poorly recorded. New questions are therefore conditioned by the epistemic infrastructure accumulated in the past. At the same time, present recording decisions shape what future investigators will be able to reconstruct. The organization of knowledge becomes part of intertemporal economic capacity.

Disagreement over epistemic orientation can be productive. Competing models, disciplinary perspectives, and interpretive frameworks can reveal different aspects of a system. GRE does not require premature convergence on a single representation. It asks whether the plurality of representations is explicit, whether their assumptions and domains of validity are understood, and whether institutions preserve the capac-

ity to revise their epistemic orientation when anomalies or changing conditions make existing categories inadequate.

This emphasis also limits the role of formal precision. A precisely estimated quantity can answer a poorly oriented question, while a qualitative observation can reveal a relation that has not yet been formalized. GRE values formal and computational methods where they perform genuine analytical work, but epistemic orientation precedes technique in the sense that the researcher must first decide what distinctions, scales, and forms of evidence are relevant to the inquiry.

3.9.6 Institutional Selection of What Is Generated

Orientation becomes institutional when durable rules, organizations, infrastructures, and evaluative procedures repeatedly privilege some generative pathways over others. Institutions do not need to specify the content of future outcomes in order to shape them. By controlling eligibility, resources, recognition, standards, timing, and access, they can alter which possibilities survive long enough to become self-sustaining.

Funding systems provide an obvious case. Research grants, venture investment, bank credit, public procurement, philanthropy, and internal organizational budgets each use different selection criteria. Those criteria can favor measurable returns, strategic importance, novelty, reliability, social need, collateral, prior reputation, or compatibility with existing infrastructure. A funding architecture therefore orients generation before the downstream value of a project is known. Its effects accumulate when successful projects create expertise, reputation, and networks that improve their access to future resources.

Legal and regulatory institutions also orient generation. Intellectual-property rules affect incentives and diffusion. Liability rules influence experimentation. Licensing can protect safety while raising entry barriers. Competition policy changes the conditions under which scale can consolidate. Data governance shapes access to informational resources. Labor and social-protection institutions influence the risks subjects can bear when changing occupations or starting new projects. In each case, legal structure changes the feasible and attractive trajectories available to economic actors.

Educational institutions orient generation by shaping capabilities, vocabularies, disciplinary boundaries, and aspirations. Curriculum determines which problems become familiar. Credentials affect access to professions and organizations. Mentorship can make previously invisible pathways imaginable. Evaluation systems influence whether students optimize for standardized performance, exploration, collaboration, or independent inquiry. Education therefore participates in economic generation long before its effects appear as wages or productivity.

Markets themselves are institutional selection environments. Prices, demand, competition, and profitability orient resources toward some activities and away from others. GRE retains this insight while asking how market selection interacts with other orientation mechanisms. Markets depend on property rules, infrastructures, classifications, information, financing, and distributions of purchasing power. A profitable opportunity can reflect genuine social demand, concentrated wealth, regulatory de-

sign, network effects, or externalized costs. Market orientation is therefore economically powerful without being normatively self-interpreting.

Platforms and algorithmic systems add another layer by combining infrastructure, ranking, rule enforcement, and data collection. Their selection mechanisms can shape which sellers are visible, which workers receive tasks, which content gains distribution, and which behaviors become economically rewarded. Because participants often adapt to these selection systems, the platform's orientation can become recursive: metrics influence behavior, behavior supplies new data, and new data update the mechanism that structures visibility or access.

Institutional orientation also creates lock-in and complementarity. Once organizations invest in a technology, standard, profession, or accounting category, adjacent investments may become more valuable. Alternative pathways then face higher switching costs even if they are technically feasible. The resulting persistence can be efficient when coordination benefits are large, but it can also preserve arrangements whose original justification has weakened. GRE therefore asks how institutional selection creates future dependency and what forms of optionality remain available.

The analytical objective is not to identify a single institution responsible for orientation. Selection is often distributed across finance, law, culture, infrastructure, expertise, and public authority. A GRE inquiry traces how these mechanisms combine and where control over selection becomes concentrated, contested, or open to revision.

3.9.7 Plural Orientations under Heterogeneous Values

Economic systems contain subjects and communities whose orientations differ. They may disagree about desirable outcomes, relevant time horizons, legitimate evidence, acceptable risk, ecological obligations, cultural continuity, forms of recognition, or the value of particular capabilities. GRE treats this heterogeneity as a constitutive feature of orientation rather than assuming that all relevant directions can be represented by one shared scalar objective.

Plural orientation creates coordination problems. A project that expands aggregate income can weaken a local form of life. A conservation policy can protect ecological conditions while constraining livelihoods unless transition mechanisms are provided. A technological system can increase convenience for users while intensifying surveillance or labor precarity. A research programme can generate broadly useful knowledge while concentrating intellectual property. These tensions cannot always be resolved by discovering a hidden common metric.

Value conversion can help decision making when the conversion rule is explicit and appropriate. Monetary valuation, cost-effectiveness, multi-criteria analysis, voting, deliberation, legal balancing, and negotiated compromise are among the mechanisms institutions use to compare heterogeneous claims. GRE does not reject such conversions. It asks what is gained and lost through them, whose valuations enter the procedure, and whether the conversion becomes mistaken for an ontological equivalence among the values involved.

Plural orientation also means that generativity itself can be evaluated differently.

One group may value rapid innovation; another may value reliability and continuity. One institution may prioritize employment; another ecological regeneration; another strategic autonomy; another freedom of inquiry. A relation can therefore be highly generative according to one orientation while appearing destructive according to another. The disagreement concerns both produced outcomes and the standards through which generation is interpreted.

Institutions can respond to plural orientation through several architectures. They can aggregate preferences into a single decision, allocate separate domains of authority, preserve local autonomy, establish rights that constrain aggregation, create deliberative procedures, or maintain experimental diversity across jurisdictions and organizations. Each architecture has generative consequences. Centralization can coordinate large-scale investment but narrow local variation. Decentralization can preserve experimentation but weaken collective capacity. Rights can protect vulnerable subjects while limiting some forms of optimization. GRE treats these trade-offs as empirical and normative objects rather than deriving a universal institutional design.

The distribution of voice matters because heterogeneous values do not enter decision processes with equal force. Wealth, legal status, expertise, organizational capacity, time, language, and control over infrastructure can affect which orientations become institutionally consequential. A formally plural process can therefore reproduce asymmetry if some actors possess much greater ability to define agendas, supply evidence, or sustain participation. Analysis of orientation must consequently include the conditions of representation and participation.

Plurality also has an epistemic benefit. Different orientations can reveal consequences that a dominant framework misses. Workers, users, local communities, engineers, ecologists, regulators, and investors can perceive different dimensions of the same system. Maintaining structured disagreement can therefore increase the system's capacity to detect emerging harms or opportunities. Diversity of orientation is not automatically valuable, but under some conditions it functions as a distributed sensing and exploration mechanism.

For GRE, the constitutional implication is that economic orientation should remain representationally plural unless a specific analytical or decision context justifies aggregation. Heterogeneous values are not noise to be removed before economic reasoning begins. They are part of the relational field through which generation is directed and evaluated.

3.9.8 Orientation as an Economic and Political Problem

Orientation becomes an economic problem because it influences the allocation and generation of scarce capacities across time. Attention, research effort, capital, infrastructure, education, organizational commitment, and institutional legitimacy cannot be devoted equally to every possibility. Selection therefore shapes which capabilities accumulate, which industries form, which questions receive answers, which risks become visible, and which subjects gain access to future opportunities. Orientation is economically consequential even when no market transaction directly prices it.

It becomes a political problem when the authority to orient generation is unevenly

distributed or collectively contested. Governments set research priorities and infrastructure plans. Firms select technologies and business models. Platforms organize visibility. Financial institutions influence investment trajectories. Professional bodies define standards. Universities establish curricula and disciplines. Communities defend or transform local practices. Individuals exercise agency within these fields but do not enter them with equal resources. Orientation is therefore partly a question of who can shape the conditions under which future possibilities become more or less available.

This form of power is upstream from many observable outcomes. Control over a final allocation matters, but control over the categories, infrastructures, questions, and selection procedures through which future allocations will be made can have longer-lived effects. A subject that determines what can be measured, funded, connected, certified, or searched can influence generation without dictating every downstream action. GRE can analyze this as power over generative conditions while still requiring concrete mechanisms rather than inferring power from asymmetry alone.

The political character of orientation also appears in conflicts over temporality. Short electoral cycles, quarterly reporting, long infrastructure lifetimes, ecological regeneration, intergenerational obligations, and scientific research operate on different temporal horizons. Institutions that privilege one horizon can redirect generation away from possibilities whose value emerges later. The question is not simply whether actors discount the future, but how organizational and institutional arrangements determine whose future, which risks, and which forms of value remain actionable in the present.

A generative orientation can also produce foreclosure. Investment in one infrastructure can make alternatives expensive. A dominant technical standard can exclude incompatible innovations. A classification can make some identities administratively invisible. A business model can generate dependency that reduces exit options. Foreclosure is therefore the counterpart of orientation: selecting and reinforcing one trajectory changes the feasibility of others. GRE evaluates orientation partly by tracing these changes in future option sets rather than only immediate outputs.

This does not imply that preserving every option is desirable. Coordination, commitment, specialization, and institution building often require closing alternatives. A society cannot maintain every infrastructure standard simultaneously, and an organization cannot pursue every project. The analytical question concerns the terms under which closure occurs, its reversibility, who bears the resulting constraints, and whether institutions retain capacities for revision when conditions change.

Orientation also connects economic analysis to governance. A governance system can attempt to specify desired outcomes directly, or it can shape fields in which desirable forms of generation are more likely to emerge. The latter approach may involve public infrastructure, open standards, rights, research capacity, plural participation, safety constraints, or mechanisms for feedback and revision. Such field-oriented governance does not eliminate political choice; it relocates part of that choice to the design of enabling and constraining conditions.

The constitutional position of GRE is therefore neither that generation should be maximized nor that orientation should be centralized. GRE makes orientation visible

as an object of economic inquiry. It asks how attention, curiosity, aesthetic judgment, epistemic practices, institutions, and heterogeneous values combine to direct generative processes; how orientation distributes future capacities and risks; how power enters selection; and how orientations themselves change through history.

This completes the present chapter's account of one major dimension of GRE's problem-space. Economic generation is mediated by subjects, but subjects themselves are formed through relations; generation is directional, but direction arises through multiple cognitive, institutional, symbolic, and political mechanisms. The next constitutional task is methodological. The following section therefore distinguishes the principal modes through which GRE can describe, explain, reconstruct, compare, interpret, formalize, evaluate, and intervene in the economic processes identified here.

3.10 Modes of GRE Inquiry

Generative Relational Economics requires methodological breadth because its objects are heterogeneous and its questions concern several different kinds of claim. A study may need to describe a relational configuration, explain how it is reproduced, reconstruct how it emerged historically, compare it with alternative configurations, interpret the meanings through which subjects act, identify causal effects, formalize a mechanism, simulate possible trajectories, evaluate consequences normatively, or design an intervention. These tasks are related, but they are not interchangeable. The role of this section is to distinguish the principal modes through which GRE can conduct inquiry while preserving their mutual compatibility. Its objective is methodological clarification rather than the prescription of a single research design. The discussion proceeds from descriptive and explanatory inquiry through historical, comparative, interpretive, causal, formal, computational, normative, and intervention-oriented modes. Across them, the governing principle is that each mode must make explicit what kind of claim it is entitled to support, which evidence or representation bears that claim, and where its warrant ends.

The distinction among modes concerns the epistemic work being performed rather than a rigid classification of disciplines or techniques. An interview can contribute to descriptive, interpretive, historical, causal, or normative inquiry depending on how it is used. A regression can support description, comparison, or causal inference under different designs. Archival material can reconstruct a historical sequence while also revealing institutional meanings and mechanisms. A simulation can clarify the consequences of specified assumptions without establishing that the modeled mechanism exists empirically. GRE therefore classifies inquiry by the relation between question, evidence, representation, and warranted conclusion rather than by the surface form of the method alone.

The modes also differ from the objects and scales identified earlier in this chapter. The same object can be approached through several modes. A platform can be described as an organization and infrastructure, interpreted through the classifications embedded in its interface, studied causally through changes in ranking rules, reconstructed historically through its institutional development, represented formally as a

multilayer network, evaluated normatively through the distribution of generated capacities and harms, and examined interventionally through alternative governance designs. Methodological plurality becomes useful precisely because the object does not determine a unique mode of inquiry.

GRE does not require every project to use every mode. A narrowly designed causal study can be valuable if its boundaries are clear. A historical reconstruction can illuminate the emergence of a generative structure without formalization. An interpretive study can reveal categories that would otherwise be mismeasured. A formal model can clarify possible mechanisms before adequate data exist. The methodological demand is therefore fit rather than comprehensiveness: the mode or combination of modes should match the question and should remain corrigible by evidence or arguments arising from other modes when their domains overlap.

3.10.1 Descriptive Inquiry

Descriptive inquiry establishes what is present, how it is distributed, how it is related, and how it changes over a specified observational domain. In GRE, description can concern entities, subjects, relations, resources, capacities, forms of value, constraints, institutional rules, symbolic representations, trajectories, or fields. Its importance is easily underestimated because description is sometimes treated as a preliminary stage before "real" explanation. Yet a relational research programme depends heavily on careful description: a mistaken boundary, omitted relation, inappropriate unit, or unstable category can distort every later explanatory or normative claim.

A GRE description is therefore more than an inventory of isolated attributes. It can map relational incidence: who is connected to whom, through which mechanism, under what terms, and with what asymmetries. It can characterize distributions of access, exposure, recognition, risk, or capability. It can identify temporal patterns such as persistence, turnover, accumulation, or decay. It can distinguish administrative recipients from affected subjects and can trace where value, constraints, or opportunities appear outside the nominal boundary of a programme or transaction. Description thereby makes the relational field empirically available before deeper attribution is attempted.

The construction of descriptive categories requires explicit judgment. Terms such as worker, household, platform, community, firm, beneficiary, asset, skill, trust, or harm are not self-interpreting. Their operationalization can depend on legal definitions, institutional records, self-identification, measurement conventions, or analytical reconstruction. GRE therefore treats descriptive categories as representations whose adequacy must be justified relative to the question and scale. A category can be useful without being ontologically final, and a stable administrative classification can remain inadequate for a relational question if it suppresses relevant interactions or affected subjects.

Description also has a temporal dimension. Cross-sectional description captures a configuration at a moment or interval, while longitudinal description tracks changes in states, relations, or distributions. The latter becomes especially important when generation concerns future capacities. A programme that appears distributively modest at one date may substantially change later educational, technological, organiza-

tional, or relational possibilities. Conversely, an apparent short-term gain may dissipate or convert into dependence. Descriptive inquiry can reveal these trajectories without yet claiming a mechanism for them.

Rich description can combine quantitative and qualitative evidence. Administrative records may establish scale and distribution; interviews may reveal unrecorded relations; ethnographic observation may show how formal rules are enacted; network data may identify patterns of connectivity; documents may clarify institutional categories; spatial data may reveal infrastructural concentration. GRE has no reason to privilege one evidence type in advance. The relevant standard is whether the descriptive representation captures the features required by the question while making omissions and uncertainty visible.

Descriptive adequacy also depends on boundaries. A study of a firm's wage policy can stop at employees, extend to households, include subcontractors, or incorporate local labor markets and public services. Each boundary produces a different descriptive object. GRE does not assume that the widest boundary is always best; wider boundaries increase complexity and can reduce tractability. The researcher instead states why a boundary is appropriate and tests whether excluded relations materially alter the description.

The output of descriptive inquiry is therefore a warranted account of configuration rather than a claim about why the configuration exists. It establishes patterns that explanatory, historical, causal, interpretive, or normative inquiry may subsequently address. In GRE, this mode is foundational because relational and generative claims become meaningful only after the relevant configurations, transitions, and affected subjects have been specified with sufficient empirical discipline.

3.10.2 Explanatory Inquiry

Explanatory inquiry asks how and why an observed configuration, transition, or regularity occurs. GRE gives particular attention to mechanisms through which relations produce, reproduce, transform, amplify, or constrain later possibilities. Explanation can therefore address immediate effects, recursive feedback, institutional reproduction, conversion among forms of value, subject formation, cross-scale propagation, or changes in the conditions under which subsequent generation occurs.

Explanation requires more than naming a correlation or attaching a familiar concept to an outcome. To say that an outcome results from power, incentives, norms, networks, institutions, culture, or path dependence is incomplete unless the operative process is specified sufficiently to connect conditions to consequences. A GRE explanation should identify the relevant actors or configurations, the relations through which effects travel, the enabling and constraining conditions, the temporal sequence where it matters, and the observations that would distinguish the proposed mechanism from plausible alternatives.

Mechanistic explanation can operate at different levels. A change in organizational behavior may be explained through individual incentives, professional norms, governance rules, technological affordances, inter-organizational dependence, or combinations among them. These explanations need not compete if they address different parts of the process. GRE is particularly interested in explanations that connect

levels without treating one as automatically fundamental. A legal rule can alter organizational incentives; organizational practices can reshape individual capabilities; repeated individual actions can stabilize a convention; a convention can later become codified. The explanatory task is to show how these relations connect rather than to reduce them to a single privileged scale.

Generative explanation extends the temporal horizon beyond the immediate outcome. A scholarship programme may explain increased enrollment through reduced cost, but GRE may also ask how participation generates networks, expectations, credentials, institutional capacities, or new constraints that alter later educational and labor-market trajectories. This does not mean every explanation must trace indefinitely downstream. It means that when later capacities are central to the research question, the explanatory account should not stop at the first measurable output merely because it is administratively convenient.

Explanatory inquiry can draw on several other modes. Historical evidence can reveal how a mechanism became possible. Interpretive evidence can show how subjects understand and respond to classifications. Causal designs can estimate whether an intervention changes an outcome. Formal models can clarify whether a proposed mechanism is internally coherent. Comparative cases can test whether the explanation travels across configurations. Computational models can explore implications that are difficult to derive analytically. Explanation is therefore often integrative, but the contributions of these components should remain distinguishable.

The standard of explanatory sufficiency depends on the claim. A local explanation of a policy effect requires less than a theory of institutional transformation. Claims about altered generative conditions require evidence that the later opportunity structure, rule environment, capacities, or relations changed in a way relevant to subsequent processes. Claims about transformation of the effective rule of change require still stronger evidence that the mechanism governing later transitions itself changed. GRE therefore scales explanatory ambition to evidential support.

Explanatory inquiry is central to GRE because the framework is concerned with more than relational association. It seeks to understand how relations become consequential through identifiable processes. At the same time, explanation remains compatible with ontological suspension: a useful mechanism model can explain an empirical pattern without establishing that its analytical categories constitute the ultimate ontology of the economic system.

3.10.3 Historical Inquiry

Historical inquiry reconstructs how economic configurations, categories, subjects, institutions, and generative conditions emerge and transform through time. Its role in GRE is constitutive rather than supplementary. If entities and relations can be historically generated, then their present form cannot always be understood by treating them as fixed inputs to analysis. Historical inquiry asks how the objects that later appear stable became available, how alternative possibilities were closed or retained, and how prior trajectories condition present generative capacity.

A historical GRE study can begin with an institution, technology, classification, market, profession, infrastructure, or relation and reconstruct the sequences through

which it acquired its current form. The relevant history may include legislation, organizational decisions, conflict, technical development, demographic change, cultural interpretation, investment, crises, accidents, or encounters with other systems. The aim is not to produce chronology for its own sake. The analytical objective is to identify transformations that changed what later actors could perceive, do, coordinate, own, exchange, contest, or generate.

Historical inquiry is especially important for categories that appear natural after stabilization. The distinction between employee and contractor, the legal form of a corporation, a standardized credential, a property right, a data category, a currency regime, or a professional jurisdiction can become embedded in administrative systems and everyday expectations. Once stabilized, these categories structure evidence and action. Historical reconstruction can reveal their contingency, the relations that produced them, and the alternatives that were once viable. Such reconstruction supports ontological suspension by showing that analytical objects may have histories of constitution.

Temporal ordering can also bear explanatory weight. The same set of conditions can produce different outcomes when encountered in different sequences. Early infrastructure can create increasing returns; a legal designation can precede and enable market formation; a crisis can accelerate an institution that had previously remained marginal; a technical standard can become difficult to displace after complementary investments accumulate. Historical inquiry can therefore identify path-dependent mechanisms while avoiding the loose use of "history matters" as an explanation.

GRE also treats methods and evaluative categories as historical. What counts as reliable evidence, recognized value, legitimate participation, acceptable risk, or relevant harm can change. A historical study may therefore examine not only the object of evaluation but the evolution of the evaluative and epistemic apparatus itself. This becomes particularly important when contemporary assessment applies categories that did not exist, had different meanings, or excluded relevant subjects in earlier periods.

Historical evidence is heterogeneous. Archives, legal documents, organizational records, correspondence, material artifacts, statistical series, oral histories, media, technical standards, and retrospective testimony can each illuminate different aspects of a process. Their survival is itself selective. GRE therefore treats the archive as part of the historical relational field: who could record, whose records were preserved, which categories were administratively legible, and which forms of experience remained unrecorded can shape what later researchers are able to reconstruct.

Historical inquiry does not imply that every present problem requires a complete genealogy. The relevant temporal horizon depends on the process. Some mechanisms can be understood through recent organizational history; others depend on decades of institutional accumulation or longer histories of law, infrastructure, or social classification. The methodological requirement is to extend the historical frame far enough that the object and its operative conditions are not mistakenly treated as timeless when their formation is relevant to the explanation.

3.10.4 Comparative Inquiry

Comparative inquiry examines similarities and differences across cases, configurations, periods, scales, or institutional arrangements. In GRE, comparison is valuable because relational and generative mechanisms are often conditional. A relation that generates capability in one institutional environment may generate dependence in another; a governance arrangement that supports participation at one scale may produce exclusion at another; the same technology can reorganize value differently under different property, labor, or regulatory structures.

Comparison can therefore reveal which features are specific to a configuration and which travel across contexts. Cases may be organizations, regions, legal systems, historical episodes, technologies, communities, markets, or interventions. A comparison can hold some features relatively stable while examining variation in others, or it can compare broader configurations whose differences are themselves analytically meaningful. GRE does not require all comparisons to approximate experiments. Configurational comparison can be valuable when the research question concerns how combinations of relations produce different generative trajectories.

The major methodological problem is commensurability. Cases become comparable only through selected dimensions, and the choice of dimensions can obscure differences in meaning or institutional constitution. "Employment," "household income," "community participation," or "innovation" may be measured similarly across jurisdictions while referring to materially different social arrangements. Comparative inquiry must therefore justify both the common dimension and the retained differences. Translation among categories can be part of the research rather than a preliminary technical step.

Comparison across time presents a related problem. A variable can retain its label while the institutional relations that constitute it change. Longitudinal comparisons of occupations, assets, industries, educational attainment, or household forms may therefore require attention to changing definitions and social significance. GRE treats historical comparability as an empirical and interpretive achievement, not an automatic consequence of having a numerical series.

Comparative inquiry is also useful for mechanism assessment. If a proposed explanation depends on a particular relation, cases in which that relation differs can help evaluate the claim. A platform governance mechanism can be compared across ownership models; a welfare intervention across administrative designs; a cooperative across legal environments; a knowledge commons across licensing regimes. The objective is not necessarily to identify a single universally best arrangement. Comparison can instead map how different relational configurations generate different distributions of capacity, value, risk, or closure.

Negative and deviant cases can be especially informative. A case in which an expected self-reinforcing process fails may reveal a missing enabling condition. A community that resists a dominant institutional trajectory can disclose alternative relations that preserve options. A technological diffusion that remains limited despite strong incentives may reveal interpretive, infrastructural, or legal constraints. GRE can use such cases to refine mechanisms rather than treating them as noise around an average effect.

Comparative inquiry thus provides a disciplined way to study plurality. It can test portability without assuming invariance, and it can illuminate alternative economic arrangements without reducing them to a single ranking dimension. Its contribution is strongest when the basis of comparison, the boundaries of each case, and the limits of generalization are stated explicitly.

3.10.5 Interpretive Inquiry

Interpretive inquiry examines the meanings, classifications, narratives, symbols, expectations, and practical understandings through which economic subjects perceive and act within relational configurations. GRE requires this mode because many economic objects are symbolically mediated. Prices, contracts, credentials, reputations, categories, metrics, risk scores, organizational roles, and legal statuses acquire consequences partly through shared or contested interpretations.

Interpretation enters economic processes in several ways. Subjects respond to what they believe a rule requires, what they expect others to do, what a category signifies, or what an action communicates. An institutional classification can alter behavior because it changes eligibility or sanctions, but also because subjects understand themselves and others through it. A market signal can influence investment because actors interpret its informational content. A policy can fail because its official category does not correspond to the categories through which affected communities organize practice. Meaning is therefore neither an ornamental layer nor a universal substitute for material explanation. It is one mechanism through which relations become actionable.

Interpretive inquiry can focus on language, documents, interviews, practices, rituals, interfaces, images, classifications, or institutional procedures. The researcher asks how a representation is produced, which distinctions it makes salient, how subjects use or contest it, and what practical consequences follow. Interpretive evidence can reveal why formally identical incentives generate different responses, why some risks remain unrecognized, or why an institutional reform changes subject positions even when resource distributions move little.

GRE distinguishes the meaning attributed by subjects from the analyst's representation. Researchers can misdescribe a relation if they impose categories that erase locally consequential distinctions. Conversely, subjects' interpretations do not exhaust causal explanation. An institution can have effects that participants neither intend nor perceive. Interpretive inquiry therefore contributes one layer of evidence within a plural methodology: it reconstructs situated meaning while remaining open to material, institutional, statistical, and historical evidence about effects beyond conscious understanding.

Symbolic mediation becomes particularly important under conditions of representational abundance. Rankings, dashboards, automated classifications, recommendation systems, financial models, and AI-generated representations can shape what becomes visible and credible. Interpretive inquiry can examine how these representations acquire authority and how subjects orient action around them. It can also ask how categories designed for one purpose migrate into other domains and begin to organize allocation, recognition, or exclusion.

Interpretive disagreement is itself an economic phenomenon. Different actors may attach incompatible meanings to the same resource, relation, technology, or institutional change. A redevelopment project can signify investment to one group and displacement to another; data sharing can signify innovation, surveillance, or public infrastructure depending on the relation. GRE does not require these meanings to be collapsed into a single utility metric before analysis begins. Their coexistence can shape conflict, coalition, legitimacy, and future generative possibilities.

Interpretive inquiry thus expands what counts as economically relevant evidence while remaining disciplined by context and consequence. Its aim is not to replace causal or material analysis with discourse, but to identify when meaning and representation form part of the mechanism through which economic relations are generated, sustained, or transformed.

3.10.6 Causal Inquiry

Causal inquiry asks whether and through what conditions a change in one factor contributes to a change in another. GRE requires causal discipline because relational language can otherwise encourage unwarranted attribution. The presence of a relation, asymmetry, institution, or field does not by itself establish that it caused an observed outcome. Causal inquiry therefore provides tools for distinguishing association, sequence, mechanism, and intervention-relevant effect.

Causal questions can be narrow or generative. A narrow question may ask whether a transfer increases school attendance. A broader question may ask whether the transfer changes household bargaining, peer networks, expectations, credential accumulation, or later labor-market options. These questions operate on different outcomes and time horizons, and they may require different designs. GRE's contribution is not to replace established causal inference but to broaden the set of causally relevant downstream and relational outcomes when theory gives reason to expect them.

Counterfactual reasoning remains central. To claim that an intervention caused an outcome requires some account of what would have occurred under a relevant alternative. Randomization, natural experiments, quasi-experimental designs, matching, synthetic controls, longitudinal models, process tracing, comparative case analysis, and mechanistic evidence can support counterfactual claims under different assumptions. GRE is methodologically plural about these tools but not indifferent to identification. The choice of design must match the causal claim.

Relational settings create additional challenges. Interference can violate assumptions that one unit's treatment does not affect another. Network spillovers can make the administrative recipient a poor unit for causal analysis. Institutional reforms can change the categories through which outcomes are measured. Feedback can make causes and effects mutually reinforcing across time. Selection into relationships can confound observed associations. GRE therefore treats relational structure as part of causal design rather than as a reason to abandon causal inference.

Causal attribution can also be distributed. A harmful outcome may depend on a sequence of financing rules, organizational incentives, technical standards, local decisions, and infrastructural constraints. No single element is sufficient on its own, yet

the configuration can reliably generate the outcome. GRE can analyze such conjunctural causation while distinguishing it from claims that every contributing condition bears equal explanatory or normative weight.

Generative causal inquiry may ask whether an intervention changes later capacities to produce further effects. This creates nested causal questions. A training programme can directly change skill, which changes network access, which changes employment opportunities, which changes household investment. The causal chain can branch and feed back. Researchers need not estimate every link simultaneously, but they should distinguish measured effects from hypothesized downstream mechanisms and avoid presenting an observed endpoint as evidence for the entire generative story.

Causal inquiry therefore disciplines GRE's ambition. It permits strong claims where design and evidence support them and encourages restraint where mechanisms remain plausible but unverified. Relational complexity expands the causal questions worth asking; it does not lower the evidential burden for answering them.

3.10.7 Formal Inquiry

Formal inquiry constructs explicit representations of economic structures or processes in mathematical, logical, graphical, or computationally specified form. Its role in GRE is clarification. Formalization can make assumptions visible, expose inconsistencies, distinguish mechanisms that natural language leaves conflated, derive consequences, and reveal which empirical observations would discriminate among alternative accounts.

The appropriate formalism depends on the problem. Dynamical systems can represent trajectories, stability, and regime change. Networks and hypergraphs can represent relational topology and higher-order interaction. Multilayer structures can distinguish relation types. Optimization and game-theoretic models can clarify strategic constraints and incentive compatibility. Probabilistic models can represent uncertainty and conditional dependence. Field-like representations can describe distributed conditions when locality or spatial organization matters. Logical or categorical formalisms can clarify compositional structure. GRE does not designate one of these as its universal mathematics.

Formal inquiry begins by specifying what the symbols represent. A node may stand for a person, organization, legal entity, document, or technical component; an edge may encode communication, ownership, exchange, dependency, recognition, or another relation. A state variable can summarize a capacity, stock, classification, or measured condition. The model becomes meaningful only through the mapping between formal object and empirical interpretation. Two models with identical mathematics can therefore represent substantively different economic mechanisms.

Formalization also requires ontological restraint. A network representation does not prove that the economy is fundamentally a network, and a state-space model does not establish that the selected variables constitute a complete economic state. The formal representation is an analytical instrument whose adequacy depends on the question, assumptions, and empirical correspondence. GRE's ontological suspension is compatible with strong formal work precisely because it separates representational

usefulness from metaphysical commitment.

One important use of formal inquiry is to distinguish levels of transformation. A model can represent change in state under fixed rules, changes in parameters, changes in topology, or transformations in the effective rule itself. These are different formal problems. GRE's concern with changing generative conditions becomes clearer when the model states which elements are permitted to vary and which remain fixed. A formalism that endogenizes network ties while fixing node identities captures one form of relational change but leaves other forms outside the model.

Formal inquiry can also produce impossibility or boundary results. Under specified assumptions, certain combinations of objectives may be incompatible; some allocation rules may generate unavoidable trade-offs; some dynamics may be unstable; some information may be insufficient for identification. Such results can be valuable even when the assumptions are idealized because they clarify where a proposed intervention requires additional structure or information.

The evidential status of a formal result must nevertheless remain explicit. A theorem establishes a consequence of assumptions. A numerical model shows behavior of a specified representation. Neither alone establishes that the assumptions hold empirically. Formal inquiry becomes empirically explanatory when the mapping, assumptions, and relevant predictions or mechanisms are supported by evidence. GRE therefore treats formalization as one rigorous mode among several, especially powerful when combined with descriptive, historical, causal, or interpretive work.

3.10.8 Computational Inquiry

Computational inquiry uses algorithmic procedures to analyze data, simulate specified systems, explore high-dimensional models, search large possibility spaces, or construct representations that would be difficult to handle analytically. It overlaps with formal inquiry but is not identical to it. A formal model can be studied without computation, while computational analysis can involve empirical pattern detection whose theoretical structure remains comparatively weak. GRE distinguishes these uses so that computational power is not mistaken for explanatory completeness.

Simulation is one major application. Agent-based models can explore how heterogeneous local rules generate aggregate patterns; network simulations can study diffusion, contagion, coordination, or rewiring; dynamical models can examine sensitivity and regime change; Monte Carlo methods can characterize uncertainty; optimization algorithms can explore feasible designs under constraints. Simulation is particularly useful when feedback, heterogeneity, or combinatorial complexity makes closed-form analysis difficult.

The epistemic status of simulation remains conditional. A simulated trajectory is evidence about the behavior of the model under specified assumptions. It becomes evidence about a target economic system only through an additional argument that the model represents relevant features adequately. Calibration, validation, sensitivity analysis, out-of-sample comparison, qualitative mechanism matching, and robustness checks can strengthen this bridge. The visual plausibility of a simulated pattern is insufficient on its own.

Computational inquiry also includes data-intensive empirical methods. Machine learning can classify, predict, embed, cluster, or detect patterns in large datasets. Natural-language processing can analyze documents and discourse. Network algorithms can identify structural positions or communities. Spatial computation can reveal geographical concentration and accessibility. These methods can extend observational capacity, but the resulting representations inherit the categories, sampling processes, missingness, labels, and objectives of the data-generating system.

For GRE, computational representation can itself become an object of inquiry. A credit score, recommendation model, allocation algorithm, or generative AI system does not merely describe an economic field; once used operationally, it can alter access, visibility, bargaining power, subject classification, and future data. The computational model can therefore enter the generative relation it represents. Researchers may need to study both model performance and the feedback through which deployment changes the target system.

Computation can further support exploratory work under ontological uncertainty. Researchers can test several network boundaries, alternative state representations, or competing mechanisms and examine which are robust to changes in specification. Such exploration is valuable if it is reported transparently and distinguished from confirmatory inference. Computational flexibility increases the importance of documenting choices because many plausible pipelines can yield different apparent structures.

GRE therefore welcomes computational inquiry without treating computation as a substitute for theory, meaning, causality, or normative judgment. Its contribution lies in extending what can be represented and explored while maintaining explicit links among algorithm, data, modeled object, and warranted conclusion.

3.10.9 Normative Inquiry

Normative inquiry evaluates economic arrangements, relations, processes, or interventions according to articulated standards of value, justice, participation, capability, harm, responsibility, freedom, sustainability, or other justified criteria. GRE requires this mode because generativity is not intrinsically beneficial. A relation can generate wealth and dependency, knowledge and exclusion, capability and ecological damage, trust and vulnerability, innovation and concentration. Description of generation therefore cannot settle whether the generated configuration is desirable.

Normative inquiry begins by making the evaluative standard visible. A study may evaluate distribution, procedure, recognition, participation, capability, rights, ecological integrity, intergenerational effects, or the preservation of future options. These standards can converge in some cases and conflict in others. GRE does not resolve such conflict by assuming that all values can be converted into a common metric. Monetary valuation, utility, capability, rights, and relational goods can each illuminate different dimensions while leaving remainders that resist equivalence.

The distinction between generated value and generated harm is central. An intervention that expands productive capacity can simultaneously concentrate decision authority. Infrastructure can increase mobility while displacing communities. A platform can create new forms of participation while producing surveillance or depen-

dency. Normative inquiry therefore follows the distribution and conversion of effects across subjects, scales, and time rather than assigning the entire process a single positive or negative label from one immediate outcome.

Participation matters both instrumentally and intrinsically. Subjects affected by an intervention may hold knowledge unavailable to designers, making participation epistemically valuable. Participation can also constitute recognition and agency rather than merely improve technical outcomes. Yet participation itself varies in form and power. Consultation, veto authority, co-design, ownership, and self-governance are not equivalent. GRE can therefore examine the relational structure of participation rather than treating its nominal presence as sufficient.

Normative inquiry also addresses capability and future generativity. An arrangement can be evaluated partly by how it changes subjects' capacities to act, learn, cooperate, exit, contest, or generate further value. This future-oriented criterion does not imply that more capability is always better or that every option must be preserved. Some capabilities are harmful, and institutional commitments often require selective closure. The normative problem concerns which capacities are expanded or foreclosed, for whom, under what justification, and with what possibilities for revision.

Evaluation must remain historically and contextually responsive. Normative concepts can have general aspirations while their application depends on institutions, technologies, ecological conditions, and available alternatives. Standards themselves can also be criticized and revised through new knowledge or previously excluded perspectives. GRE therefore treats normative inquiry as reasoned and contestable rather than as a final scoring procedure appended after positive analysis.

The mode remains analytically distinct from empirical explanation even when the two interact. Evidence can show who is harmed, which capacities change, or how participation is distributed. It cannot by itself determine how conflicting claims should be weighted. Conversely, normative arguments that ignore empirical mechanisms can recommend interventions that reproduce the very harms they seek to address. GRE joins the modes through mutual constraint while preserving the distinction between what occurs and how it ought to be evaluated.

3.10.10 Intervention-Oriented Inquiry

Intervention-oriented inquiry asks how knowledge can inform deliberate attempts to alter a relational configuration, its generative conditions, or the processes through which future outcomes are produced. It is distinct from normative inquiry because deciding that a condition is undesirable does not establish how it can be changed. It is also distinct from causal inquiry because estimating the effect of one intervention does not by itself provide a complete strategy for governance under changing conditions.

A GRE intervention begins with diagnosis. The researcher or practitioner identifies the relevant relations, subjects, constraints, capacities, value flows, representations, and scales. The intervention target may be an allocation, a rule, an infrastructure, a relation among organizations, an information environment, a participation mechanism, or a field condition that makes certain actions easier or harder. This breadth allows GRE to consider interventions that modify generative conditions rather than

only redistribute final outputs.

Intervention design then requires an explicit theory of change. Which relation is expected to change? Through what mechanism? Which subjects can respond? Which enabling conditions are required? What downstream pathways are anticipated? Which unintended effects are plausible? At what time horizon should evaluation occur? These questions prevent "relational intervention" from becoming a vague label for any complex policy.

Field-oriented intervention is one important possibility. Instead of specifying a single terminal outcome, governance can alter conditions under which desirable forms of generation become more feasible. Open standards can lower barriers to entry; public infrastructure can expand capability; rights can protect participation; information systems can make harms visible; funding structures can diversify inquiry; modular regulation can preserve reversibility. Such approaches remain interventions with distributive and political consequences even when they do not centrally prescribe final behavior.

Intervention-oriented inquiry also requires feedback. Economic systems respond to policy, and subjects can adapt strategically or creatively. An initially effective rule can become ineffective after behavior changes. A subsidy can create dependence; a measurement target can be gamed; a new right can generate institutional innovation; an infrastructure can enable uses that designers did not anticipate. GRE therefore treats monitoring and revision as part of intervention rather than as post hoc maintenance.

Reversibility and repair deserve explicit attention. Some interventions are easy to modify, while others create sunk costs, legal entitlements, ecological damage, technical lock-in, or institutional dependencies. An intervention that transforms generative conditions can make later reversal difficult even if the original allocation was modest. Design can therefore consider exit, rollback, sunset, compensation, remediation, and mechanisms for affected subjects to challenge or revise the arrangement.

Intervention-oriented inquiry is necessarily ethical and political. Choosing what to change, whose capacities to expand, which risks to accept, and which alternatives to close involves normative judgment and distributions of authority. Technical sophistication cannot remove these questions. What GRE can contribute is a disciplined account of how proposed interventions enter relational fields, how their effects propagate beyond immediate recipients, how they alter future capacities and constraints, and how governance can remain responsive to evidence and contestation.

The ten modes distinguished in this section are therefore complementary ways of making GRE's research programme operational. Descriptive inquiry establishes configurations; explanatory inquiry identifies mechanisms; historical inquiry reconstructs formation; comparative inquiry tests variation and plurality; interpretive inquiry recovers meaning and symbolic mediation; causal inquiry disciplines attribution; formal inquiry clarifies explicit structures; computational inquiry extends representation and exploration; normative inquiry evaluates consequences and arrangements; and intervention-oriented inquiry connects analysis to deliberate change. Their combination is problem-dependent rather than fixed.

Methodological plurality, however, requires epistemic discipline. Combining

modes does not automatically produce stronger knowledge if their assumptions, evidential statuses, and inferential limits remain implicit. The next constitutional task is therefore to state the commitments that govern how GRE moves among these modes: ontological suspension, partial observation, distinction between relation and representation, explicit boundary and scale selection, mechanism-sensitive attribution, historical dependence, methodological pluralism, revisability, and epistemic humility.

3.11 Epistemic Commitments of GRE

The methodological plurality established in the preceding section creates a further constitutional requirement. If Generative Relational Economics permits descriptive, historical, interpretive, causal, formal, computational, normative, and intervention-oriented inquiry, it also requires standards governing how claims move across those modes and how uncertainty is represented. Methodological plurality without epistemic discipline can produce a collection of incompatible assertions whose evidential status remains unclear. The role of this section is therefore to state the principal epistemic commitments that constrain GRE inquiry across methods and domains. Its objective is neither to supply a complete philosophy of science nor to impose a single theory of knowledge. It instead specifies a working discipline for research conducted under relational complexity, historical change, partial observability, heterogeneous forms of evidence, and revisable analytical categories.

The commitments are organized around nine requirements: ontological suspension, acknowledgment of partial observation, separation of relation from representation, explicit boundary and scale selection, mechanism before unwarranted attribution, historical and contextual dependence, methodological pluralism, revisability of analytical categories, and epistemic humility. They are mutually reinforcing. Ontological suspension restrains the conversion of useful models into premature metaphysical claims. Partial observation prevents the observed record from being equated with the whole relational configuration. Distinguishing relation from representation keeps measurements, categories, graphs, narratives, and models analytically separate from the processes they represent. Explicit boundary and scale selection makes exclusions visible. Mechanism disciplines attribution. Historical dependence limits the portability of claims across contexts and periods. Methodological pluralism allows different forms of evidence to correct one another. Revisability makes the analytical vocabulary responsive to changing objects and evidence. Epistemic humility calibrates the strength of conclusions to the scope of their warrant.

These commitments do not require a researcher to remain permanently agnostic about every substantive question. GRE can make strong empirical or theoretical claims when evidence, design, and argument justify them. The commitments instead determine what must be shown before such strength is warranted. A causal estimate obtained from a credible design can support a bounded causal claim. A historically reconstructed mechanism can support an explanation when the documentary and comparative record is sufficiently strong. A formal theorem can establish consequences within a defined model. A normative argument can defend criteria un-

der stated premises. Epistemic restraint does not weaken inquiry; it clarifies where the force of a conclusion comes from and which transformations of the claim would exceed the evidence that supports it.

The same discipline is particularly important because GRE studies processes that may alter the categories through which they are observed. A platform can reorganize what counts as work, a legal reform can alter the recognized economic subject, an accounting standard can change what becomes economically visible, an artificial system can redistribute capacities among human and organizational actors, and a governance intervention can transform the relations that later measurements attempt to describe. In such settings, the research object and the research representation can co-evolve. GRE therefore requires epistemic commitments that are compatible with historical transformation rather than assuming a permanently fixed ontology, vocabulary, or observation regime.

3.11.1 Ontological Suspension

Ontological suspension is the first epistemic commitment because GRE deliberately works with heterogeneous representations of economic reality. An inquiry may describe persons, organizations, institutions, flows, relations, fields, trajectories, networks, states, constraints, events, capacities, or symbolic objects. Each representation can disclose features that another suppresses. GRE therefore withholds claims about the ultimate ontological status of these objects unless the local inquiry requires such a claim and adequate argument is available.

Ontological suspension does not imply that nothing exists independently of description, nor does it reduce inquiry to arbitrary perspectivism. It is a methodological restraint concerning the relation between analytical usefulness and metaphysical conclusion. Treating a firm as an entity can be economically useful because the firm has relatively stable legal, organizational, accounting, and decision-making properties. Treating the same firm as a nexus of contracts, a field of authority, a network of relations, a bundle of productive capacities, or a historical process can also be useful for other questions. The availability of several productive representations does not by itself decide which description identifies the firm's final or most fundamental mode of being.

This suspension is especially important when scientific formalisms are transferred into economic analysis. A state space can organize possible configurations without proving that the economy literally consists of points in a pre-given mathematical space. A network model can represent relations without proving that node and edge ontology is fundamental. A field representation can model distributed conditions without establishing a physical field ontology for social life. An agent-based model can operationalize actors without settling the philosophical status of agency. GRE treats such formalisms as analytical constructions whose adequacy depends on the question, assumptions, empirical correspondence, and explanatory gain.

The commitment also protects inquiry against premature reduction. Economic value need not be reduced to price because price is measurable. Institutional recognition need not be reduced to individual preference because choice data are available. Collective capacities need not be reduced to the sum of personal attributes when orga-

nizational relations contribute to what can be done. Conversely, relational language does not license the reduction of entities to relations in every context. Relational constitution and relative entityhood can coexist at different scales and for different purposes.

Ontological suspension therefore supports a layered practice of commitment. GRE can commit locally to an operational ontology for a study: it may define firms, households, algorithms, jurisdictions, or communities as analytical units and proceed rigorously within that specification. The suspension concerns the elevation of that local choice into a universal claim. A representation is adequate when it supports warranted inquiry into the relevant mechanism or phenomenon; it becomes ontologically overextended when its convenience is treated as proof that excluded dimensions are unreal or insignificant.

This commitment also preserves the possibility of theoretical correction. New evidence can reveal that an apparently stable entity is internally heterogeneous, that a presumed relation is mediated by an unobserved institution, or that a category formerly treated as natural is historically contingent. GRE should permit the analytical ontology to change with the inquiry rather than defend the initial representation merely because it was useful at an earlier stage. Ontological suspension is thus not indecision. It is a discipline of keeping the strength of ontological claims proportionate to the work they actually perform.

3.11.2 Partial Observation

GRE assumes that economic observation is structurally partial. Researchers encounter traces, measurements, classifications, documents, transactions, interviews, images, records, behavioral outputs, and other manifestations of processes rather than an exhaustive presentation of the processes themselves. This partiality is not a temporary defect that disappears once sufficiently large datasets are obtained. Even abundant observation remains conditioned by what can be recorded, which categories are used, which events become legible, which populations are included, and which temporal or relational scales are accessible.

Partial observation has several forms. Some variables are simply unobserved. Others are observed through proxies whose validity depends on context. Some relations leave weak administrative traces. Informal activity may be systematically missing from official records. Household labor can remain economically consequential while being absent from market transactions. Platform data can be highly granular while revealing little about off-platform constraints. Historical archives can preserve institutional voices more consistently than marginalized ones. A sensor system can continuously observe behavior while remaining unable to identify meaning or motive. The volume of evidence therefore does not determine its completeness.

The relational character of GRE makes this issue especially consequential. Observing an individual without observing relevant relations can produce a misleading description of capacity, constraint, or choice. A worker's income does not fully disclose bargaining power, household obligations, visa dependence, care responsibilities, access to infrastructure, or exposure to algorithmic evaluation. A firm's balance sheet can omit the public infrastructures, ecological dependencies, cultural resources, or

community relations that condition production. A policy's administrative beneficiary list can omit subjects affected through prices, labor markets, household relations, ecological effects, or institutional precedents.

Partial observation also has a temporal dimension. Data may capture a process after important generative events have already occurred. Current inequality can reflect earlier institutional selections that are no longer directly visible. An observed preference can be the result of prior adaptation, exclusion, learning, or habituation. A stable relation may have emerged from a sequence of contingencies that cross-sectional evidence cannot recover. GRE therefore distinguishes observing a current configuration from knowing the history that generated it.

The commitment to partial observation changes how evidence is reported. Missingness, measurement error, selection, proxy construction, archival survival, model dependence, and unobserved mediation should be treated as substantive features of the epistemic situation rather than technical footnotes. A study need not solve every limitation, but it should identify those that materially affect interpretation. When evidence supports only a restricted claim, the claim should remain restricted.

Partiality also motivates triangulation without turning triangulation into automatic confirmation. Different evidence sources can compensate for different blind spots. Administrative data may establish distributional patterns; interviews can identify mechanisms or meanings absent from records; archival sources can reconstruct institutional change; ethnography can reveal enactment; experiments can isolate effects under constrained conditions; computational traces can show large-scale patterns. Agreement among these sources can strengthen confidence, while disagreement can reveal that they are observing different layers of the process.

GRE therefore treats observability as part of the economic and institutional environment. What becomes observable can itself be shaped by law, technology, organizational incentives, classification systems, and power. Some actors can make their activities legible while others remain invisible; some institutions can require reporting; some platforms can monopolize data; some harms appear only after measurement categories are created. Observation is consequently both an epistemic relation and, in many settings, an object of economic analysis.

3.11.3 Distinction between Relation and Representation

GRE distinguishes the relations under study from the representations through which those relations become analytically accessible. A representation can be a variable, category, graph, matrix, equation, narrative, map, model, legal classification, accounting entry, database schema, or visual diagram. Each representation selects and organizes features of a target domain. None should be treated as identical to the relation merely because it is useful for describing it.

This distinction is fundamental to relational inquiry because representations can create an appearance of precision that exceeds their empirical warrant. A network edge can encode communication, ownership, authority, trust, exchange, co-membership, or inferred association. Two edges of identical graphical form can represent substantively different relations. A weight attached to an edge may record frequency, monetary value, probability, distance, or a model-derived score. The

mathematical object is therefore interpretable only through the measurement and theoretical decisions that produced it.

The same issue appears in categorical and institutional representations. A legal category can stabilize a relation for governance without exhausting its social meaning. An accounting classification can make a form of value visible while excluding others. A survey category can facilitate comparison while compressing heterogeneous experiences. An algorithmic score can summarize observed correlates while becoming institutionally consequential through decisions made on its basis. Representation can therefore both describe relations and participate in their transformation.

GRE consequently requires researchers to specify the mapping between representation and target. If "trust" is represented by repeated cooperation, the inferential gap should be stated. If "power" is represented by network centrality, the mechanism connecting centrality to power must be argued rather than assumed. If a latent variable is used to summarize capability, the construction and interpretation of that variable should remain visible. If text embeddings represent semantic similarity, similarity in the model space should not automatically be equated with shared meaning among subjects.

This distinction also protects formal analysis from reification. A model can derive properties of a representation with complete mathematical rigor while leaving open whether the represented mechanism is empirically operative. Computational sophistication cannot bridge that gap by itself. A simulation result is a consequence of a model and its parameterization. It becomes evidence about an empirical target only through validation, calibration, comparison, and argument connecting the representation to observed processes.

Representations can nevertheless become economically real in a second sense: actors may respond to them. Credit scores, rankings, performance indicators, ratings, risk categories, forecasts, and accounting metrics can alter behavior and resource allocation. The fact that a representation becomes causally consequential does not erase the distinction between representation and relation; it creates an additional relation in which the representation enters the system it describes. GRE should then study both its descriptive adequacy and its performative effects.

Maintaining this distinction enables stronger rather than weaker modeling. It allows researchers to use abstraction aggressively while keeping track of what has been abstracted. A representation can be deliberately narrow if the local question is narrow. The epistemic requirement is transparency concerning what the representation contains, what it excludes, how it was constructed, and which claims can legitimately be inferred from it.

3.11.4 Explicit Boundary and Scale Selection

Every GRE inquiry selects a boundary and scale. The selection determines which entities, relations, periods, jurisdictions, infrastructures, ecological conditions, and forms of value enter the analysis. Because GRE often studies effects that propagate beyond administrative recipients or immediate transactions, boundary selection is an epistemic decision with direct consequences for what can be observed and explained.

A boundary is never justified merely by being available in the data. Firm-level data encourage a firm boundary; household surveys encourage a household boundary; national statistics encourage a national boundary. These sources can be appropriate, but the research question may require a different relational domain. A wage change can affect households, local demand, public revenue, migration, or subcontracting. A technological intervention can change organizational workflows, professional identities, educational demand, and infrastructural dependence. An ecological extraction can produce effects beyond the jurisdiction in which economic value is recorded. The boundary should therefore be selected in relation to the mechanism under investigation.

Scale selection poses a related problem. The individual, organization, community, institution, ecosystem, and transnational system are not simply nested containers with fixed causal priority. A process that appears exogenous at one scale can become endogenous at another. An organizational rule can constrain an individual while being generated by industry regulation, professional norms, or platform infrastructure. A national policy can appear autonomous until cross-border capital, legal regimes, or supply chains are included. GRE requires the researcher to state which scale is analytically primary and which cross-scale effects are being omitted or modeled.

Explicit selection does not require maximal expansion. The widest possible system boundary is rarely the most useful. Expanding a model can reduce identification, tractability, interpretability, or evidential quality. A bounded inquiry can be superior when the excluded relations are unlikely to alter the conclusion materially. GRE therefore favors justified boundaries rather than maximal boundaries. The researcher should explain why the chosen domain is sufficient for the claim and identify plausible pathways through which excluded relations could matter.

Temporal boundaries require equal attention. A programme evaluated after six months may appear successful while longer-term dependency, capability formation, institutional learning, or ecological cost remains unobserved. Conversely, a long historical window can obscure short-run mechanisms by aggregating distinct institutional regimes. The relevant temporal scale depends on the generation process being studied. Some effects are immediate; others emerge through accumulation, threshold crossing, learning, reproduction, or delayed conversion.

Boundary and scale choices can themselves be politically consequential. Administrative categories define who counts as a beneficiary, employee, resident, household member, owner, victim, or stakeholder. Jurisdictional boundaries determine which costs enter public accounting. Corporate boundaries can externalize labor or ecological relations into subcontracting and supply chains. GRE therefore examines not only the researcher's boundary but also the boundaries through which economic actors and institutions organize responsibility and visibility.

The epistemic commitment is straightforward: boundary and scale should be stated, defended, and revisable. Where conclusions are sensitive to alternative boundaries, that sensitivity is part of the result. A claim that survives reasonable changes in scale has different epistemic status from one that depends on a narrow administrative frame. GRE treats this sensitivity as informative rather than embarrassing because it reveals where economic descriptions are relationally contingent.

3.11.5 Mechanism before Unwarranted Attribution

GRE is interested in generation, propagation, conversion, subject formation, power, orientation, and structural transformation. These concepts can become excessively expansive if they are used to attribute every downstream difference to an initial relation. The fifth epistemic commitment therefore requires mechanism before unwarranted attribution. A relational association or temporal sequence becomes a generative claim only when the study provides a defensible account of how the earlier configuration contributed to the later one.

Mechanism can take different forms. It may involve incentives, authority, learning, information, legal recognition, technological affordances, resource transfer, network diffusion, social interpretation, institutional reproduction, ecological feedback, or strategic adaptation. The relevant mechanism can be probabilistic rather than deterministic and can operate jointly with other causes. GRE does not require a single universal mechanism of generation. It requires the mechanism invoked in a particular explanation to be specified sufficiently that evidence could distinguish it from plausible alternatives.

This standard is especially important for relational language. A relation between two actors does not automatically explain an outcome merely because the actors are connected. Network position, for example, can matter through access to information, bargaining leverage, reputational visibility, control of brokerage, exposure to contagion, or institutional authority. Different mechanisms can produce similar network patterns. A claim about the economic significance of structure therefore requires more than descriptive topology.

The same discipline applies to power. Persistent asymmetry is relevant to power, but asymmetry alone does not establish the mechanism through which one actor constrains another's options, shapes rules, controls resources, determines classifications, or alters future generative conditions. GRE should identify how asymmetry becomes actionable. Ownership rights, legal authority, infrastructure dependence, agenda control, data access, financial leverage, or control over recognition may provide such mechanisms. Where the pathway remains uncertain, the claim should be framed as a hypothesis rather than a conclusion.

Mechanism also disciplines claims about value conversion. If educational participation is said to generate social capital, which interactions produce continuing relations? If trust is said to generate economic cooperation, what institutional or experiential processes stabilize expectations? If cultural recognition is said to improve economic capability, through which access, motivation, legitimacy, or network pathways does the conversion occur? Naming the initial and final categories is insufficient; the transformation between them is the object that requires explanation.

This commitment does not imply that every GRE study must identify a complete micro-mechanism. Some phenomena are best explained at organizational, institutional, or ecological scales. A legal rule can have a causal effect without being reduced to individual psychology. A market design can alter incentives without reconstructing every subjective deliberation. Mechanistic adequacy is scale-relative. The requirement is that the explanatory link be more specific than a retrospective association and that the proposed pathway fit the level at which the claim is made.

Mechanism before attribution also protects normative analysis. Harm should not be assigned to a particular actor or intervention merely because the harm occurred within a broader relational system. Responsibility can be distributed, mediated, historically inherited, or structurally reproduced. Normative attribution may therefore require a separate analysis of control, foreseeability, benefit, capacity, institutional role, and available alternatives. GRE's relational orientation expands the field of possible responsibility while simultaneously requiring greater care in attributing it.

3.11.6 Historical and Contextual Dependence

GRE treats economic categories, mechanisms, and regularities as potentially dependent on historical and institutional context. This commitment follows from the earlier chapters' emphasis on changing productive relations, subject forms, technologies, norms, legal categories, and value structures. A relation that operates in one institutional environment may change meaning or effect in another. Historical and contextual dependence therefore constrains generalization without eliminating the possibility of general knowledge.

Context dependence can enter through mechanisms. Credit can expand productive capacity in one institutional setting and reinforce dependence in another. Informal networks can provide resilience where formal systems are weak while reproducing exclusion where membership is restrictive. Algorithmic evaluation can reduce some forms of discretion while creating new informational asymmetries and dependencies. A cooperative structure can enable collective control under supportive legal and financial conditions yet remain marginal under a regime that withholds access to capital or procurement. The nominal form of a relation therefore does not uniquely determine its generative effects.

Historical dependence also affects categories. The economic meaning of "worker," "firm," "household," "property," "skill," "platform," or "currency" is shaped by institutional arrangements that change over time. A category can retain its name while the relations that constitute it transform. GRE should therefore avoid treating administrative continuity as proof of substantive continuity. Historical reconstruction can be necessary even when contemporary data appear precise.

The commitment does not require every proposition to be historically unique. Recurrent mechanisms can be identified across cases, and comparative analysis can reveal robust patterns. The epistemic task is to specify the domain of portability. A mechanism may generalize across institutional settings under identifiable conditions; a formal model may describe a family of processes; a causal effect may transport when relevant effect modifiers are sufficiently similar. GRE therefore distinguishes universalizing language from conditional generalization.

Context dependence also concerns meaning. Economic actors interpret rules, resources, risks, and opportunities through historically situated symbolic and normative frameworks. The same monetary transfer can signify compensation, obligation, charity, recognition, debt, or entitlement in different settings, with different relational consequences. Interpretive evidence can therefore be necessary when the mechanism depends on how actors understand the relation.

The historical commitment extends to the researcher's categories and methods.

Measures calibrated in one period can lose validity as institutions change. A proxy for employment stability can fail when contractual forms transform. A model of media attention can become obsolete after a platform redesign. A measure of technological capability can change meaning as complementary infrastructures diffuse. GRE should treat measurement regimes as historically situated rather than assume that a stable variable label guarantees stable construct validity.

This commitment encourages temporal comparison and repeated evaluation. A finding can be valid for the period studied and later require revision because the object changed. Such revision does not necessarily invalidate the earlier research; it can reveal the historical conditions under which the earlier claim held. GRE therefore regards the temporal domain of a claim as part of its specification.

3.11.7 Methodological Pluralism

Methodological pluralism is an epistemic commitment because no single method has privileged access to every aspect of a generative relational process. Quantitative estimation, qualitative interpretation, historical reconstruction, formal modeling, computational simulation, comparative analysis, experiments, ethnography, archival work, network analysis, and participatory methods each make some features more visible and others less so. GRE therefore treats methods as differentiated instruments of inquiry whose adequacy depends on the claim being made.

Pluralism differs from methodological eclecticism without standards. The presence of several methods does not strengthen a study automatically. Each method must contribute an identifiable epistemic function. A qualitative study can identify mechanisms and meanings that guide quantitative measurement. A quantitative design can estimate the distribution or magnitude of an effect suggested by qualitative evidence. Historical analysis can reveal institutional transitions that make a cross-sectional association intelligible. Formal modeling can clarify whether a proposed mechanism is internally coherent. Simulation can explore trajectories under specified assumptions. Their combination is valuable when the outputs constrain or inform one another.

Pluralism also means that methodological disagreement can be productive. If administrative data indicate improved employment while interviews reveal increased insecurity, the discrepancy may reflect different populations, time horizons, definitions, or dimensions of the outcome. GRE should investigate the divergence rather than force immediate convergence. Different methods can reveal multiple aspects of a heterogeneous value structure or relational configuration.

No hierarchy follows automatically from formal precision. Mathematical and computational methods can make assumptions explicit, derive implications, and handle complexity that prose alone cannot. Their precision concerns the representation once specified. Empirical relevance still depends on the quality of the mapping between model and target. Conversely, qualitative richness does not eliminate the need for disciplined inference. Interpretive accounts require transparent evidence, plausible alternatives, and attention to scope. Historical narratives require source criticism. Normative arguments require defensible premises. Methodological pluralism therefore expands the repertoire of rigor rather than relaxing it.

The commitment also preserves compatibility with established economics. GRE does not require replacing econometrics, experiments, equilibrium analysis, mechanism design, industrial organization, public economics, labor economics, or other established approaches when they answer the relevant question well. A GRE inquiry can incorporate these methods and add relational or generative analysis where it materially changes explanation. Pluralism includes the possibility that the best answer to a bounded question is supplied by an existing method without specifically GRE additions.

Pluralism has institutional implications for research design. Data infrastructures, publication norms, disciplinary training, and funding systems often privilege some evidence types over others. A research programme that studies heterogeneous relational processes must resist converting institutional convenience into epistemic hierarchy. This does not mean every project must be interdisciplinary. It means that exclusions among methods should be justified by the question rather than inherited uncritically from disciplinary boundaries.

The strongest form of methodological pluralism in GRE is mutual corrigibility. Formal models can expose ambiguity in conceptual claims. Historical evidence can show that apparently universal categories are contingent. Qualitative evidence can reveal omitted mechanisms. Causal designs can challenge compelling narratives. Computational models can test whether proposed local rules produce the claimed system-level pattern. Normative analysis can reveal that an empirically efficient intervention depends on contested evaluative premises. Methods become part of a common research programme when they can correct one another without being forced into a single epistemology.

3.11.8 Revisability of Analytical Categories

GRE treats its analytical categories as revisable. Relation, subject, value, capacity, institution, field, constraint, trajectory, generativity, and power are working concepts whose definitions should become more precise through research. The commitment to revisability follows from ontological suspension and historical dependence: if the objects of inquiry can change and if different representations disclose different aspects of them, then the vocabulary of the research programme cannot be permanently fixed at its founding stage.

Revisability does not imply conceptual looseness. A study should define its categories precisely enough to support inference. The revision occurs when evidence, theoretical contradiction, cross-case comparison, or improved formalization shows that the existing category fails. The relevant distinction is between local precision and global finality. GRE can use a precise operational definition while remaining open to revising that definition in later research.

Category revision can take several forms. A category can be subdivided when previously hidden heterogeneity becomes important. Several categories can be combined when distinctions prove analytically unproductive. Boundaries can change when new relations become visible. A category can move from exogenous condition to endogenous object of inquiry. A variable treated as an attribute can be reconceptualized as relationally generated. A representation can be abandoned if it systemat-

ically misclassifies the phenomenon.

Economic subjecthood provides one example. A research programme built exclusively around human individuals would be strained by organizations, automated systems, collective entities, or hybrid arrangements that make economically consequential selections. Expanding the category of operational economic subject can improve analysis, but that revision need not erase distinctions concerning consciousness, personhood, legal standing, or moral status. Revisability allows the category to change while preserving distinctions that remain normatively or empirically necessary.

Value provides another example. Price can remain a central economic representation of value without exhausting the relevant evaluative or relational phenomena. Research can discover forms of value whose realization depends on access, recognition, participation, ecological capacity, institutional continuity, or future capability. Revising the analytical vocabulary to capture these forms does not require treating them as commensurable or collapsing them into a single metric.

Revisability also applies to GRE itself. Concepts introduced in this book are provisional elements of a research programme rather than protected doctrine. Later empirical work may show that some distinctions are unproductive, that other concepts are missing, or that the framework overstates the usefulness of generative analysis in particular domains. A research programme becomes cumulative not by preserving every founding category but by creating procedures through which categories can be criticized, compared, refined, and replaced.

This commitment places a burden on documentation. When categories change across studies or over time, researchers should record how definitions differ and why. Conceptual drift can otherwise appear as empirical change. GRE therefore favors transparent conceptual provenance: the history of a category's operationalization is part of the knowledge needed to compare results.

3.11.9 Epistemic Humility

Epistemic humility is the concluding commitment because it governs the relation among all the preceding ones. It requires the strength, scope, and precision of a claim to remain proportionate to the evidence and argument that support it. Humility does not require weak conclusions where strong conclusions are justified. It requires researchers to distinguish what has been observed from what has been inferred, what has been modeled from what has been validated, what is locally supported from what is generalized, and what is normatively defended from what is empirically established.

In relational economic inquiry, overstatement can arise easily because the studied systems are interconnected. Once a downstream effect is observed, it is tempting to narrate a complete chain of generation. Once a network pattern appears, it is tempting to attribute power or influence. Once a simulation reproduces a stylized fact, it is tempting to treat the mechanism as confirmed. Once an intervention succeeds locally, it is tempting to generalize it across contexts. Epistemic humility interrupts these moves by requiring an explicit account of the inferential bridge.

Humility also concerns uncertainty that cannot be reduced to a probability es-

timate. Researchers can face model uncertainty, category uncertainty, boundary uncertainty, interpretive disagreement, historical incompleteness, unknown unknowns, or normative pluralism. Quantification is valuable when a defensible probability model exists, but not every epistemic limitation is probabilistic. GRE therefore permits qualitative statements of uncertainty where numerical precision would be misleading.

The commitment is especially important for intervention. Application-dominant praxis often requires action before knowledge is complete. Epistemic humility does not imply inaction under uncertainty. It changes how intervention is designed: assumptions are made explicit, monitoring is built in, reversible steps are preferred where feasible, affected subjects retain opportunities for contestation, and the intervention is treated as a source of new evidence rather than the execution of a final truth. Learning and governance become coupled.

Humility also requires attention to the distribution of epistemic authority. Researchers, administrators, firms, communities, workers, users, and affected populations can possess different forms of knowledge. Expertise can be real without being total. Local experience can identify mechanisms invisible to aggregate data while remaining limited in scope. Institutional actors can possess operational information while having incentives to frame it selectively. GRE therefore treats disagreement among knowledge holders as an object for analysis rather than assuming that one standpoint has automatic priority across all questions.

This commitment extends to artificial and computational systems. Large models, automated inference, and high-dimensional data can increase the scale and speed of analysis, but they do not eliminate uncertainty concerning data generation, representation, causal identification, normative criteria, or institutional effects. Computational confidence can be numerically precise while remaining epistemically narrow. GRE should therefore distinguish predictive performance from explanatory adequacy, statistical calibration from normative legitimacy, and representational capacity from knowledge of the target process.

Epistemic humility finally concerns the research programme's own historical position. GRE is being constituted under particular contemporary conditions: changing productive relations, computational abundance, new forms of artificial capability, ecological constraints, institutional complexity, and increasing visibility of relational and generative processes. These conditions make the programme plausible and potentially useful; they do not guarantee its enduring adequacy. Future economic forms may require different concepts. Existing theories may explain domains where GRE adds little. Evidence may contradict central hypotheses. The programme should be organized so that such correction is possible without treating revision as failure.

Taken together, the commitments of this section define a disciplined epistemic posture for Generative Relational Economics. GRE can make strong claims, employ sophisticated formalisms, combine diverse evidence, and participate in intervention, but it should do so while suspending unnecessary ontological conclusions, acknowledging partial observation, separating relations from their representations, making boundaries and scales explicit, demanding mechanisms for attribution, locating claims historically, preserving methodological pluralism, revising categories when required, and calibrating confidence to warrant. These commitments prepare the

transition from inquiry to praxis. The following section turns to how GRE moves from explanation and evaluation toward relational diagnosis, generative diagnosis, and intervention under conditions where knowledge remains necessarily incomplete.

3.12 Praxis in Generative Relational Economics

The preceding sections established the objects, scales, questions, analytical perspective, modes of inquiry, and epistemic commitments of Generative Relational Economics. Those elements define how GRE can study economic relations, but a research programme concerned with generative conditions also requires an account of how inquiry can enter practice. The role of this section is to specify a preliminary praxis architecture for GRE: a disciplined way of moving from explanation toward intervention while preserving the epistemic restraints developed above. Its objective is not to provide a universal policy cycle or a general theory of governance. It identifies a recurrent sequence of practical operations through which relational and generative knowledge can inform action under conditions of incomplete knowledge, heterogeneous values, changing environments, and effects that propagate beyond the administratively designated recipient.

GRE praxis begins from a distinction between understanding a system and acting within it. Explanation can identify mechanisms, constraints, distributions, histories, and relational structures, yet intervention changes the very configuration that explanation describes. An intervention can redistribute resources, alter expectations, create or dissolve relations, redefine institutional categories, shift bargaining positions, generate new dependencies, reorganize attention, and modify later capacities for action. Praxis therefore cannot be represented as the simple application of a finished model to a passive target. It is an entry into an evolving relational domain in which the intervention, the affected subjects, the environment, and the relevant knowledge can all change through their interaction.

For that reason, the praxis architecture developed here is iterative. It moves through relational diagnosis, generative diagnosis, identification of constraints and enabling conditions, intervention design, allocation understood as relational intervention, tracing of downstream effects, feedback and revision, adaptive governance, and, where required, withdrawal, reversal, or repair. These operations can overlap, recur, or be entered from different points. They are not a mandatory sequence imposed on every practical problem. Their function is to prevent a narrow intervention logic in which resources are allocated, an immediate output is measured, and wider changes are treated as externalities unless they happen to fit the original administrative frame.

The praxis perspective also preserves the distinction between research-dominant and application-dominant activity. Research-dominant praxis principally seeks improved understanding, even when research design itself changes the studied field. Application-dominant praxis principally seeks to alter an economic or institutional situation under practical constraints. The difference concerns orientation rather than an absolute separation between knowledge and action. Research can generate interventions, and interventions can generate knowledge. GRE therefore treats

praxis as a domain in which explanation, evaluation, experimentation, governance, and learning become coupled while remaining analytically distinguishable.

A further constraint is normative. Generativity is not itself a sufficient criterion of success. An intervention can generate economic activity while deepening dependence, produce capabilities for one group while foreclosing possibilities for another, increase circulation while accelerating extraction, or create institutional stability by suppressing exit and contestation. Section 3.12 therefore develops the architecture of intervention without resolving the normative standards by which generated consequences should be judged. Those standards are taken up in the following section. Here the central concern is more basic: how GRE can intervene without treating either the target of intervention or the intervention's own consequences as fixed in advance.

3.12.1 From Explanation to Intervention

The movement from explanation to intervention is a change in epistemic and practical burden. Explanatory inquiry asks what relations, mechanisms, histories, and conditions contributed to an observed pattern. Intervention asks what may happen if some part of that configuration is deliberately altered. The second question contains the first but adds counterfactual, organizational, ethical, and temporal demands. A mechanism that explains a past outcome may not remain invariant after actors learn about the intervention, institutions adapt, or the distribution of resources changes. GRE therefore resists the assumption that an explanatory model can be converted directly into a policy instrument without re-examining the relations through which the intervention will operate.

A practical intervention enters a field already structured by prior relations. Subsidizing a household, financing a firm, redesigning a public service, opening access to data, changing a legal entitlement, or introducing an artificial system does more than modify one variable. It can alter who interacts with whom, which claims become enforceable, which actions become feasible, whose knowledge becomes authoritative, and which future trajectories become easier to sustain. The intervention should therefore be represented not only by its administrative action but also by the relational changes through which its consequences may be mediated.

This perspective changes the meaning of implementation. Implementation is often treated as the stage in which a previously selected intervention is executed with fidelity. GRE instead treats implementation as an epistemically productive period in which assumptions about relations, mechanisms, and capacities encounter an evolving empirical configuration. Deviations from the original design can indicate administrative failure, but they can also reveal that the initial model omitted relevant actors, constraints, interpretations, or feedback mechanisms. Praxis requires distinguishing avoidable execution error from informative evidence that the intervention theory requires revision.

The transition from explanation to intervention also introduces strategic interaction. Subjects can anticipate policy, resist classification, exploit new opportunities, reorganize coalitions, change reporting behavior, or redirect resources. Organizations can internalize an intervention into routines that differ from its stated purpose. Plat-

forms can redesign interfaces in response to regulation. Beneficiaries can combine an allocation with household, community, or informal resources in ways that produce unanticipated effects. These responses are part of the relational system rather than noise surrounding an otherwise fixed treatment.

GRE therefore favors interventions whose theory of change states at least four elements. First, it identifies the relevant relations through which the intervention is expected to operate. Second, it specifies the generative claim: what capacities, structures, opportunities, constraints, or forms of value are expected to emerge or transform. Third, it states the anticipated temporal and scalar pathways through which effects may propagate. Fourth, it identifies observations that would count against the intervention theory. The resulting design remains provisional, but its provisionality is disciplined rather than vague.

Intervention under uncertainty does not imply paralysis. Many economic and governance problems require action before the relational system is fully known. The practical question is how to make action compatible with learning. GRE therefore gives special weight to staged implementation, monitoring, contestability, modularity, reversible components, and explicit review points where feasible. These features do not eliminate uncertainty. They reduce the cost of discovering that the intervention has altered the field in ways the initial explanation did not anticipate.

3.12.2 Relational Diagnosis

Relational diagnosis identifies the configuration within which the practical problem is constituted. Its purpose is not to produce an exhaustive map of all social relations. It asks which relations are materially relevant to the problem, how they are organized, which boundaries have been selected, and where the apparent administrative object depends on actors or conditions outside that boundary. Diagnosis therefore precedes intervention design because the same nominal problem can require different action when its relational constitution differs.

A relational diagnosis begins by identifying the subjects, organizations, institutions, infrastructures, symbolic systems, and ecological conditions that participate in the relevant economic situation. It then asks how access, authority, recognition, information, resources, obligations, and opportunities are distributed among them. The resulting map may be qualitative, quantitative, historical, network-based, institutional, or mixed. Its adequacy depends on whether it reveals relations that are necessary to understand the practical problem rather than on whether it maximizes representational complexity.

Consider a programme intended to improve employment access. An administrative diagnosis might begin with unemployed individuals and available jobs. A relational diagnosis can reveal additional mechanisms: transportation, childcare, credential recognition, social networks, disability access, hiring intermediaries, platform ranking, visa status, household obligations, employer risk practices, or regional housing costs. These are not automatically the correct variables in every case. Their relevance depends on whether they mediate the conversion of an employment opportunity into an actual capability to obtain and sustain work.

Relational diagnosis also identifies asymmetry. The relevant question is not only

who possesses more resources, but which actors can define categories, set terms of exchange, control infrastructures, impose switching costs, delay decisions, externalize risk, or withdraw without comparable loss. Two actors may exchange voluntarily while facing highly unequal exit conditions. A platform and a small supplier may both be organizations, yet their capacity to redesign the interaction can differ drastically. Diagnosing these asymmetries matters because an intervention that treats formally similar actors as substantively equivalent can reproduce the mechanism that generated the problem.

The diagnosis should also be historical. Present relations can depend on prior institutional settlements, accumulated debts, inherited infrastructures, past exclusions, or sequences of investment that make current alternatives unequally costly. A cross-sectional map can show who is connected to whom while missing why the relation has its present form or why some apparently available alternatives are practically inaccessible. Historical reconstruction helps distinguish a relation that is contingent and readily modifiable from one stabilized by layered commitments and path-dependent investments.

The output of relational diagnosis is therefore a bounded working representation of the practical field. It should make its exclusions visible. No map captures every relation, and an attempt to include everything can make intervention impossible. GRE instead requires an explicit statement of which relations are treated as inside the diagnostic boundary, which are treated as environmental conditions, and which remain uncertain. The map is revisable as intervention reveals previously hidden dependencies.

3.12.3 Generative Diagnosis

Relational diagnosis identifies the configuration; generative diagnosis asks what that configuration tends to produce. The distinction matters because the same relational structure can be significant for different reasons depending on the processes it sustains. A credit relation can generate productive capacity, dependency, reputational effects, data, bargaining power, future borrowing opportunities, or combinations of these. A school can distribute instruction while also generating networks, credentials, expectations, classifications, and future access. A platform can facilitate exchange while generating information asymmetries, behavioral dependence, market visibility, or new organizational capabilities.

Generative diagnosis therefore focuses on transformations rather than only states. It asks what changes because a relation persists, intensifies, weakens, or is removed. The relevant outcomes can include resources, capacities, identities, institutional routines, legal positions, expectations, symbolic categories, ecological conditions, or the ability to enter later relations. This focus is particularly important when immediate outputs are poor proxies for longer-horizon consequences. A grant may be fully disbursed while failing to produce the organizational capacity it was intended to support. A training programme may improve measured skills while weakening participation because the credential is not institutionally recognized. A subsidy may increase adoption while entrenching dependence on a proprietary infrastructure.

The generative diagnosis should distinguish several pathways. Some effects arise

directly from the intervention target. Others are mediated through relations with third parties. Some emerge from feedback: an initial change alters behavior, which changes the environment faced by later participants. Some effects accumulate only after repeated interactions. Others occur through symbolic or classificatory change, where being recognized as eligible, risky, employable, innovative, or compliant modifies later treatment by institutions.

Generative diagnosis also asks what is reproduced. A relational configuration may produce no dramatic new outcome while continually regenerating a distribution of advantage, vulnerability, or access. Stable inequality can be generative in this sense because institutions repeatedly convert initial asymmetries into later opportunities. Conversely, a relation can sustain capabilities that would deteriorate if the relation disappeared. Maintenance, reproduction, and repair are therefore forms of generation when they preserve conditions that require continuing relational work.

A further question concerns foreclosure. Generation can expand possibilities for some actors while reducing the future option set for others or for the same actors at a later time. Infrastructure investment can enable activity while creating technological lock-in. Debt can finance capacity while narrowing future discretion. Standardization can reduce coordination costs while suppressing alternative forms of practice. Generative diagnosis therefore traces both enabling and constraining transformations without assuming that generation is uniformly expansive.

The practical output of generative diagnosis is a set of plausible mechanism pathways linking the relational configuration to changes that matter for the intervention. These pathways can be compared, tested, revised, or ranked by evidential support. GRE does not require every pathway to be fully identified before action. It requires the intervention to state what it expects to generate and why, so that later observations can update rather than merely decorate the original theory.

3.12.4 Identification of Constraints and Enabling Conditions

Diagnosis becomes actionable when it identifies conditions that limit or enable transformation. GRE uses constraint in a broad but disciplined sense: a constraint changes the set, cost, probability, or viability of available transformations without necessarily making an action logically impossible. Enabling conditions operate in the opposite direction by making some transformations more feasible, durable, or accessible. The same condition can constrain one pathway while enabling another.

Constraints can be material, institutional, relational, informational, temporal, symbolic, ecological, or cognitive. A lack of capital is a material constraint, but the ability to use capital may depend on licenses, trusted partners, language access, data, infrastructure, or the timing of payments. A legal entitlement can exist while remaining practically inaccessible because procedural complexity, documentation requirements, or fear of institutional contact limits its use. An organization can possess technical capacity while lacking the authority to deploy it. A community can possess knowledge while lacking channels through which institutions recognize that knowledge as actionable.

The distinction between constraint and symptom is central. Low participation can be treated as a behavioral problem and addressed through incentives, yet the under-

lying constraint may be timing, distrust, inaccessible procedures, reputational risk, or exclusion from the networks through which information circulates. Raising an incentive can improve participation while leaving the deeper constraint unchanged, or it can worsen inequality if only already advantaged actors can respond. Constraint identification therefore asks which conditions actually regulate the transformation pathway relevant to the intervention.

Enabling conditions deserve equal analytical attention. Praxis often becomes overly problem-centered and maps only deficits. Existing trust relations, local organizations, informal knowledge, public infrastructure, legal protections, professional norms, ecological capacities, and mutual-aid practices can already support generation. An intervention that ignores these conditions can displace them with a formal system that appears more legible while being less generatively capable. GRE therefore asks which existing relations should be preserved, strengthened, connected, or left undisturbed.

Constraints and enabling conditions are also scale-relative. A national regulation can constrain an organization while enabling fairer competition across a sector. A household norm can constrain an individual's labor-market participation while enabling care provision that sustains other members. A standardized protocol can constrain local discretion while enabling interoperability. Praxis requires representing these tensions rather than declaring a condition simply enabling or constraining in the abstract.

The identification process should therefore produce intervention points rather than a flat inventory. Some constraints are proximal and modifiable; others are structural conditions that cannot be changed within the intervention horizon. Some enabling conditions can be activated with modest resources; others require institutional reform. Distinguishing these categories helps prevent designs that target visible but weakly generative variables while leaving the mechanisms of exclusion or capacity formation intact.

3.12.5 Intervention Design

Intervention design translates diagnosis into a provisional configuration of actions, resources, institutions, and learning procedures. GRE does not require a distinctive policy instrument. Taxes, transfers, public investment, regulation, organizational redesign, information provision, infrastructure, standards, cooperative arrangements, educational programmes, platform rules, procurement, or combinations of these can all be compatible with GRE. What distinguishes the praxis perspective is how the intervention is specified: in relation to mechanisms, downstream generation, scale, feedback, and revisability.

A GRE intervention should first identify its operative target. The target can be a resource constraint, a relation, a conversion mechanism, an institutional rule, a boundary, a feedback loop, an information structure, or an enabling condition. Target clarity matters because interventions with the same administrative recipient can act through different mechanisms. A cash transfer and a childcare service may both support household economic participation, but they alter different constraints and relational structures. Their effects should not be inferred from the shared identity of

the recipient.

Second, intervention design should distinguish the intended immediate change from the intended generative effect. Providing equipment is an immediate allocation. Developing a durable productive capacity may be the generative objective. Changing a regulation is an immediate institutional act. Increasing entry, reducing dependency, or enabling new organizational forms may be the intended downstream effect. This distinction makes it possible to observe successful implementation together with failed generation, or imperfect implementation together with unexpected generative benefits.

Third, design should state relevant temporal horizons. Some interventions seek rapid stabilization; others seek capacity formation whose effects appear slowly. A short evaluation window can misclassify a long-horizon intervention as ineffective or reward interventions that produce immediate outputs by drawing down future resources. GRE therefore encourages explicit differentiation among immediate, intermediate, and longer-horizon effects without assuming that longer is always better.

Fourth, intervention design should anticipate heterogeneity. Subjects differ in resources, vulnerabilities, interpretation, institutional status, and ability to convert an allocation into later capacity. Uniform provision can therefore generate unequal outcomes. The design question is not necessarily to individualize every intervention, which can become administratively costly or intrusive. It is to identify forms of heterogeneity that are mechanism-relevant and to determine whether adaptive, tiered, or plural pathways are needed.

Fifth, design should include learning architecture. Monitoring variables, qualitative feedback, review intervals, stop conditions, and procedures for incorporating affected participants should be established before implementation where possible. This prevents evaluation from becoming an after-the-fact search for favorable indicators. It also recognizes that some of the most important effects may be discovered only after the intervention enters the field.

Intervention design in GRE is therefore closer to constructing a revisable relational hypothesis than to selecting a fixed treatment. The design states what is being changed, through which relations, toward which generative effects, under which assumptions, across which scales and time horizons, and with what procedures for detecting error. The resulting intervention can still be administratively simple. Analytical sophistication does not require operational complexity when the mechanism is clear.

3.12.6 Allocation as Relational Intervention

Allocation is a central economic operation, but GRE treats allocation as the beginning of a relational process rather than its endpoint. Money, time, attention, infrastructure, rights, data access, institutional recognition, expertise, or productive assets enter existing relations when allocated. Their consequences depend on conversion conditions, obligations, expectations, complementary resources, and the position of the recipient within wider structures.

This perspective changes the unit of practical analysis. A transfer to an individ-

ual may affect a household, landlord, creditor, employer, local market, or platform through expenditure, bargaining, debt repayment, mobility, or information. Funding an organization can change its internal authority, external partnerships, reputational standing, and future ability to attract resources. Granting data access can create research capacity while redistributing informational advantage. Allocation therefore changes relations even when the formal instrument is directed to a discrete recipient.

Relational allocation does not mean that every allocation must be socially conditioned or collectively administered. Direct individual transfers can be valuable precisely because they reduce dependence on gatekeepers. The analytical point is that the intervention should ask what relations the allocation enters or transforms. An unconditional transfer can weaken a coercive relation by increasing exit capacity. A conditional transfer can create a new monitoring relation. A loan can expand productive capacity while strengthening a creditor's claims. The relational effects depend on design and context rather than on the category of instrument alone.

Allocation also has temporal structure. Resources can be consumed, invested, circulated, pooled, converted, or used to maintain existing capacities. Timing can determine which pathway becomes viable. A delayed payment can destroy a fragile organization even if the total allocation is adequate. A predictable stream can generate planning capacity beyond its nominal monetary value. A one-time grant can enable experimentation but fail to sustain maintenance. GRE therefore treats schedule, predictability, reversibility, and duration as properties of the allocation relation.

The recipient itself may be generated through allocation. Programmes define eligibility categories, create beneficiary identities, establish reporting obligations, and sometimes produce organizations capable of receiving funds. Public procurement can constitute firms as qualified suppliers. Credit scoring can define economically consequential categories of risk. Allocation systems therefore participate in the production of subjects and classifications, not merely in the distribution of pre-existing resources among them.

For praxis, the implication is that allocation should be evaluated through both direct transfer and relational transformation. The relevant questions include what capacity the resource creates, what dependencies accompany it, what complementary conditions are required, which actors gain authority, how value is recirculated or extracted, and what happens when the allocation stops. These questions extend ordinary allocation analysis rather than replacing it.

3.12.7 Tracing Downstream Effects

Once an intervention enters a relational field, praxis requires tracing effects beyond its immediate output. Downstream tracing follows the propagation, conversion, recirculation, dissipation, extraction, and stabilization of changes generated by the intervention. The purpose is not to attribute every later event to the intervention. It is to identify plausible pathways through which initially local changes become economically consequential elsewhere or later.

Downstream effects can be direct, mediated, recursive, or displaced. A subsidy can increase demand directly, alter supplier investment through expectation, change local prices through market response, and affect future policy through political inter-

pretation. A new infrastructure can reduce transport costs, reorganize land values, change settlement patterns, and later alter fiscal capacity. A platform rule can affect user behavior, which changes the data used by the platform, which then changes ranking or recommendation, producing a recursive effect.

Tracing requires temporal discipline. Early indicators can differ from later effects because actors adapt and complementary investments emerge. Some harms are delayed. Some benefits require repeated interaction before they become visible. GRE therefore distinguishes outcome timing from causal distance. An effect that occurs quickly can still be relationally distant if it is mediated through several actors, while a delayed effect can arise from a simple accumulation mechanism.

Tracing also requires counterfactual restraint. Observing a later change in a connected actor does not prove that the intervention generated it. Evidence can come from experimental or quasi-experimental designs, process tracing, comparative cases, administrative sequences, qualitative testimony, network change, simulation, or combinations of these. The method should match the claim. The broader the asserted downstream attribution, the greater the burden of distinguishing intervention effects from concurrent change.

Some downstream effects concern value conversion rather than magnitude. An allocation can be converted into political influence, social recognition, technical capacity, ecological pressure, or future access. These forms may not be commensurable with the original resource. Tracing therefore cannot always be reduced to adding monetary benefits and costs. GRE can use monetary valuation where appropriate while preserving additional dimensions when conversion into a scalar measure would erase mechanism-relevant differences.

The practical function of downstream tracing is to maintain contact between intervention and evolving reality. It provides evidence for revision, identifies beneficiaries or harmed parties omitted from the original frame, and detects when an intervention's generative pathway has changed. It also prevents a programme from declaring success solely because the administratively proximate output was delivered as planned.

3.12.8 Feedback and Revision

Feedback converts intervention into learning when observations are allowed to alter the intervention theory and design. GRE distinguishes feedback from mere monitoring. Monitoring records whether specified indicators change. Feedback becomes analytically consequential when those observations can revise assumptions about relations, mechanisms, boundaries, timing, subject heterogeneity, or normative effects.

A useful feedback architecture separates implementation evidence from generative evidence. Implementation evidence asks whether the intervention occurred as intended: funds reached recipients, infrastructure was built, a rule was applied, or a service became available. Generative evidence asks whether the intended transformations followed and what additional transformations occurred. Maintaining this distinction prevents implementation fidelity from being mistaken for substantive success.

Revision can occur at several levels. Parameters can be adjusted while the intervention theory remains intact. Delivery can change because conversion conditions differ across groups. The relational target can change when a hidden intermediary becomes visible. The generative objective itself can be revised when the original aim proves infeasible, harmful, or normatively contested. In more substantial cases, the intervention can reveal that the original problem representation was wrong and requires reconstruction.

Feedback should include affected subjects where their experience provides access to mechanisms or harms not visible in aggregate indicators. Participation is not automatically epistemically superior; local actors can disagree, possess partial information, or face incentives that shape reporting. Their knowledge nevertheless belongs to the evidential field. A feedback system that listens only to administrative data can systematically miss changes in trust, dignity, informal burden, strategic adaptation, or hidden exclusion.

Revision also requires institutional capacity. An organization can collect excellent evidence yet be unable to change because budgets, legal mandates, procurement contracts, professional incentives, or political commitments lock the intervention into its original form. GRE therefore treats the ability to revise as part of intervention design. Review authority, modular contracts, contingency funds, sunset clauses, and explicit decision rules can create practical room for learning, where appropriate.

Feedback is thus not a final stage after implementation. It is a continuing relation between action and evidence. Praxis becomes adaptive when the intervention is organized so that new information can change subsequent action without abandoning accountability or making goals infinitely movable.

3.12.9 Adaptive Governance

Adaptive governance is the institutionalization of revision under changing conditions. It becomes relevant when the intervention affects a system whose relations, actors, or environment evolve on a time scale comparable to the governance process. In such settings, a one-time optimal design can become obsolete even if it was well justified when adopted. GRE therefore treats governance as an ongoing arrangement for observing, deciding, revising, coordinating, and contesting changes in a relational field.

Adaptation does not mean continuous discretionary change. Constant revision can destroy predictability, undermine investment, and make rights dependent on administrative mood. Stable rules can themselves be enabling conditions. Adaptive governance therefore requires deciding which elements should remain stable and which should be revisable. Constitutional protections, procedural rights, or long-horizon commitments may provide a stable frame within which parameters, implementation mechanisms, or experimental components can change.

The architecture of adaptation should match the distribution of knowledge and consequence. Centralized revision can coordinate across regions and prevent local capture, while decentralized adaptation can respond to context and reveal heterogeneous mechanisms. Multi-level governance can combine these functions when authority, information, and accountability are allocated explicitly. GRE does not presume decentralization to be intrinsically more relational or generative. The relevant

question is which governance structure can perceive and respond to the mechanisms that matter while preserving legitimate constraints on power.

Adaptive governance also involves threshold decisions. Some observed variation is noise; some indicates a changing mechanism. Revising too quickly can chase temporary fluctuations, while revising too slowly can entrench harm. Governance therefore needs criteria for escalation, experimentation, suspension, and review. These criteria can be quantitative, qualitative, procedural, or mixed depending on the domain.

Learning across cases is another component. Local adaptation can generate knowledge that becomes useful elsewhere, but portability requires comparison of mechanisms and boundary conditions. A successful intervention in one institutional environment may fail where trust, infrastructure, legal authority, or subject composition differs. Adaptive governance therefore builds cumulative knowledge by documenting not only whether an intervention worked, but under which relational conditions and through which pathway.

At its strongest, adaptive governance alters its own learning capacities. Monitoring systems improve, categories are revised, participation channels change, and institutional memory accumulates. Governance thereby becomes a generative process whose output includes future ability to govern. This recursive feature is central to GRE praxis: the intervention should be evaluated partly by whether it leaves the system more capable of perceiving, contesting, and responding to later problems.

3.12.10 Withdrawal, Reversal, and Repair

A praxis architecture is incomplete if it specifies how to begin and revise interventions but not how to stop them. Withdrawal, reversal, and repair are distinct practical operations. Withdrawal ends or reduces an intervention. Reversal seeks to restore a prior condition or undo a change where feasible. Repair addresses harms, dependencies, damaged relations, or lost capacities that persist after withdrawal. GRE treats these operations as part of intervention design rather than exceptional responses to obvious failure.

Withdrawal can be required for several reasons. An intervention may fail to generate its intended effect, produce unacceptable harm, become obsolete as conditions change, or create costs that exceed its continuing value. It can also succeed so thoroughly that the intervention is no longer required. A temporary guarantee, emergency subsidy, or transitional institution should not become permanent merely because its removal was never designed.

Stopping an intervention can itself be generatively consequential. Organizations may have invested around a subsidy, households may depend on a service, communities may have reorganized around infrastructure, or markets may have adapted to a regulatory regime. Abrupt withdrawal can therefore destroy capacities that the intervention helped create. Exit design should consider notice, transition periods, transfer of responsibilities, preservation of useful infrastructure, and the distribution of adjustment costs.

Reversal is more demanding because relational change is often path dependent.

Restoring a prior rule does not necessarily restore the prior system. Actors have learned, investments have shifted, expectations have changed, and some capacities may have disappeared. A policy reversal can therefore create a third configuration rather than return to the first. GRE treats reversibility as a graded property: some components can be reversed mechanically, others only approximately, and some transformations are effectively irreversible within the relevant horizon.

Repair addresses the residual consequences of intervention. It can involve compensation, restoration of access, institutional reform, rebuilding trust, data deletion or correction, ecological remediation, debt restructuring, reinstatement of rights, or support for capacities weakened by the intervention. Repair is not equivalent to monetary compensation because the harmed object may be relational, institutional, ecological, symbolic, or temporal. A payment can acknowledge loss while leaving the mechanism that produced the loss intact.

The possibility of repair also changes how interventions should be designed. Systems that preserve audit trails, appeals, modularity, data provenance, and institutional responsibility are easier to correct. Interventions that diffuse responsibility across opaque chains can make harm difficult to attribute and repair. GRE therefore treats repairability as a practical design consideration alongside effectiveness and adaptability.

Withdrawal, reversal, and repair complete the preliminary praxis cycle developed in this section. GRE moves from explanation toward intervention by diagnosing the relational field, identifying what the field generates, locating constraints and enabling conditions, designing a provisional intervention, treating allocation as a relational act, tracing downstream effects, learning through feedback, adapting governance, and retaining the capacity to stop or repair what has been created. The sequence remains heuristic rather than universal. Its purpose is to organize intervention under incomplete knowledge without reducing practice to either static optimization or unconstrained experimentation.

This praxis architecture also clarifies why evaluation cannot be postponed to a single terminal outcome. Each stage creates questions about value, harm, participation, capability, dependency, future possibility, and domination. An intervention may be operationally adaptive while normatively unacceptable, or normatively attractive in intention while generatively destructive in practice. The following section therefore turns from the architecture of action to the standards by which generated consequences can be evaluated under plural and sometimes incommensurable values.

3.13 Evaluation and Normative Orientation

Generative Relational Economics requires a normative vocabulary because the processes it studies can enlarge possibility, redistribute capacity, stabilize cooperation, create dependency, intensify domination, or foreclose alternative futures. The role of this section is to specify the evaluative dimensions through which such consequences can be examined without converting generativity itself into a moral criterion. Its objective is to distinguish descriptive claims about what an economic relation generates

from normative judgments about whether the generated configuration should be sustained, revised, constrained, or repaired. The discussion proceeds through ten connected dimensions: the normative status of generativity; generated value and harm; participation; capability; relational quality; future possibility; dependency and domination; generative foreclosure; plural and incommensurable values; and the division of labor between GRE and GREthic. The method is constitutive and normative. It does not attempt to derive one complete moral theory from GRE. It identifies evaluative objects and inferential disciplines that allow GRE to remain normatively explicit while preserving plurality among competing theories of justice and ethical judgment.

The need for this distinction follows directly from the analytical architecture developed above. A relation can be highly generative in the descriptive sense because it produces new organizations, knowledge, technologies, markets, habits, classifications, capabilities, and forms of value. The same relation can distribute those consequences asymmetrically, externalize harms, narrow exit options, or reorganize the field so that some future possibilities become inaccessible. An intervention can therefore succeed according to one generative objective while producing losses elsewhere in the relational domain. GRE evaluation must trace both kinds of consequence rather than allowing the presence of generation to function as evidence of desirability.

Normative evaluation also requires attention to temporal depth. Immediate welfare gains can be accompanied by long-run dependency. Short-term loss can sometimes create later capability. A stable relation can protect vulnerable participants while also becoming difficult to contest. An institution can increase aggregate opportunity while decreasing the range of trajectories available to a particular group. GRE therefore treats present outcome, relational position, future capacity, and transformation of possibility as analytically separable evaluative objects. Their relative importance cannot be fixed once for every inquiry.

Evaluation is also complicated by heterogeneous value. Economic decisions can affect income, security, care, recognition, ecological integrity, autonomy, knowledge, belonging, trust, aesthetic experience, institutional legitimacy, and many other forms of value whose relations are only partially commensurable. Monetary valuation can be useful within a defined problem while leaving significant evaluative remainders. GRE consequently distinguishes commensuration as an analytical or institutional operation from the stronger claim that the values being compared possess a common natural metric.

The resulting normative stance is neither value-neutrality nor normative closure. GRE accepts that economic inquiry frequently contains evaluative choices in the selection of outcomes, boundaries, scales, and affected subjects. It therefore seeks to make those choices explicit and contestable. At the same time, GRE does not treat its own analytical categories as sufficient to decide every ethical conflict. Participation, capability, relational quality, future possibility, dependency, domination, and foreclosure provide a multidimensional evaluative field. Normative judgment still requires specification of who is affected, which values are at stake, how conflicts among values are handled, and which ethical or political principles justify intervention.

This distinction creates an interface with GREthic. GRE supplies economic analysis of generative structures, distributions, dependencies, conversion pathways, and changes in future possibility. GREthic addresses the broader ethical problem of how

such findings should enter judgment, justification, institutional design, and the evolution of normative criteria. Their relation is therefore collaborative without being identical. The present section establishes that interface while keeping GRE's disciplinary center within economics.

3.13.1 Normative Status of Generativity

Generativity describes a capacity of a relation, process, institution, or configuration to produce further states, capacities, relations, values, or possibilities. That descriptive property has no fixed normative sign. Productive networks, monopolistic infrastructures, extractive regimes, scientific communities, predatory markets, mutual-aid institutions, and systems of surveillance can all generate durable consequences. The fact that a configuration generates more than its immediate output identifies an important economic property; it does not establish that the resulting trajectory should be preferred.

This distinction is foundational because GRE gives generativity an unusually prominent analytical role. Without an explicit normative separation, the vocabulary of generation could encourage a subtle bias toward expansion, novelty, proliferation, or self-reproduction. Economic history supplies many cases in which highly generative arrangements produced wealth together with coercion, ecological depletion, exclusion, or durable hierarchy. A relation can reproduce itself efficiently because the costs of exit are high. An institution can generate rapid innovation because risks are shifted toward actors with weak bargaining power. A platform can generate dense interaction while concentrating control over the infrastructure through which that interaction occurs. Descriptive generativity therefore requires an additional evaluative step.

The relevant question is not whether generation occurs, but what is generated, for whom, through which relations, under which constraints, and with what effects on later possibility. These questions prevent GRE from treating generativity as a scalar objective that can be maximized independently of content. More generation can be desirable in one dimension and damaging in another. A research system can generate knowledge while degrading working conditions. A credit system can generate entrepreneurial capacity while expanding vulnerability to debt. A welfare programme can generate security while also creating administrative classifications that constrain mobility. Evaluation therefore concerns the structure and distribution of generation.

Normative analysis must also distinguish generativity from regeneration. A system can generate novelty while eroding the material or social conditions required for continuation. Another system can maintain those conditions without producing substantial novelty. A third can restore damaged capacities while limiting some current activities. These trajectories involve different evaluative questions. GRE therefore avoids equating novelty, persistence, resilience, growth, and regeneration with one another. Each describes a different relation between current activity and future conditions.

A similar distinction applies to self-reinforcement. Some beneficial institutions require positive feedback to remain viable. Some harmful institutions also acquire self-reproducing capacities. The presence of a stable attractor-like pattern, increasing

returns, or institutional persistence does not imply normative legitimacy. Evaluation must examine whether the mechanisms of reproduction preserve contestability, participation, and the possibility of revision or whether they make domination and exclusion increasingly difficult to reverse.

The normative status of generativity is consequently conditional and relational. GRE can identify generative mechanisms and compare their consequences without assigning a universal value to generation itself. Normative evaluation begins when the analysis asks how generated consequences affect subjects, relations, capacities, values, dependencies, and future possibility. The remaining subsections specify those dimensions in greater detail.

3.13.2 Generated Value and Generated Harm

Generated value and generated harm are parallel analytical objects. Both can emerge downstream from an economic relation, both can propagate beyond the administrative recipient, and both can change form as they circulate. The evaluative task is therefore broader than measuring the immediate benefit and subtracting a directly observed cost. GRE asks how value and harm are produced, distributed, converted, accumulated, displaced, and transmitted across scales and time.

Generated value can include income, capability, knowledge, security, trust, coordination, infrastructure, recognition, institutional capacity, ecological restoration, or access to future opportunities. Some forms of value are directly appropriable by a subject; others exist only through a relation or shared condition. A public standard, a trusted institution, a functioning ecosystem, or a community of practice can generate benefits whose value cannot be represented adequately as the possession of one individual. GRE therefore evaluates value at the level at which it is generated and realized.

Generated harm has equally varied forms. An intervention can increase surveillance, dependency, stigma, ecological burden, exclusion, precarity, misinformation, or concentration of bargaining power even when the designated recipient receives a material benefit. Harm can also be displaced. A low consumer price can be sustained through labor conditions elsewhere in the supply chain. Local ecological improvement can depend on transferring waste or extraction to another region. An automated system can reduce transaction costs while increasing the exposure of a minority of users to unreviewable classification errors. Evaluation must therefore examine relational incidence rather than only administrative incidence.

Value and harm can coexist within the same generative pathway. Education can expand capability while imposing debt. Infrastructure can improve access while displacing residents. Intellectual-property protection can support some forms of investment while constraining downstream experimentation. Social protection can reduce insecurity while creating reporting burdens or intrusive eligibility regimes. Such configurations should not be forced into a premature net-value judgment when the affected values are heterogeneous and differently distributed.

Temporal ordering further complicates evaluation. Harm can be immediate while value is delayed, or the reverse. Some effects are reversible; others create durable path dependence. A temporary subsidy may generate a lasting market or a lasting de-

pendency. A short-lived exclusion can alter educational or professional trajectories for decades. GRE therefore records persistence and reversibility as part of the evaluative description rather than treating all consequences as contemporaneous flows.

This framework also makes attribution important. A downstream harm may be associated with an intervention without being generated by the mechanism under study. Conversely, a benefit may be credited to an intervention even though it depends mainly on pre-existing relations or complementary institutions. Normative evaluation should therefore inherit the epistemic discipline of Section 3.11: claims about generated value and harm require a stated mechanism, boundary, scale, and degree of evidential confidence.

3.13.3 Participation

Participation concerns the capacity of affected subjects to enter, influence, contest, benefit from, and withdraw from the relations through which economic life is organized. It is an evaluative object because economic systems do more than distribute resources. They distribute positions from which subjects can speak, act, create, coordinate, challenge classifications, and contribute to future generation. A configuration can therefore increase material output while narrowing meaningful participation.

Participation has several dimensions. Access concerns whether a subject can enter a relevant institution, market, infrastructure, profession, community, or decision process. Voice concerns whether the subject can make claims that receive institutional attention. Influence concerns whether participation can alter decisions rather than merely register preference. Recognition concerns whether the subject is legible within the categories through which resources and rights are allocated. Contestability concerns whether classifications, decisions, or rules can be challenged. Exit concerns whether participation remains voluntary in a meaningful sense or is sustained by dependence and prohibitive switching costs.

These dimensions need not move together. A platform can provide wide access while retaining centralized control over ranking and rule change. A formal consultation process can permit voice while leaving participants with little influence. A labor market can allow nominal exit from an employer while economic insecurity makes exit practically costly. A public service can grant rights in principle while administrative categories render some users difficult to recognize. GRE therefore avoids reducing participation to formal inclusion.

Participation also has a generative dimension. Being able to participate can develop knowledge, confidence, social ties, institutional literacy, bargaining capacity, and new forms of collective organization. Exclusion can have the opposite effect by reducing opportunities to acquire the capacities later required for participation. Present access can therefore shape future access. Evaluation should examine whether an arrangement generates broader capacities for participation or produces cumulative disadvantages that narrow future entry.

The economic significance of participation becomes especially visible under conditions of technological abundance. If productive tasks can increasingly be performed by artificial or highly automated systems, a framework that ties economic participation exclusively to productive necessity can leave human subjects with reduced ac-

cess to income, institutions, social recognition, or meaningful collective activity. GRE does not presume a particular technological outcome, but it treats the institutional organization of participation as a distinct problem from the allocation of productive tasks.

Participation should not be romanticized. More participation can impose time costs, reproduce inequalities in voice, or shift responsibility onto subjects with limited resources. Some technical decisions require specialized knowledge; some participants may prefer delegation. The normative question therefore concerns the quality and consequences of participation, including who bears its burdens, what forms of representation are available, and whether nonparticipation is compatible with protection from arbitrary decisions.

3.13.4 Capability

Capability concerns the effective ability of subjects to pursue relevant actions and ways of living within their actual relational and institutional conditions. For GRE, capability is an especially important evaluative object because economic relations can generate or destroy the conditions through which resources become usable. An allocation that appears equal at the level of resources can produce unequal capability when subjects face different conversion conditions.

Capability therefore extends evaluation beyond possession. Access to money, information, technology, or legal rights matters only partly through the quantity received. Its practical significance depends on health, time, knowledge, infrastructure, social recognition, legal status, language, care obligations, physical accessibility, institutional trust, and many other conversion conditions. GRE can analyze these conditions as part of the relational field through which a resource becomes an effective opportunity.

Capabilities can also be cumulative. Education can increase the ability to learn further skills. Secure housing can improve the ability to sustain employment or study. Access to digital infrastructure can expand the capacity to participate in markets, administration, and knowledge production. Conversely, repeated exclusion can reduce the capacities needed to take advantage of later opportunities. Evaluation should therefore trace capability trajectories rather than treating capability as a static stock.

The generative perspective adds a second question: who controls the conditions under which capability can be exercised? A subject may possess technical competence while depending on a platform, license, visa, credential, payment network, data infrastructure, or institutional recognition. Capability is then relationally enabled. If access to the enabling condition can be withdrawn unilaterally, the subject's practical freedom may be more fragile than a simple skill inventory suggests.

Capability evaluation must also preserve normative pluralism. GRE does not need to specify one universal list of valuable capabilities in order to treat capability formation as economically significant. Different inquiries can justify different evaluative sets depending on the affected population, institutional context, and normative framework. The important discipline is to state which capabilities are being evaluated, why they matter, and how their measurement relates to the actual opportunities of subjects.

The distinction between capability and performance is equally important. A subject can possess a genuine opportunity without exercising it. Economic evaluation should not automatically infer deprivation from nonuse or success from observed functioning. Choices can reflect preference, but they can also reflect adaptation to constraint, uncertainty, social expectation, or limited information. GRE therefore treats capability as an evaluative lens that requires contextual interpretation rather than direct inference from observed behavior alone.

3.13.5 Relational Quality

Relational quality concerns the properties of the relations through which economic activity is organized. It directs evaluation toward features that can disappear when analysis looks only at individual outcomes. Two arrangements can deliver similar material distributions while differing substantially in reciprocity, transparency, recognition, reliability, contestability, vulnerability to arbitrary power, or the burdens required to sustain cooperation.

Relational quality is deliberately a plural category. A high-quality relation in one context can emphasize trust and continuity; another can require independence and easy exit; a third can require procedural transparency or protection from discrimination. GRE therefore does not assume that one relational form is universally superior. It asks which properties are normatively relevant to the local relation and how those properties affect both current experience and later generative possibility.

Trust provides one example. Trust can reduce transaction costs, support cooperation, and enable forms of joint action that formal contracting cannot fully specify. Yet trust can also create vulnerability when one party controls information or enforcement. Dense trust within a group can coexist with exclusion of outsiders. Evaluation therefore concerns the conditions under which trust is generated, whether reliance is reciprocated, and what protections exist when trust is breached.

Recognition provides another example. Economic relations can treat subjects as interchangeable units or as participants whose claims and histories matter. Recognition can affect bargaining, access, dignity, willingness to cooperate, and institutional legitimacy. At the same time, institutional recognition often depends on categories that simplify complex identities. A recognition regime can include some subjects by making others invisible. Relational quality therefore includes the revisability of the categories through which recognition is granted.

Contestability is especially important in relations involving asymmetry. A subject may accept unequal expertise, authority, or capability when decisions remain reviewable and reasons can be challenged. The same asymmetry can become more problematic when rules are opaque, appeals are impossible, or dependence makes disagreement costly. GRE therefore treats relational quality as connected to the governance of asymmetry rather than to equality in every dimension.

Relational quality also has generative consequences. Relations characterized by reliability and fair contestation can support investment, experimentation, and long-term cooperation. Relations characterized by arbitrary sanction or unstable recognition can encourage defensive behavior, information withholding, and short planning horizons. Evaluation should consequently examine both the intrinsic and generative

significance of relational quality without assuming that its value can be reduced to later efficiency gains.

3.13.6 Future Possibility

Future possibility concerns the range and quality of trajectories that remain realistically available after an economic relation or intervention has taken effect. It is central to GRE because present arrangements continually reshape the conditions of later action. Evaluation therefore extends beyond current welfare to ask whether subjects and institutions retain meaningful capacity to revise, learn, exit, recombine resources, or pursue alternative forms of life and organization.

Future possibility differs from abstract logical possibility. An option can exist formally while remaining practically inaccessible because of cost, law, infrastructure, knowledge, social position, or path dependence. GRE is concerned with feasible and relationally supported possibility. The relevant question is whether subjects possess the conditions required to convert an apparent option into a credible trajectory.

Economic development can expand future possibility by generating infrastructure, education, savings, institutional competence, public knowledge, and trusted coordination. It can also narrow possibility through debt lock-in, ecological depletion, monopoly, rigid standards, irreversible investment, or loss of local capability. The same intervention can expand options for one group while constraining another. Evaluation must therefore be distributional and multiscale.

Optionality also interacts with commitment. Some valuable projects require long-term coordination, sunk investment, and stable expectations. Preserving every option can prevent the formation of institutions whose value depends on continuity. GRE therefore does not treat maximal reversibility as a universal goal. It asks whether commitments are justified, whether affected subjects understand the resulting constraints, whether revision remains possible under changing conditions, and whether the burdens of irreversibility are distributed fairly.

The temporal horizon of evaluation matters. A policy that preserves short-run choice can undermine long-run ecological or fiscal possibility. A restrictive rule can reduce present options while protecting conditions needed for future generations. GRE therefore requires explicit time horizons and rejects the assumption that present preference alone exhausts normative relevance. Intergenerational effects become part of economic evaluation when current activity alters the capability and action space available later.

Future possibility also provides a bridge between economic and political evaluation. Control over infrastructure, standards, data, property, legal categories, or knowledge systems can determine which later projects become feasible. Power can therefore operate by structuring possibility before any specific decision is made. Evaluation of future possibility helps identify such upstream effects and prepares the analysis of power in the following section.

3.13.7 Dependency and Domination

Dependency is a pervasive feature of economic life. Individuals depend on households, organizations, infrastructures, ecological systems, legal institutions, markets, and other persons. Firms depend on suppliers, finance, standards, workers, customers, and public order. Dependency therefore cannot serve as a simple indicator of injustice. The evaluative problem concerns the structure of dependence: how essential the relation is, whether alternatives exist, how burdens and benefits are distributed, and whether one party can exercise discretionary power over another's conditions of action.

Some dependencies are reciprocal and mutually enabling. Specialization creates interdependence because actors can achieve more through coordinated reliance than through autarky. Care relations can involve deep dependence while also generating security, capability, and belonging. Public infrastructure creates dependence on collective institutions that may be normatively desirable. GRE therefore distinguishes dependency from domination rather than treating self-sufficiency as the default ideal.

Domination becomes relevant when dependency is combined with power that is difficult to contest, exit, or subject to accountable rules. A worker can depend on an employer, a seller on a platform, a tenant on a landlord, or a state on a creditor. Whether the relation becomes dominating depends on the available alternatives, procedural protections, transparency, collective organization, legal constraints, and the ability to challenge arbitrary decisions. The analysis therefore concerns relational structure rather than the mere presence of unequal capability.

Generative mechanisms can deepen dependency over time. A platform can become more indispensable as participants invest in platform-specific reputation or data. A lender can acquire increasing influence when refinancing becomes necessary. A technology ecosystem can create switching costs through proprietary standards and complementary investments. Such processes transform an initially optional relation into one that shapes the subject's future possibilities. GRE evaluates the trajectory of dependency, not only its initial contractual form.

Dependency can also be hidden by administrative boundaries. An organization may appear autonomous while relying on unpaid care, public infrastructure, ecological services, or precarious subcontracting. A wealthy region can reduce local dependence by externalizing extraction elsewhere. Evaluation should therefore trace dependency across scales and identify whose capacities sustain the apparent independence of others.

The normative task is consequently to distinguish enabling interdependence from dependency that concentrates arbitrary power or systematically transfers risk. This distinction is contextual and requires attention to alternatives, voice, exit, reciprocity, and governance. GRE can map these conditions economically while leaving broader ethical judgment open to explicit normative argument.

3.13.8 Generative Foreclosure

Generative foreclosure occurs when a present economic relation, intervention, or institutional arrangement reduces the capacity to generate relevant future alternatives. Foreclosure is stronger than an ordinary opportunity cost. Every choice excludes some alternatives because resources and time are finite. Generative foreclosure concerns changes to the conditions of future generation themselves: the loss of capabilities, relations, infrastructures, ecological conditions, institutional pluralism, or epistemic resources required to create or recognize later options.

A technological standard can produce generative foreclosure when complementary investment makes alternative architectures prohibitively costly. Concentrated ownership of research infrastructure can narrow which questions can be investigated. Educational exclusion can reduce not only present opportunity but also the later capacity to formulate and pursue new projects. Ecological degradation can remove future productive and cultural possibilities that current actors cannot fully specify. In each case, the loss concerns the generative field rather than one foregone transaction.

Foreclosure can be intentional or emergent. A dominant actor may deliberately raise barriers to entry. An institution may unintentionally create lock-in through cumulative coordination. A society may deplete a resource without any actor intending to eliminate later possibilities. Normative evaluation therefore cannot rely only on motive. It must examine the mechanisms through which possibility is narrowed and the distribution of the resulting loss.

The concept also requires restraint. Stable institutions necessarily reduce some degrees of freedom by creating rules, commitments, standards, and expectations. Such constraint can itself enable generation by lowering uncertainty and coordinating investment. GRE therefore distinguishes productive structuring from foreclosure by asking whether the constraint preserves meaningful routes for learning, contestation, recombination, and revision relative to the values at stake.

Irreversibility is an important but incomplete indicator. Some irreversible changes are desirable; some reversible systems can still reproduce severe domination. The evaluative question concerns which future capabilities and relations are lost, who bears the loss, whether the loss was foreseeable, whether affected subjects had meaningful participation, and whether compensating generative capacities are created elsewhere. Foreclosure is thus a relational and normative concept rather than a synonym for permanence.

Generative foreclosure gives GRE a way to evaluate economic processes whose most important harms are difficult to observe in present output measures. The absence of a future innovation, institution, community, ecological state, or life trajectory cannot be measured in the same way as an existing commodity. Evaluation therefore requires counterfactual and historical reasoning, explicit uncertainty, and humility concerning possibilities that current categories may fail to represent.

3.13.9 Plural and Incommensurable Values

GRE assumes that economic evaluation can involve several forms of value whose relations are partial, contested, or context-dependent. Income, security, autonomy, care, recognition, ecological integrity, knowledge, cultural continuity, trust, and future possibility can matter simultaneously without reducing naturally to one metric. The presence of plural value therefore creates a problem of judgment rather than a technical defect awaiting universal conversion.

Commensuration can still be useful. Budgets require numerical comparison; cost-effectiveness analysis can clarify trade-offs within a defined objective; markets generate prices that coordinate many transactions; legal and administrative systems require thresholds and categories. GRE treats these operations as institutionally situated forms of comparison. The existence of a price or index demonstrates that a conversion rule has been established for a purpose. It does not prove that every ethically relevant dimension has been captured.

Partial comparability is often sufficient for action. One option can dominate another across several relevant dimensions without requiring a common cardinal scale. Thresholds can exclude arrangements that violate minimum conditions of safety, participation, or rights. Deliberative procedures can address remaining conflicts. Scenario analysis can reveal how rankings change under different value weightings. GRE therefore does not infer decision paralysis from incommensurability.

Plural value also changes the interpretation of conversion. An institution can transform cultural recognition into market demand, social trust into credit access, educational status into employment opportunity, or ecological resources into monetary revenue. Such conversions can create value while also degrading or crowding out the source relation. Evaluation should therefore examine who controls conversion interfaces, which values become legible after conversion, and which remainders disappear from institutional accounting.

Conflicts among values can also be distributional. A policy may maximize aggregate income while concentrating ecological harm in one community. A conservation programme may protect biodiversity while limiting livelihoods or customary access. An automated service may improve average efficiency while weakening procedural recognition for individuals who require exceptions. These conflicts cannot be resolved by naming all values equally important. Normative judgment must specify priority rules, procedural safeguards, compensation, thresholds, or other principles appropriate to the case.

GRE's contribution is to keep the value architecture visible. It can trace where values are generated, converted, captured, dissipated, or rendered institutionally invisible. It can identify the relations through which one value form gains priority over another. It can also expose where apparent commensurability depends on a contested institutional convention. The choice among competing normative resolutions remains an explicit ethical and political task.

3.13.10 Relation between GRE and GREthic

The normative dimensions developed in this section create a direct interface between GRE and GREthic. Their division of labor should remain explicit. GRE is an economic research programme concerned with relational constitution, generation, allocation, value transformation, capability, power, dependency, and changes in future possibility. GREthic addresses the broader ethical problem of how relational and generative consequences should be interpreted, justified, contested, and governed when several values, subjects, and temporal horizons are involved.

This division does not make GRE normatively empty. Economic research already contains evaluative choices in the definition of welfare, harm, efficiency, opportunity, risk, and admissible intervention. GRE adds explicit dimensions such as participation, relational quality, future possibility, dependency, domination, and foreclosure. These dimensions belong legitimately within economic evaluation because they describe economically generated conditions. The ethical question becomes more demanding when the inquiry asks how competing dimensions should be weighted, which constraints should function as side conditions, whose claims have priority, or what constitutes a just relation.

GREthic can therefore operate as a neighboring normative domain rather than as a final module appended after economic analysis. Ethical judgment can alter the research boundary, the choice of evaluative dimensions, the treatment of uncertainty, the design of participation, and the interpretation of evidence. Conversely, economic analysis can revise ethical judgment by revealing hidden dependencies, indirect harms, conversion mechanisms, or long-run consequences that were absent from the initial normative description. The relation between GRE and GREthic is consequently iterative.

A generative ethical perspective also faces the problem of changing criteria. Institutions learn, social meanings evolve, new subjects become visible, and technologies create forms of action that earlier normative vocabularies did not anticipate. Ethical evaluation therefore cannot assume that a fixed list of criteria will remain sufficient under every historical condition. GREthic must be capable of examining how normative categories themselves emerge, stabilize, exclude, and require revision. This does not imply that every value is historically arbitrary. It means that the institutional expression and interpretation of values require continuing critical examination.

The interface is especially important for application-dominant praxis. An intervention can be technically effective and economically generative while raising unresolved questions of justice. In such cases GRE can provide the relational diagnosis, trace the effects, identify capability changes, map dependency, and evaluate future possibility. GREthic can help articulate the normative standards governing participation, acceptable asymmetry, protection from domination, treatment of irreversible harm, and procedures for revising the intervention when values conflict.

The distinction also protects disciplinary restraint. GRE need not become a complete moral philosophy in order to analyze normatively significant economic processes. GREthic need not replace economic explanation with ethical vocabulary. Their productive relation depends on maintaining both the empirical and normative burdens of argument. Ethical claims require justification; economic claims require

evidence and mechanism; interventions require both.

The normative architecture established in Section 3.13 therefore completes an important part of Chapter 3's constitution of GRE. Generativity becomes an object of evaluation rather than a criterion of goodness. Generated value and harm, participation, capability, relational quality, future possibility, dependency, domination, foreclosure, and plural values provide a multidimensional field for judgment. The following section turns to one of the most consequential mechanisms through which these dimensions become unequally distributed: power and asymmetry within the GRE problem-space.

3.14 Power and Asymmetry within the GRE Problem-Space

Generative Relational Economics requires an explicit account of power because economic relations rarely begin from symmetric positions, and the consequences of those asymmetries can accumulate through the very processes that GRE studies. The role of this section is to identify the principal forms of asymmetry that can become economically consequential and to clarify the conditions under which asymmetry is converted into power. Its objective is to avoid two opposite reductions: treating every difference between subjects as domination, and treating power as a property possessed independently of the relations through which it becomes effective. The discussion proceeds through resource, capability, knowledge, institutional, vulnerability, and exit asymmetries; the conversion of asymmetry into power; the limits of capability equalization and counter-power; and relational governance under persistent asymmetry. The method is constitutive and analytical. It establishes a vocabulary for later empirical, normative, and governance work without presuming that one scalar measure can represent every relevant form of power.

The starting point is a distinction between *asymmetry* and *power*. An asymmetry exists when subjects occupy different positions with respect to resources, capacities, information, institutional authority, vulnerability, or alternatives. Power arises when such differences become usable, durable, or institutionally supported means of shaping another subject's feasible actions, access to resources, interpretive environment, exposure to risk, or future conditions of generation. A highly capable subject can therefore remain weak in a particular relation when its capabilities are irrelevant to the terms of interaction. Conversely, a subject with modest resources can exercise substantial power when it controls a scarce interface, legal authorization, standard, platform, bottleneck, or exit option on which others depend.

Power is consequently relational, domain-specific, and temporally structured. The same pair of subjects can be asymmetric in opposite directions across different domains. A worker can possess knowledge essential to production while remaining institutionally subordinate in wage negotiation. A state can regulate a corporation domestically while depending on that corporation for infrastructure, tax revenue, or technological expertise. A user can choose among digital services while having little capacity to alter the standards through which data are collected and converted into commercial value. The relevant question for GRE is therefore not simply who has more, but how a difference is connected to a mechanism through which one subject

can affect another subject's present options or future generative conditions.

This emphasis also distinguishes power from immediate coercion. Power can operate through direct commands, but it can also operate by shaping defaults, eligibility criteria, technical standards, access routes, classifications, expectations, and the cost of refusal. It can be episodic or structurally persistent. It can be consciously exercised or reproduced through institutions whose participants do not individually intend the resulting asymmetry. GRE therefore treats power as a family of relational mechanisms that affect the generation and distribution of possibility. Normative evaluation enters when those mechanisms are assessed in terms of domination, justice, harm, participation, capability, or foreclosure, but descriptive power analysis must first identify how the relation works.

3.14.1 Resource Asymmetry

Resource asymmetry concerns unequal access to economically consequential stocks or flows such as money, land, infrastructure, energy, data, equipment, labor time, organizational slack, credit, logistics, or legally protected assets. It is among the most visible forms of economic difference because many resources are already measured through accounting, ownership, or administrative systems. Yet possession alone does not determine relational power. What matters is the role that a resource plays within a specific relational configuration.

A resource becomes power-relevant when control over it changes another subject's feasible set or bargaining position. The owner of a scarce input can influence downstream producers when substitutes are limited and switching is costly. A lender can impose conditions when borrowers face liquidity constraints and alternative finance is unavailable. A landlord's control over housing can become consequential when residence is tied to employment, schooling, legal status, or local social networks. A platform's control over computational infrastructure can matter when users, firms, or public institutions depend on that infrastructure for participation in other economic processes. The same nominal resource can therefore carry very different power consequences depending on substitutability, timing, dependence, and institutional context.

Resource asymmetry also has a generative dimension. Resources can be consumed, but they can also be converted into capacities for producing later resources. Capital can finance research, data collection, legal representation, lobbying, recruitment, or acquisition. Infrastructure can make future coordination cheaper. Land ownership can generate collateral. A large user base can generate additional data and network effects. Resource inequality can therefore reproduce or amplify itself when existing holdings enable access to mechanisms that generate further advantage.

GRE analysis should distinguish this recursive possibility from simple accumulation. A subject can possess more resources without gaining additional structural leverage if the relevant relation remains competitive and alternatives remain accessible. Conversely, a relatively small resource difference can become decisive when it controls a bottleneck or threshold. The analytical task is thus to identify the conversion mechanism: which resource matters, to which relation, over what time horizon, through which institutional or technical structure, and with what downstream effects

on future capacity.

This distinction also matters for policy. Redistribution of money can reduce one resource asymmetry while leaving infrastructural, legal, informational, or organizational asymmetries intact. Access subsidies can improve current consumption without altering control over the mechanisms that generate future options. Resource equalization is therefore one possible intervention among several. GRE asks whether the relevant inequality lies in holdings, access, conversion capacity, rule-making position, or the structure through which resources become generative.

3.14.2 Capability Asymmetry

Capability asymmetry concerns differences in what subjects are able to do within a defined economic relation. Capabilities may include technical competence, organizational coordination, computational capacity, mobility, learning, bargaining skill, physical endurance, social connectivity, legal competence, linguistic access, or the ability to mobilize resources under time pressure. Capability differs from resource possession because two subjects with formally similar resources can have very different capacities to convert them into effective action.

This distinction is central in contemporary economies where productive capability can differ sharply across persons, organizations, and artificial systems. A large model can process information at scales unavailable to an individual worker. A multinational firm can coordinate legal, financial, and logistical operations across jurisdictions that a small supplier cannot match. An experienced organization can exploit a regulatory opportunity that a newly formed association does not yet understand. These differences can affect bargaining positions, speed, error tolerance, and the range of feasible strategies.

Capability asymmetry becomes power-relevant when it changes the terms under which other subjects must participate. Superior prediction can support price discrimination. Superior legal capacity can make contractual complexity costly for weaker parties to contest. Superior computational capacity can enable rapid experimentation over markets, attention, or product design. Superior logistical coordination can make a supplier difficult to replace. In each case the capability matters because it is connected to a relation through which the more capable subject can shape conditions faced by others.

At the same time, capability differences do not by themselves establish domination, moral superiority, or ontological hierarchy. Specialized capabilities are common in cooperative systems. A surgeon and patient, pilot and passenger, engineer and user, or teacher and student occupy asymmetric capability relations that can be socially valuable when authority, accountability, consent, and institutional safeguards are appropriately organized. The relevant GRE question is whether capability asymmetry becomes a mechanism for unilateral control, extraction, dependency, or foreclosure, or whether it is embedded in reciprocal and revisable arrangements that distribute benefits and protect affected subjects.

Capability asymmetry also changes historically. Training, tools, institutional access, automation, collective organization, and technical infrastructure can expand or reduce particular capabilities. The introduction of artificial intelligence makes this es-

pecially visible because capability gaps can change quickly and unevenly across tasks. A useful GRE analysis therefore tracks the trajectory of capability differences rather than treating them as fixed attributes. It asks who gains new capabilities, who loses the economic relevance of existing ones, what new dependencies arise, and which institutions govern the conversion of capability differences into economic authority.

3.14.3 Knowledge Asymmetry

Knowledge asymmetry concerns unequal access to information, interpretive resources, expertise, explanatory models, evidence, or the capacity to recognize the significance of available information. It extends beyond the familiar problem of one party knowing more facts than another. Economic power can also arise from asymmetries in classification, prediction, interpretation, and the ability to determine which descriptions become institutionally actionable.

A seller may know more about product quality than a buyer. A financial institution may know more about pricing models and contractual risk than a client. A platform may observe aggregate behavioral patterns invisible to individual users. A government agency may hold administrative records unavailable to the public. A technical community may control specialized vocabularies required to contest a decision. These are distinct knowledge relations, and their power effects depend on how the knowledge is connected to action.

Knowledge becomes especially consequential when one subject can make decisions on the basis of information that another cannot inspect, verify, or meaningfully interpret. The weaker subject may then depend on assurances, reputation, certification, professional norms, or institutional oversight. Such dependence is not intrinsically pathological; complex economies require extensive reliance on expertise. The power problem emerges when epistemic dependence combines with weak accountability, conflicts of interest, high switching costs, or control over the channels through which claims can be challenged.

Knowledge asymmetry also includes the power to produce or stabilize representations. Economic subjects are frequently acted upon through categories: credit scores, risk classes, performance metrics, eligibility rules, rankings, profiles, diagnoses, forecasts, and algorithmic classifications. The subject who controls the production or interpretation of a category can influence access to employment, credit, insurance, visibility, public benefits, or market participation. In such cases knowledge power does not consist only in possessing hidden information. It also consists in shaping the representational architecture through which institutions perceive other subjects.

GRE therefore distinguishes informational access, interpretive competence, model authority, and representational control. These dimensions can diverge. Data can be publicly available while computational requirements make meaningful analysis inaccessible. A model can be technically transparent while the institutional consequences of its output remain opaque. A subject can understand a classification yet lack any procedure for contesting it. Knowledge governance consequently requires more than disclosure. It may require intelligibility, auditability, contestability, alternative expertise, evidential access, and institutional routes through which interpretations can be revised.

The generative dimension of knowledge asymmetry is equally important. Knowledge can generate later knowledge, and control over data or research infrastructure can compound advantages. Organizations with larger observational fields can train better models, attract more users, and generate still more data. Institutions that define legitimate evidence can also shape which questions receive funding and which phenomena become visible. Knowledge asymmetry can therefore alter the future epistemic field itself, making it a central GRE object rather than merely a background imperfection in exchange.

3.14.4 Institutional Asymmetry

Institutional asymmetry concerns unequal positions within rule-making, authorization, recognition, enforcement, classification, and dispute-resolution structures. It is distinct from resource or capability asymmetry because an institution can grant authority to a subject whose private resources are limited. A regulator, court, standards body, professional association, university, central bank, certification agency, or platform governance unit can exercise substantial influence through the rules it is authorized to establish or interpret.

Institutional position shapes who can define admissible participation, whose claims count, which categories receive legal recognition, and which remedies are available when conflict occurs. Formal authority is one obvious form. Less visible forms include agenda-setting, control over procedure, discretionary interpretation, default-setting, accreditation, and the capacity to delay or accelerate decisions. Timing itself can become power when one party can tolerate delay and another cannot.

Institutional asymmetry is often self-reinforcing because rules influence the resources and capabilities available to participants. Licensing can protect quality and safety while also raising entry barriers. Intellectual-property rules can reward innovation while concentrating control over subsequent use. Procurement standards can improve accountability while favoring organizations with administrative capacity to comply. Corporate governance rules can distribute formal voting rights while leaving agenda formation concentrated. Institutional analysis therefore asks not only what a rule states but how it reorganizes relational possibilities.

GRE treats institutional asymmetry as especially important because institutions mediate conversion among other forms of asymmetry. Wealth can be translated into lobbying, litigation, or organizational access. Expertise can be converted into recognized professional authority. Formal office can provide privileged information. Institutional status can determine whose vulnerability receives protection and whose losses remain externalized. Institutions are thus conversion structures through which resources, capabilities, knowledge, and recognition become power.

This does not imply that institutional asymmetry should be eliminated. Governance itself requires differentiated roles, mandates, and responsibilities. The relevant question is how authority is bounded, justified, monitored, revisable, and connected to affected subjects. An institution can exercise asymmetric authority while remaining constrained by procedure, transparency, appeal, rotation, representation, or substantive rights. GRE therefore analyzes the architecture of authority rather

than treating formal symmetry as the only legitimate institutional form.

3.14.5 Vulnerability Asymmetry

Vulnerability asymmetry concerns differences in exposure to loss and differences in the capacity to absorb, recover from, or adapt to that loss. It introduces a dimension of power that is easy to miss when analysis focuses only on holdings or productive capacities. Two subjects may enter the same formal transaction while facing radically different consequences if the transaction fails.

A worker dependent on one employer can face greater loss from contract termination than the employer faces from replacing one worker. A small supplier can be more vulnerable to delayed payment than a large purchaser is to delayed delivery. A tenant can face relocation costs that exceed the landlord's costs of replacing the tenant. A household with minimal savings can be more affected by a small price shock than a wealthier household is by a larger nominal loss. These differences change bargaining relations even when contractual rights appear formally symmetric.

Vulnerability can arise from biological, social, legal, ecological, financial, or infrastructural conditions. It can also be generated by prior economic relations. Debt can increase sensitivity to income interruption. Loss of public infrastructure can increase dependence on private providers. Concentrated employment can make a region vulnerable to one firm's decisions. Data-driven personalization can expose particular groups to targeted exploitation. Vulnerability is therefore often historically produced rather than merely given.

The conversion of vulnerability into power occurs when another subject can credibly condition access to necessities, impose risks, or shift costs onto those less able to bear them. The stronger party need not intentionally threaten harm. Structural vulnerability can influence behavior because subjects anticipate the consequences of refusal. A worker may accept unfavorable terms because unemployment is costly. A state may offer concessions to a mobile investor because local employment is concentrated. A consumer may accept invasive data practices because essential services have become digitally mediated.

GRE analysis should also distinguish vulnerability from weakness in every domain. A subject can be technologically capable and financially wealthy while highly vulnerable to reputational, legal, ecological, or infrastructural disruption. Conversely, a subject with few resources can be relatively resilient when needs are modest, alternatives are available, and social support is strong. Vulnerability therefore requires explicit specification of the relevant hazard, exposure, recovery capacity, and time horizon.

This perspective has normative implications, but the descriptive analysis comes first. Governance can reduce vulnerability by creating buffers, insurance, redundancy, public options, collective support, or guaranteed access to essentials. Yet such interventions can create new dependencies if they centralize provision without contestability. The GRE question is how vulnerability is generated, distributed, converted into leverage, and transformed by the institutions intended to manage it.

3.14.6 Exit Asymmetry

Exit asymmetry concerns differences in the cost, feasibility, and consequences of leaving a relation. It is one of the clearest mechanisms through which other asymmetries become durable. A relation can appear voluntary at entry while becoming difficult to leave once investments, identities, data, legal obligations, infrastructures, social ties, or specialized capabilities accumulate around it.

Exit costs take many forms. Financial penalties and contractual restrictions are explicit examples. Others include retraining, relocation, loss of reputation, incompatibility of technical systems, loss of accumulated data, social isolation, disruption of care arrangements, immigration consequences, or forfeiture of institution-specific benefits. Exit can also be asymmetric because one party can replace the other more easily. A large platform can lose an individual user with little consequence, while the user may lose access to a network on which professional or social activity depends.

Exit asymmetry matters because it alters the practical meaning of consent. Continued participation can reflect genuine preference, but it can also reflect high switching costs, dependence, fear of retaliation, or lack of viable alternatives. GRE therefore treats observed continuation as evidence that requires interpretation rather than as automatic proof that a relation remains mutually beneficial.

The generative dimension of exit is particularly important. Participation in a relation can produce assets that are specific to that relation: reputation scores, social connections, customized tools, accumulated knowledge, eligibility, or identity. These assets can increase productivity and value while simultaneously making exit more costly. Successful cooperation can therefore deepen dependence even without intentional lock-in. The governance problem is to preserve the benefits of relational investment while preventing accumulated specificity from becoming unilateral leverage.

Exit is also only one response to problematic relations. Voice, contestation, collective bargaining, institutional appeal, and internal reform can be preferable when relationships are valuable and exit would destroy jointly generated capacities. An exclusive focus on exit can therefore privilege subjects already able to move while leaving the most embedded or vulnerable participants unprotected. GRE analyzes exit together with voice, representation, repair, and alternative provision.

Exit asymmetry can be reduced through interoperability, portability, non-retaliation rules, social insurance, public alternatives, transferable credentials, data mobility, and limits on restrictive contracts. Such measures alter the relational field even if few subjects actually leave. The credible possibility of exit can change bargaining power. Exit governance is therefore about the structure of alternatives, not merely the observed frequency of departure.

3.14.7 Conversion of Asymmetry into Power

The preceding forms of asymmetry become analytically significant when they are connected to mechanisms of conversion. GRE treats conversion as the process through which a difference in resources, capability, knowledge, institutional position, vulnerability, or exit becomes effective influence over another subject's options or over the conditions from which future options are generated. This conversion is

neither automatic nor uniform.

Several relational conditions commonly affect conversion. Scarcity matters because control over abundant and substitutable resources usually provides less leverage than control over bottlenecks. Dependence matters because the value of an asymmetry rises when other subjects rely on the advantaged subject for essential functions. Replaceability matters because subjects with many alternatives can resist conditions that dependent subjects must accept. Coordination matters because individually weak subjects can aggregate resources or voice. Institutional recognition matters because formal rules can authorize, limit, or redirect the use of an advantage. Information matters because leverage can depend on subjects understanding their alternatives and the likely consequences of refusal. Time matters because a party that can wait often has bargaining advantages over a party facing urgent costs.

Power conversion can also be recursive. A resource advantage can buy expertise; expertise can influence institutional design; institutional design can protect future resource accumulation. Superior knowledge can improve targeting; improved targeting can increase profit; profit can finance further data collection. Control over infrastructure can generate dependence; dependence can support contractual authority; contractual authority can increase exit costs. Such cycles matter to GRE because they transform temporary differences into persistent relational structures.

The concept of conversion also helps distinguish power from inequality. A wealthy subject can lack power over a regulator empowered to impose binding rules. A technically capable firm can remain dependent on a monopolistic supplier. A state with formal sovereignty can be constrained by financial, technological, or security dependencies. Power maps therefore need not reproduce wealth rankings. GRE analysis should trace conversion pathways rather than infer power from one observable variable.

Power can furthermore operate through the generation of expectations. If subjects anticipate that one party can impose costs, deny access, classify them adversely, or shape future opportunities, they may alter behavior before any explicit exercise occurs. This anticipatory effect can make power difficult to observe through events alone. Stable compliance can coexist with strong asymmetry precisely because overt conflict becomes unnecessary. Empirical inquiry may therefore need to study suppressed alternatives, unrealized options, counterfactual bargaining positions, and institutionalized expectations.

The conversion perspective also clarifies why power is domain-specific. A subject can be powerful in hiring and weak in finance, powerful in data and weak in law, powerful domestically and dependent internationally. GRE should therefore resist the temptation to compress heterogeneous power relations into one universal rank. A multidimensional mapping of asymmetries, conversion mechanisms, and affected generative conditions is often more informative than a single power score.

3.14.8 Limits of Capability Equalization

Capability enhancement is one important response to asymmetry. Education, public infrastructure, assistive technology, access to finance, legal aid, data access, computational tools, collective organization, and social protection can increase the ability

of weaker subjects to participate, contest, adapt, and generate alternatives. Yet capability equalization has limits as a general theory of power reduction.

First, some asymmetries arise from differentiated roles rather than remediable deficits. Regulators and regulated entities, doctors and patients, judges and litigants, infrastructure operators and users, or specialized technical teams and general publics occupy different positions because complex systems distribute functions. Governance must then organize accountability across unequal roles rather than assume that every participant should acquire identical capabilities.

Second, capability enhancement can leave institutional conversion mechanisms untouched. Training workers may improve mobility while employers retain unilateral control over scheduling, surveillance, or termination. Financial literacy can improve decisions while contractual complexity and market concentration remain. Digital skills can expand participation while platforms retain control over standards, visibility, and data. Strengthening the weaker subject can therefore be valuable without fully altering the relation that generates the asymmetry.

Third, capabilities can themselves become positional. If all participants acquire a skill that was previously scarce, the advantage associated with that skill can move elsewhere. Credential inflation provides one familiar pattern: expanding qualifications can increase absolute competence while preserving relative competition for scarce positions. In technological domains, widespread adoption of one tool can raise the baseline expected from all participants and create a new asymmetry around access to more advanced infrastructure.

Fourth, equalization can impose burdens. Requiring vulnerable subjects to become expert negotiators, data analysts, legal specialists, or cybersecurity practitioners shifts responsibility onto those already facing structural disadvantage. Some protections are better provided through institutional design, fiduciary duties, public options, default rules, or limits on permissible extraction than through endless demands for individual capability upgrading.

GRE therefore treats capability equalization as one component of relational governance. The relevant question is which asymmetry should be reduced by expanding capability, which should be bounded through institutional rules, which should be made contestable through collective organization, and which should be accepted as functionally necessary but governed through accountability. The objective is not symmetry for its own sake. It is to prevent capability differences from becoming unjustified control over the conditions of participation and future generation.

3.14.9 Limits of Counter-Power

Counter-power refers to capacities that enable subjects to resist, negotiate, constrain, or redirect an existing concentration of power. Collective bargaining, competition, regulatory oversight, courts, professional associations, consumer organization, public alternatives, investigative journalism, open technical standards, mutual aid, and democratic participation can all function as forms of counter-power in different contexts. GRE treats them as relational interventions rather than as automatic restorations of balance.

Counter-power is often necessary because persistent asymmetry cannot be addressed by individual adaptation alone. Workers can negotiate more effectively through collective organization. Small firms can benefit from shared infrastructure or interoperability mandates. Consumers can rely on regulators or courts when individual monitoring is costly. Communities can build institutions that reduce dependence on a single provider. Such arrangements change the structure through which asymmetry is converted into power.

Yet counter-power has limits. It can become concentrated in its own right. A union, regulator, professional body, platform cooperative, or civic organization can develop internal hierarchies and exclusion mechanisms. Institutions created to represent weaker subjects can become difficult for those subjects to contest. Competition can constrain one monopoly while producing instability or shifting concentration to another layer of the system. Transparency can expose misconduct while advantaging actors with superior capacity to process disclosed information. Counter-power therefore requires its own governance.

Counter-power can also reproduce the ontology of the power it contests. If resistance must use the same metrics, platforms, legal categories, or technical infrastructure established by the dominant actor, alternatives may remain confined within the existing field. A community can gain representation without gaining control over the categories through which its interests are recognized. A new market entrant can challenge price while leaving data extraction practices unchanged. GRE therefore asks whether counter-power changes bargaining within a relation or transforms the generative conditions of the relation itself.

Temporal asymmetry further complicates counter-power. Concentrated actors can sometimes act quickly while collective organizations require deliberation, consent, and coordination. Conversely, public institutions can impose durable constraints that private actors cannot easily evade. The relevant balance is therefore dynamic. Effective governance must consider response speed, persistence, institutional learning, and the capacity of power holders to adapt around controls.

The limit of counter-power does not imply resignation. It indicates that balancing strategies should be evaluated recursively. A mechanism introduced to constrain power should itself be analyzed for new dependencies, exclusions, and conversion pathways. GRE's contribution is to keep that second-order question visible: what does the counter-power generate, whose capacities does it strengthen, which relations does it stabilize, and what new asymmetries emerge from its operation?

3.14.10 Relational Governance under Persistent Asymmetry

Many economic systems will continue to contain substantial asymmetries even under ambitious reforms. Subjects differ in knowledge, scale, specialization, mobility, resources, biological needs, legal mandates, technical capabilities, and exposure to risk. Relational governance therefore cannot depend on the expectation that legitimate order will emerge only after differences have been eliminated. Its task is to organize persistent asymmetry so that necessary differentiation does not become uncontrolled domination or generative foreclosure.

A GRE governance perspective begins by specifying the relevant asymmetries and

their conversion mechanisms. It asks which subjects depend on which others, what alternatives exist, which resources or capabilities function as bottlenecks, who defines the institutional categories of participation, how vulnerability is distributed, and what happens if a subject attempts to exit or contest the relation. This diagnosis identifies where safeguards are likely to matter.

Several governance principles follow from the analysis, although their concrete form remains context-dependent. Authority can be bounded by mandate and review. Essential services can be protected by continuity obligations or public alternatives. Exit can be made more credible through portability and interoperability. Knowledge asymmetry can be addressed through independent expertise, audit, contestation, and evidential access. Vulnerability can be reduced through buffers, insurance, redundancy, and guaranteed minimum capacities. Collective organization can strengthen voice. Rule-making can include affected subjects without presuming that participation alone resolves all asymmetry. Institutions can preserve appeal, revision, and sunset mechanisms so that temporary arrangements do not harden into unchallengeable structures.

Relational governance also requires attention to generative conditions. A policy can constrain abusive behavior in the present while leaving the mechanisms that reproduce future dependence untouched. Conversely, an intervention can redistribute immediate resources while weakening the organizational capacities through which a community previously governed itself. GRE therefore evaluates governance at more than one temporal layer: present protection, future capability, relational quality, structural transformation, and preservation of alternative pathways.

The concept of persistent asymmetry also changes the meaning of fairness. Formal equality of rules can coexist with radically unequal vulnerability or exit costs. Identical disclosure can be useless when interpretive capacities differ. Equal access to a market can mask unequal control over infrastructure. Governance may therefore require differentiated protections or obligations in order to make participation substantively contestable. Such differentiation must itself remain transparent and revisable because protective categories can reify the subjects they are intended to assist.

Power analysis should also remain separate from final normative judgment. A concentrated authority may sometimes be justified by coordination, safety, fiduciary responsibility, or public purpose. A decentralized arrangement can reproduce severe power through infrastructure, convention, or cumulative advantage. GRE therefore does not infer justice from decentralization, symmetry, or participation alone. It supplies a relational map of how influence is generated and sustained; normative evaluation then asks whether those mechanisms are justified under the relevant ethical, legal, and political standards.

This section therefore places power within the GRE problem-space as a dynamic relation among asymmetries, conversion mechanisms, dependencies, institutional structures, and future generative conditions. Resource, capability, knowledge, institutional position, vulnerability, and exit are analytically distinct sources of asymmetry. Their conversion into power depends on scarcity, substitutability, dependence, coordination, authorization, time, and the structure of alternatives. Capability equalization and counter-power can alter these relations, but each has limits and can gen-

erate new asymmetries. Relational governance must consequently remain adaptive, contestable, and attentive to second-order effects.

The analysis also prepares the next constitutive problem. Persistent asymmetry does not occur among identical subjects. Economic relations increasingly connect persons, organizations, states, artificial systems, ecological systems, and other heterogeneous participants whose capacities, temporalities, vulnerabilities, and value structures differ in kind as well as degree. The following section therefore turns from asymmetry within relations to the broader problem of heterogeneity and coexistence.

3.15 Heterogeneity and Coexistence

Generative Relational Economics requires an explicit account of heterogeneity because many economic relations connect subjects, systems, and processes that differ in ways that cannot be reduced to variation along a single scale. The role of this section is to establish coexistence across heterogeneous forms as a constitutive problem of GRE rather than as a residual complication added after a homogeneous model has been constructed. Its objective is to clarify how economic coordination, exchange, dependence, conflict, and joint generation remain possible when participants differ in subject form, intelligence, temporality, vulnerability, value structure, and degree of mutual intelligibility. The discussion proceeds from heterogeneous subjects and forms of intelligence through temporal and vulnerability differences, heterogeneous values, partial mutual intelligibility, economic relation under incomplete commensurability, human–AI relations, more-than-human relations, and boundary cases involving radically different subjects. The method is constitutive and analytical. It identifies conditions under which heterogeneous coexistence can be studied without presuming either complete commonality or complete incomparability.

Heterogeneity matters to GRE for a reason deeper than descriptive diversity. Difference can alter the mechanisms through which relations are formed, interpreted, stabilized, and transformed. Subjects that process information at different speeds can experience the same contract differently. Subjects with different vulnerabilities can bear the same nominal risk unequally. Subjects organized around different value structures can participate in the same economic arrangement while understanding its significance in different terms. Human and artificial systems can cooperate productively while differing sharply in embodiment, temporal horizon, memory, responsibility, and normative status. Economic coexistence therefore often depends on interfaces that enable coordination across difference rather than on the elimination of difference itself.

This perspective also changes the analytical meaning of coordination. Coordination need not imply shared ontology, identical preferences, common measures of value, or full mutual comprehension. It can arise through partial translation, rule-governed interfaces, protocols, conventions, negotiated thresholds, legal forms, institutional guarantees, or stable expectations concerning a limited domain of interaction. Such arrangements can be robust even when deeper interpretations remain divergent. They can also be fragile when the interface suppresses differences that

later become economically consequential. GRE therefore asks both how heterogeneous subjects manage to relate and which differences remain unresolved beneath an apparently successful relation.

Heterogeneity should consequently be distinguished from disorder. A heterogeneous system can possess highly organized relations, and a homogeneous representation can conceal important differences. Likewise, coexistence should be distinguished from harmony. Subjects can coexist through cooperation, competition, dependency, conflict, indifference, mutual constraint, or asymmetric accommodation. The relevant GRE question is not whether heterogeneity produces agreement, but how different forms remain connected, how the relation distributes benefits and burdens, and how the terms of coexistence shape future generative possibilities.

3.15.1 Heterogeneous Subjects

The first dimension of heterogeneity concerns the kinds of subjects that participate in economic relations. Earlier sections treated economic subjecthood as relationally situated, institutionally recognized, temporally persistent, and historically transformable. The present section extends that argument by emphasizing that an economy can contain multiple subject forms at once. Individual persons, households, firms, states, cooperatives, communities, platforms, algorithmic systems, hybrid organizations, and other collective or artificial arrangements can all occupy economically consequential positions while remaining different in constitution and status.

These differences matter because the capacities through which subjects enter relations are not interchangeable. A natural person may possess legal rights, embodied needs, lived vulnerability, memory, social identity, and moral standing that differ categorically from the capacities of a corporation or software system. A corporation can persist across changes in personnel, accumulate assets, sign contracts, and coordinate action across large spatial scales. A public institution can exercise legally authorized powers that private actors lack. An artificial system can process or generate representations at speeds and volumes unavailable to human participants while lacking many forms of embodied participation through which human economic life is organized.

GRE therefore resists the temptation to create one abstract subject model and treat every participant as a parameterized instance of it. A unified formal representation can be useful for a local task, but the analyst must identify which dimensions of subjecthood have been suppressed. Treating a household, a company, and an automated trading system as “agents” can clarify interaction structure while obscuring differences in accountability, embodiment, temporal persistence, legal rights, or the capacity to experience harm. The representational convenience of a common agent label does not establish ontological or normative equivalence.

Heterogeneous subjecthood also means that relations can be constitutive in different ways for different participants. Employment may constitute livelihood and social identity for a worker while functioning as a cost and organizational input for a firm. Credit can appear as a portfolio exposure to a lender and as a condition of continued residence or enterprise survival to a borrower. A platform can treat a user interaction as data-generating activity while the user experiences it as communication,

work, entertainment, or social participation. The same relation can therefore occupy different places in the reproduction of each subject.

This asymmetry of significance is analytically important. Economic relations cannot always be understood by assigning the same type of variable to each side. The relation may link subjects whose persistence conditions are fundamentally different. One participant can exit with limited consequence while another loses access to income, identity, infrastructure, or social connection. GRE analysis should therefore specify what the relation does for each subject, which capacities it supports, which vulnerabilities it exposes, and how these differences affect bargaining, interpretation, and future generation.

Heterogeneous subjects can nevertheless form stable relations. Stability may arise through law, trust, standards, routines, contracts, technical interfaces, conventions, organizational design, or repeated adaptation. The existence of such stability shows that shared subject form is not a prerequisite for economic relation. What matters is whether the relation contains sufficiently compatible interfaces for action, interpretation, and expectation within the domain that must be coordinated.

3.15.2 Heterogeneous Forms of Intelligence

Economic analysis often speaks of information, knowledge, skill, and rationality as though intelligence were a single capacity that subjects possess in greater or lesser amounts. GRE treats intelligence more cautiously. Different subjects can exhibit different forms of problem solving, inference, adaptation, memory, perception, coordination, judgment, and representation. These forms may be partly comparable for a defined task without being reducible to one general economic scale.

Human economic intelligence includes dimensions that are difficult to separate cleanly: practical know-how, embodied familiarity, social interpretation, linguistic competence, moral judgment, imagination, aesthetic discrimination, memory, emotional response, and the capacity to act under incomplete and ambiguous conditions. Collective subjects can display organizational intelligence that no member possesses individually, including routines, distributed expertise, institutional memory, and coordinated response. Computational systems can display high performance in search, optimization, prediction, generation, classification, or symbolic transformation while relying on infrastructures, training processes, objectives, interfaces, and external forms of validation that structure what their outputs mean and how they are used.

Task-specific comparison is therefore often more informative than a universal ranking. One system may outperform another at high-dimensional pattern recognition while performing poorly where contextual interpretation, embodied judgment, accountability, or long-horizon institutional memory is decisive. An expert organization may coordinate a complex regulatory process effectively while responding slowly to unfamiliar technological change. A local community may possess detailed ecological knowledge that is poorly represented in standardized datasets. Heterogeneous intelligence appears as differentiated capability profiles rather than as a single ladder.

This matters economically because different forms of intelligence can become complementary. A relation can generate value precisely because participants perceive

or process different features of a problem. Human–machine systems can combine computational scale with human contextual judgment. Interdisciplinary teams can connect different epistemic traditions. Firms can coordinate specialized units whose local knowledge would be insufficient in isolation. Markets themselves can sometimes coordinate dispersed information without requiring any participant to possess a complete representation of the system.

Complementarity, however, does not eliminate power. The party that controls the interface among forms of intelligence can shape which outputs count, which errors are visible, which judgments are overridden, and which forms of knowledge become economically legible. Standardization can facilitate coordination while devaluing tacit or local knowledge. Automated decision systems can increase processing capacity while concentrating control over model design, data, thresholds, or appeals. The governance of heterogeneous intelligence is therefore partly a problem of interface design and partly a problem of institutional power.

GRE should accordingly distinguish capability difference from epistemic authority. Superior performance in one domain does not automatically justify decision authority in another. Prediction accuracy does not itself settle normative legitimacy. Computational scale does not settle interpretive authority. Human status does not guarantee technical competence. A mature analysis asks which form of intelligence is relevant to which claim, what evidence supports its reliability, how different forms are combined, and who controls the terms of combination.

3.15.3 Heterogeneous Temporalities

Economic subjects also inhabit different temporal structures. Temporal heterogeneity concerns differences in pace, horizon, persistence, delay, memory, reversibility, and the timing through which consequences become visible. These differences can be as consequential as differences in resources or capability because a relation that is sustainable at one temporal scale can be destructive at another.

Individuals often make decisions under lifetimes measured in decades, daily needs measured in hours, and contractual obligations measured in months or years. Firms may evaluate projects through reporting cycles, investment horizons, product lifecycles, or expectations concerning market entry and exit. Public institutions can operate through electoral, budgetary, legal, and infrastructural timescales. Financial systems can react within milliseconds while housing, education, ecological restoration, demographic change, and institutional trust can unfold over decades. Artificial systems can process and update representations rapidly while the social institutions required to evaluate, regulate, or contest their deployment move more slowly.

Temporal heterogeneity creates coordination problems. A rapidly adjusting actor can repeatedly change strategy before a slower institution completes review. Short-term financial incentives can conflict with long-term maintenance or ecological resilience. A policy may generate immediate benefits while degrading capacities that become visible only years later. Conversely, insisting on very long evaluation horizons can leave urgent present vulnerabilities insufficiently addressed. No single time horizon is automatically privileged across all economic questions.

GRE therefore treats temporal alignment as an analytical problem. Contracts, stan-

dards, insurance, reserves, review periods, waiting times, sunset clauses, intergenerational institutions, and adaptive governance can all be understood partly as devices for coordinating subjects whose consequences and capacities unfold at different rates. Such devices do more than schedule action. They distribute whose temporality receives priority. A deadline can privilege the actor able to mobilize quickly. A long approval process can protect against irreversible harm while disadvantaging subjects facing immediate need. A quarterly reporting regime can orient organizations toward measurable near-term outputs at the expense of slower generative effects.

Temporal heterogeneity also complicates attribution. A downstream effect may emerge long after the originating intervention, after intermediate relations have changed and after responsible institutions or personnel have disappeared. Conversely, a long-standing structure can condition present action without appearing in short observational windows. GRE analysis should therefore state the temporal horizon of its claims and examine whether the relevant mechanism operates faster or slower than the data used to identify it.

Coexistence across heterogeneous temporalities requires more than synchronization. Some differences should remain. Ecological regeneration cannot necessarily be accelerated to match financial expectations. Human deliberation may require time that automated processing does not. Institutional due process can be intentionally slower than market reaction. The governance question is therefore which temporal differences should be bridged, which should be protected, and how costs created by temporal mismatch are distributed.

3.15.4 Heterogeneous Vulnerabilities

Subjects differ not only in what they can do but also in what can harm them, how quickly harm occurs, how visible it is, and how readily recovery is possible. Vulnerability heterogeneity concerns these differentiated exposures and recovery conditions. It is especially important because relations that appear symmetric in formal terms can create highly asymmetric consequences when participants have different capacities to absorb loss.

The same monetary loss can be marginal for one subject and existential for another. A temporary service interruption can inconvenience a large organization while eliminating a small firm's only route to customers. Delayed payment can be a minor accounting issue for a well-capitalized buyer and a liquidity crisis for a supplier. Exposure of personal information can create embodied or social risks for an individual that have no equivalent in the experience of an automated system. Environmental degradation can affect communities whose livelihoods depend directly on local ecosystems while remaining abstract in the accounting of distant investors.

Vulnerability is therefore relational and domain-specific. A subject can be highly capable in one domain and vulnerable in another. Large firms can possess extensive resources while depending critically on specific infrastructure or regulatory permissions. States can exercise coercive authority while remaining technologically dependent. Artificial systems can be operationally powerful yet dependent on electricity, hardware, data centers, network access, maintenance, and human authorization. Vulnerability analysis should identify the failure conditions that matter for the par-

ticular relation rather than infer resilience from general size or capacity.

Recovery is as important as exposure. Two subjects exposed to the same disturbance can differ in reserves, insurance, social support, legal recourse, substitutability, repair knowledge, or access to alternative relations. These differences affect bargaining because the subject that can survive delay or failure usually possesses greater strategic freedom. Exit asymmetry, discussed in the previous section, is one expression of this wider vulnerability structure.

GRE also asks how relations generate vulnerability over time. Specialization can increase efficiency while producing dependence on narrow supply chains. Platform participation can expand market access while making future income dependent on ranking systems or account continuity. Debt can finance productive capacity while increasing sensitivity to interest rates or income interruption. An ecological intervention can raise present output while reducing resilience to later shocks. Vulnerability is therefore often produced jointly with value.

Governance under heterogeneous vulnerability should not assume that formally equal treatment produces equivalent protection. Uniform rules can distribute risk unequally when participants have different failure thresholds. At the same time, vulnerability should not be used as a permanent identity that freezes subjects into protected categories. The analytical task is to identify specific exposure, consequence, recovery capacity, and the mechanisms through which the relation modifies them.

3.15.5 Heterogeneous Value Structures

Economic coexistence frequently connects subjects that organize value differently. Value heterogeneity includes differences in what is valued, how value is recognized, which trade-offs are acceptable, what temporal horizon matters, what forms of loss are considered substitutable, and which goods are treated as inappropriate for exchange. GRE therefore treats value structure as plural rather than assuming that all relevant evaluation can be represented through a single utility, price, welfare index, or scalar measure.

Some values are readily expressed through monetary exchange because institutions already provide stable units, markets, contracts, and accounting conventions. Others are represented through rights, duties, thresholds, rankings, narratives, professional norms, ecological indicators, cultural meanings, or qualitative judgments. A community may value continuity of place in ways poorly represented by compensation for relocation. A worker may value autonomy, recognition, security, or meaningful participation alongside income. A public institution may be bound by legality and equal treatment even where another arrangement would reduce cost. Ecological relations can involve irreversibility, species loss, or system resilience that resists straightforward substitution.

Heterogeneous value structures do not imply that coordinated decision is impossible. Institutions routinely make decisions under plural values. They use budgets together with rights constraints, technical standards, minimum thresholds, deliberation, priority rules, side constraints, multicriteria evaluation, and negotiated settlements. These devices are forms of practical ordering rather than proof that all underlying values have become commensurable.

This distinction between ordering and commensurability is central. A decision can select one option without establishing a universal measure that converts every relevant value into a common unit. A legal prohibition can exclude some options before cost comparison begins. A safety threshold can structure a feasible set without pricing every possible injury. Negotiation can produce agreement acceptable to different parties for different reasons. GRE can analyze these arrangements as relational mechanisms for coordinating value heterogeneity.

Value heterogeneity also creates power questions. The institution that chooses the metric can privilege values that fit that metric. Monetary valuation can make some losses legible while rendering others peripheral. Quantitative indicators can improve transparency while narrowing attention to what is measurable. Expert vocabularies can facilitate comparison while excluding affected participants whose reasons are expressed differently. The politics of value therefore includes the design of representation and conversion rules.

GRE evaluation should preserve this plurality where it is substantively real. Scalar measures remain useful where a common measure is justified, but they should not acquire authority merely because they simplify optimization. When values are only partially commensurable, the analysis should record the remaining plurality rather than treating it as noise around a preferred metric.

3.15.6 Partial Mutual Intelligibility

Heterogeneous subjects rarely understand one another completely. Their categories, temporal horizons, sensory access, institutional roles, languages, models, and value structures can differ. Yet complete mutual understanding is not required for economic relation. Partial mutual intelligibility refers to the degree of shared interpretation sufficient for a defined form of coordination while leaving other aspects of the participants' worlds untranslated.

A buyer and seller can agree on quantity, quality, price, and delivery without sharing the same reasons for valuing the transaction. Organizations from different legal cultures can cooperate through contracts and technical standards while retaining different institutional assumptions. Humans can use computational systems whose internal representations they do not fully reconstruct, provided interfaces, validation procedures, and accountability arrangements make the relevant outputs sufficiently interpretable for the task. Scientific and local knowledge systems can sometimes coordinate around observable indicators while interpreting causal significance differently.

Partial intelligibility is therefore often produced by interfaces. A contract translates complex intentions into enforceable obligations. A standard reduces heterogeneous production processes to specified performance criteria. An API enables computational systems built on different internal architectures to exchange defined messages. A price compresses information relevant to exchange while leaving many reasons and consequences outside the transaction. A legal category makes different cases administratively comparable while suppressing detail. These interfaces enable relation precisely by limiting what must be mutually understood.

The reduction involved in an interface can be productive, but it can also generate

misrecognition. When the interface omits a difference that later becomes consequential, coordination can fail. A metric can appear shared while participants interpret it differently. A model output can be operationally accepted without agreement on its epistemic status. A standardized category can group subjects whose vulnerabilities diverge sharply. The existence of a functioning interface therefore does not establish deep mutual understanding.

GRE analysis should ask what must be intelligible for the relation to function and what remains opaque. It should also ask who bears the risk created by opacity. If one party can demand explanation while the other cannot, interpretive asymmetry can become power. If a computational system influences access to credit, employment, or public services, the intelligibility required for legitimate use can be greater than the intelligibility required merely for technical operation.

Partial mutual intelligibility offers a middle position between two unrealistic assumptions: complete transparency and complete incommensurability. Economic life often proceeds through workable but incomplete translations. The quality of coexistence depends on whether these translations are sufficient for the stakes involved, revisable when they fail, and governed in ways that distribute interpretive risk fairly.

3.15.7 Economic Relations without Full Commensurability

Economic relation does not require every relevant object, value, subject, or consequence to be representable on one common scale. Exchange itself can involve commensuration for a limited purpose while broader aspects of the relation remain incommensurable. GRE therefore distinguishes local comparability from full commensurability.

A wage places a monetary value on labor time for the purpose of employment, but it does not establish that income exhausts the value of work, identity, health, autonomy, or social recognition. Insurance can assign compensation schedules to losses without implying that the compensated state is equivalent to the pre-loss state. Environmental markets can price particular emissions or ecosystem services while leaving cultural, ecological, and intergenerational values only partially represented. Cost-benefit analysis can support a decision under specified assumptions without becoming a complete theory of value.

Relations under incomplete commensurability often rely on layered decision rules. Some dimensions are priced. Others are protected through rights or prohibitions. Some are represented through minimum standards, negotiated conditions, or procedural safeguards. Others remain open to qualitative judgment. Such layered arrangements can be analytically messy, but the mess may reflect genuine plurality rather than methodological failure.

GRE can therefore study conversion without assuming equivalence. A value can be converted into another form through an institution even when the conversion is contested or incomplete. Time can be converted into wages; attention into advertising revenue; reputation into credit access; ecological damage into compensation obligations; research prestige into funding opportunity. The existence of a conversion mechanism shows that a relation connects the forms. It does not prove that the forms are intrinsically equivalent.

This distinction helps analyze exploitation and loss. When an institution repeatedly converts one form of value into another under asymmetric terms, the question is not only how much is transferred but which dimensions disappear during conversion. A platform can monetize social interaction while leaving users with limited claims on the resulting economic value. A development project can compensate property loss while failing to restore community networks. A labor contract can pay for output while externalizing health or care burdens. In each case, commensuration can enable exchange while concealing residual effects.

Coexistence under plural values therefore requires institutional creativity. Markets are one mechanism among several. Deliberation, commons governance, public provision, professional standards, rights, mutual aid, licensing, quotas, thresholds, and hybrid arrangements can coordinate heterogeneous values in different ways. GRE does not presume in advance which mechanism is appropriate. It asks how the chosen mechanism makes some values comparable, leaves others outside comparison, distributes authority over conversion, and alters future possibilities.

3.15.8 Human–AI Relations as a Contemporary Case

Human–AI relations provide a contemporary case in which heterogeneity of subject form, intelligence, temporality, vulnerability, and value can appear simultaneously. GRE can analyze these relations without first resolving philosophical questions about machine consciousness or personhood. The immediate economic question is how human and artificial operational subjects become connected through production, decision, communication, ownership, infrastructure, and institutional authority.

The asymmetry is multidimensional. Artificial systems can process or generate large volumes of symbolic material rapidly, replicate outputs at low marginal cost, and operate continuously within suitable infrastructure. Humans retain forms of embodiment, lived vulnerability, social membership, legal standing, moral responsibility, contextual experience, and value formation that are not established by computational performance. Organizations often mediate between the two, determining data access, deployment goals, review procedures, liability, and the distribution of gains.

This heterogeneity creates complementary possibilities. Artificial systems can extend search, translation, drafting, prediction, pattern recognition, or simulation. Human participants can contribute contextual interpretation, problem selection, normative judgment, embodied knowledge, accountability, and decisions concerning what purposes should be pursued. The generative question is how the relation changes the capabilities of both the immediate participants and the surrounding institutions.

It also creates new dependencies. Workers can become dependent on tools they do not control. Organizations can become dependent on model providers, computational infrastructure, or proprietary interfaces. Users can rely on systems whose update cycles alter behavior faster than institutional procedures adapt. Expertise can shift from producing outputs directly to evaluating, directing, integrating, or contesting machine-generated outputs. These changes can redistribute bargaining power even when aggregate productivity rises.

Human–AI coexistence therefore should not be analyzed through replacement

alone. Substitution is one possible relation. Others include complementarity, supervision, delegation, contestation, infrastructural dependence, mutual adaptation, and reorganization of occupational or institutional roles. The relevant GRE object is the evolving relational configuration: who controls the system, who defines objectives, who bears error, who receives generated value, which human capacities are strengthened or weakened, and how future alternatives are shaped.

The case also clarifies partial mutual intelligibility. Humans may use outputs without understanding every internal computational process, while artificial systems operate on representations that do not amount to human understanding in any straightforward sense. Economic coordination can nevertheless occur through interfaces, tests, standards, feedback, and institutional review. The adequacy of that partial intelligibility should depend on stakes. A low-risk drafting aid and a system affecting liberty, livelihood, healthcare, or public authority require different evidential and governance conditions.

GRE therefore treats human–AI relations as an important contemporary domain of heterogeneous coexistence, while maintaining ontological and normative caution. Operational capability does not settle personhood. Performance difference does not settle moral status. Economic usefulness does not settle legitimacy. These questions remain connected but analytically distinct.

3.15.9 More-than-Human and Ecological Relations

Economic systems also coexist with organisms, ecosystems, climatic processes, material cycles, and other more-than-human structures whose dynamics are constitutive of production and life. GRE includes these relations because economic generation depends on ecological and material conditions even when those conditions are poorly represented by conventional economic subjects.

More-than-human analysis requires ontological care. A forest, river, species, or ecosystem need not be treated as a subject in exactly the same sense as a human person or organization for its relational role to be economically consequential. Ecological systems can impose constraints, provide capacities, absorb waste, regenerate resources, transmit disturbances, and respond to interventions through dynamics that exceed the intentions of economic actors. Some legal or cultural traditions may also recognize nonhuman entities through forms of representation or standing. GRE can study these arrangements without requiring one universal theory of nonhuman subjecthood.

Ecological heterogeneity is strongly temporal. Soil formation, forest succession, hydrological cycles, species recovery, and climate processes can unfold at rates that differ from market, budgetary, and political cycles. An economic system can therefore appear productive within a short window while drawing down slower regenerative capacities. Conversely, ecological protection can impose immediate costs while preserving long-horizon generative conditions. The choice of temporal scale becomes part of evaluation rather than a neutral technical setting.

Vulnerability is likewise heterogeneous. An industrial actor may be able to relocate while a local ecosystem cannot. A community may depend on a specific river or coastal system whose loss is not replaceable by monetary compensation. Species and

ecological processes can cross thresholds beyond which recovery becomes difficult or impossible on humanly relevant timescales. These differences complicate models that assume reversible substitution among resources.

Partial intelligibility appears here as well. Human institutions do not fully observe ecological systems. Models, indicators, monitoring networks, local knowledge, and scientific interpretation provide partial representations. Intervention therefore occurs under uncertainty about feedback, thresholds, and delayed effects. GRE's epistemic commitments require the distinction between ecological reality and its representation to remain explicit, especially where uncertainty interacts with potentially irreversible change.

The economic question is how relations with more-than-human systems affect present and future capacities. Extraction, cultivation, conservation, restoration, pollution control, infrastructure, and land-use rules all modify ecological conditions from which later economic possibilities emerge. More-than-human coexistence is thus central to generative analysis because the future economy is partly generated through relations with systems that exceed the boundaries of human institutions.

3.15.10 Boundary Cases of Radically Different Subjects

The most demanding cases for GRE arise when participants differ so substantially that ordinary assumptions of shared preference, common language, reciprocal recognition, or comparable vulnerability become unreliable. These boundary cases may involve relations among human communities with sharply different ontologies, future artificial systems with unfamiliar forms of agency, interspecies relations, intergenerational relations in which one party is not yet present, or institutional interactions with ecological systems that cannot participate in negotiation in conventional terms. The purpose of considering such cases is not to classify every entity as a subject. It is to test which parts of GRE remain usable when mutual similarity is minimal.

The first requirement is to separate relation from reciprocity. A subject or system can be economically affected by another without being able to respond in the same channel. Future generations can bear consequences of present debt, infrastructure, ecological damage, and knowledge preservation without participating in present bargaining. Nonhuman systems can constrain or respond to economic activity without expressing preferences through markets or language. An artificial system can alter human opportunities while its own status as a bearer of interests remains unsettled. Economic relation can therefore exist under asymmetric capacities for representation and response.

The second requirement is representational humility. When one side cannot articulate its interests through the dominant institutional interface, another actor often speaks on its behalf. Guardians, regulators, scientific experts, community representatives, trustees, legal advocates, or technical proxies can perform this role. Representation may be necessary, but it creates a second-order relation in which the representative's categories can shape what becomes visible. GRE analysis should therefore examine not only the represented subject or system but also the institutions that authorize, translate, and contest representation.

The third requirement is to distinguish coordination from assimilation. Radically

different subjects need not become similar in order to coexist. Governance can instead create protected distances, limited interfaces, non-interference rules, thresholds, buffer zones, rights, or protocols that make coexistence possible while preserving difference. In some cases the appropriate relation is closer integration; in others it may be separation or restriction of contact. GRE does not prescribe one universal form of coexistence because the relevant vulnerabilities, values, and generative effects differ.

Boundary cases also expose the limits of commensuration. Where interests or values cannot be credibly translated into one metric, decision may require procedural legitimacy, precaution, rights, representation, plural evaluation, or explicit acknowledgment of unresolved disagreement. A decision can still be made, but the residual disagreement remains part of the record rather than disappearing into a scalar result. This is especially important where the affected party cannot later recover from the imposed decision.

The broader constitutional implication is that GRE should be able to study economies composed of heterogeneous forms without making homogeneity a hidden precondition of analysis. Economic relation can persist through partial intelligibility, bounded interfaces, heterogeneous values, differentiated temporalities, unequal vulnerabilities, and incomplete commensurability. The task is to identify which differences matter to the relation, which interfaces make coordination possible, which conversions obscure residual losses, and how the terms of coexistence alter future generative possibilities.

Heterogeneity therefore belongs inside the GRE problem-space rather than at its margins. It prevents the economic subject from being silently standardized, prevents intelligence from being reduced to one ranking, prevents temporality from being treated as uniform, prevents vulnerability from being inferred from formal equality, and prevents value from being collapsed into a single measure. It also provides a bridge to the next constitutional problem. Once GRE accepts heterogeneous forms as legitimate participants and objects of inquiry, it must state more precisely where its own disciplinary boundaries lie and how it relates to neighboring economic and social-scientific traditions. The following section therefore turns to the boundaries of Generative Relational Economics.

3.16 Boundaries of Generative Relational Economics

Generative Relational Economics is intended to remain intellectually permeable without becoming disciplinarily indeterminate. The role of this section is to specify the principal boundaries through which GRE relates to neighboring economic and social-scientific traditions while preserving a recognizable problem-space of its own. Its objective is neither to rank adjacent approaches nor to absorb them into a single synthesis. Instead, the section clarifies where GRE can borrow concepts, methods, evidence, and explanatory mechanisms; where genuine overlap exists; and where a distinction should be maintained because the neighboring tradition asks a different primary question, uses a different evaluative register, or makes commitments that GRE does not need to adopt. The discussion proceeds through mainstream eco-

nomics, political economy, relational economics, economic sociology, complexity economics, evolutionary economics, capability approaches, ecological and regenerative economics, generative justice, and general Generative Relational Theory. The method is boundary-setting rather than genealogical. Chapter 2 reconstructed intellectual lineages; the present task is to define interfaces for an emerging research programme.

A disciplinary boundary in this sense is not a wall. GRE can use optimization, causal inference, institutional analysis, network models, historical interpretation, capability concepts, ecological accounting, or justice-oriented evaluation whenever those tools are appropriate to the claim under investigation. The boundary concerns the conditions under which such borrowing remains intelligible. A borrowed method does not make a study identical with the field from which that method came, and a shared object does not erase differences in analytical emphasis. Firms, households, technologies, institutions, ecosystems, capabilities, and power can all be studied by several traditions at once while being rendered differently by each.

This openness is necessary because many GRE questions are intrinsically composite. A study of platform labor may require conventional price and labor-market analysis, institutional and legal interpretation, network structure, computational measurement, political-economic analysis of control, and normative evaluation of capability or dependency. A study of agricultural transition may require cost and productivity analysis, ecological constraints, household reproduction, institutional history, technological coevolution, and long-horizon generative effects. GRE contributes when the inquiry asks how relations among these elements generate, distribute, stabilize, transform, or foreclose later capacities and possibilities. It does not require every neighboring perspective to be translated into GRE terminology.

Boundary maintenance therefore serves two purposes. First, it protects GRE from conceptual inflation. If every relational, dynamic, institutional, or justice-oriented economic study were automatically classified as GRE, the programme would lose analytical content. Second, it protects neighboring fields from retrospective appropriation. GRE can inherit and recombine resources while acknowledging that those resources have their own histories, standards, and unresolved debates. The disciplinary identity developed in this chapter depends on dialogue without theoretical identity.

3.16.1 GRE and Mainstream Economics

GRE has no constitutive need to define itself through opposition to mainstream economics. Standard economic analysis contains powerful tools for studying prices, incentives, choice under constraints, equilibrium, strategic interaction, causal effects, welfare consequences, production, and allocation. Where a research problem is adequately specified by those objects, GRE gains little by redescribing the same analysis in relational vocabulary. The boundary is therefore positive: GRE becomes useful when the research question concerns how the relevant preferences, capacities, constraints, institutional positions, relations, or future opportunity sets are themselves generated and transformed through economic processes.

This distinction can be stated through analytical depth rather than disciplinary hierarchy. A conventional model may treat preferences as given over the horizon of

analysis. GRE can accept that local simplification when preference formation is irrelevant to the question. A different study may need to explain how advertising, institutions, peer relations, platform design, education, or repeated participation reshape preferences or salience. In that setting, what was reasonably exogenous in the first model becomes an object of inquiry. The same logic applies to technology, endowments, legal categories, information structures, capabilities, and market boundaries.

Equilibrium analysis provides another example. GRE does not reject equilibrium as a mathematical or empirical concept. A stable or approximately stable configuration can be analytically important. The additional GRE question concerns what relations sustain the configuration, how the stability distributes capacities and vulnerabilities, whether the configuration generates new conditions that alter its own persistence, and what happens when the relevant state space or institutional rules change. Equilibrium can therefore appear within GRE without defining the whole research programme.

The relation is similarly complementary in empirical work. Econometric identification, experimental design, structural estimation, administrative data analysis, and causal inference can provide strong evidence for particular mechanisms or effects. GRE should use such evidence where available and should not substitute relational prose for identification. At the same time, an estimated local causal effect does not automatically reveal downstream institutional transformation, changing subject positions, altered exit conditions, or long-run generative consequences. Those further claims require further evidence.

The boundary can thus be summarized in terms of problem selection. Mainstream economics often provides the strongest available analysis when the relevant agents, constraints, preferences, technologies, and institutional rules can be treated as sufficiently stable. GRE becomes especially relevant when those conditions are part of what must be explained. The relationship is therefore one of selective extension and mutual correction rather than displacement.

3.16.2 GRE and Political Economy

GRE overlaps substantially with political economy because both can treat economic outcomes as inseparable from institutions, power, historical formation, distribution, and collective organization. Questions concerning ownership, labor, state capacity, financial structure, class, technological control, colonial legacies, regulation, and asymmetric dependence are naturally shared terrain. GRE does not need a separate vocabulary when political economy already provides an adequate account of the relevant mechanism.

The principal difference lies in analytical center of gravity. Political economy frequently organizes inquiry around the distribution and exercise of power among classes, states, firms, institutions, or social groups. GRE includes these objects but asks an additional family of questions concerning what those relations generate over time: capacities, subject positions, dependencies, values, institutional pathways, representational structures, ecological conditions, and the possibility of later action. Power remains central, yet GRE does not make every economic relation reducible to power.

This distinction matters because a relation can be generatively important even when domination is weak or absent. Cooperative institutions can generate capabilities and norms. Public infrastructure can create new spaces of participation. Educational systems can alter the subjects capable of entering later markets or political processes. Technological standards can coordinate activity without being explainable primarily through coercion. Political-economic analysis may already address these effects; GRE emphasizes their generative structure as a recurring cross-domain problem.

Conversely, GRE should not dilute political-economic mechanisms by translating them into neutral language of relation. Ownership, coercion, exclusion, dispossession, monopoly, dependency, and state authority possess specific institutional and historical content. When such mechanisms explain an outcome, they should be named directly. Relational vocabulary is not a substitute for analyzing who controls resources, who bears risk, who sets rules, or who can credibly exit.

GRE therefore sits near political economy while preserving a broader generative question. It can investigate how power structures generate future inequalities and institutional lock-in, but it can also study relations of learning, cooperation, care, ecological reproduction, or symbolic orientation whose economic importance is not exhausted by power. The boundary allows GRE to inherit political economy's seriousness about history and asymmetry without treating political-economic conflict as the sole grammar of economic generation.

3.16.3 GRE and Relational Economics

The strongest conceptual overlap may appear between GRE and approaches that explicitly place relations at the center of economic analysis. Relational economics, relational goods, network-based economic analysis, and other relation-sensitive traditions already challenge the assumption that economic value and behavior can always be understood through isolated individuals and possessed objects. GRE shares the view that access, interaction, recognition, coordination, dependency, and participation can be economically constitutive.

The boundary arises from the second term in the name: generative. GRE is interested not only in the existence or quality of relations but also in what relations bring into being, reproduce, transform, or foreclose. A relation can connect already-defined actors, but it can also alter their capabilities, identities, institutional positions, preferences, expectations, and future relations. The analytical question moves from the structure of a relation to the consequences of participating in and reproducing that relation.

This distinction prevents a relation-first approach from becoming static. Two networks can share similar topology while differing in what their ties generate. Two contractual arrangements can appear similar at one moment while producing different long-term capabilities or dependencies. A cooperative relation can initially create shared capacity and later become exclusionary. A market relation can transmit value while also changing the conditions under which future exchange occurs. GRE therefore requires temporal and generative specification beyond identifying relational structure.

At the same time, GRE does not claim that every relation generates deep transformation. Many relations may be transient, weak, or analytically negligible for the research question. The researcher must establish which relations matter, through which mechanisms, and over what horizon. Relation itself is not an explanatory endpoint.

The boundary with relational economics is thus narrow but meaningful. GRE belongs naturally within a wider family of relational economic approaches, while adding a systematic focus on downstream generation, recursive transformation, heterogeneous forms of value, changing subjects, and future possibility. That addition should be treated as a research orientation rather than as a claim that earlier relational work failed to recognize change or emergence.

3.16.4 GRE and Economic Sociology

Economic sociology provides many of the concepts required for GRE to avoid an overly thin account of economic action. Institutions, social networks, conventions, organizations, classifications, trust, status, embeddedness, cultural interpretation, and collective identity can all shape what economic relations are possible and how they are understood. GRE therefore shares a substantial empirical and conceptual domain with economic sociology.

The boundary is not based on a sharp separation between "economic" and "social" facts. GRE rejects such a simple partition. The distinction is better located in the organizing research problem. Economic sociology can ask how markets, firms, money, organizations, or valuation are socially constituted. GRE can use those analyses and then ask how the resulting economic relations transform later capacities, values, constraints, subject positions, and structures of possibility. The two directions can be mutually reinforcing.

GRE also retains an explicitly economic concern with allocation, production, circulation, extraction, capability, scarcity, and the organization of resources. These objects prevent the programme from dissolving into a general sociology of relations. A sociological account of trust may explain why exchange becomes possible; GRE may further analyze how the exchange redistributes capacity, creates dependency, alters future bargaining positions, or changes the institutions that sustain trust. A sociological account of classification may explain category formation; GRE may examine how that classification changes access to credit, work, insurance, mobility, or recognition.

This interface is especially important for symbolic and representational objects. Prices, ratings, credentials, risk scores, categories, and rankings can be both social facts and economic mechanisms. GRE can study their generative effects without claiming that economic sociology is merely a precursor to GRE. The traditions differ in disciplinary history and in the questions they prioritize.

The boundary therefore remains porous. GRE depends on sociological evidence whenever economic relations are constituted by social meaning, institutional recognition, or organizational form. It remains recognizably economic when the inquiry centers on how such relations organize resources, capacities, value, scarcity, exchange, production, and future economic possibility.

3.16.5 GRE and Complexity Economics

Complexity economics and GRE share an interest in heterogeneous agents, nonlinearity, adaptation, path dependence, interaction effects, emergent macro-patterns, and systems that change outside simple equilibrium descriptions. Complexity methods can be especially valuable when aggregate outcomes arise from distributed interactions and when feedback alters the trajectory of the system.

The overlap is methodological as well as conceptual. Agent-based models, network models, simulation, nonlinear dynamics, and computational experiments can all contribute to GRE where the research problem is compatible with their assumptions. These tools allow researchers to study distributed generation, threshold effects, coordination, cascading change, and multiple possible trajectories.

GRE nevertheless remains broader than a complexity methodology. A GRE contribution need not contain a simulation, a network model, or a nonlinear formal system. Historical interpretation, institutional analysis, qualitative research, comparative case studies, legal analysis, causal inference, and participatory inquiry can all be appropriate. Complexity is one representational and explanatory family among several.

A second boundary concerns the representation of emergence. A computational model can demonstrate how a macro-pattern emerges from specified micro-rules. That result is important, but it establishes emergence within the model. GRE must still ask whether the selected agents, rules, state variables, and interactions adequately represent the empirical process. It may also need to explain how the rules themselves were historically generated, interpreted, contested, or transformed.

A third boundary concerns normativity and meaning. Complex adaptive behavior can persist without being desirable. A resilient system can stabilize exclusion, ecological harm, or domination. Actors can interpret the same rule differently, and those interpretations can alter later action. GRE therefore combines complexity-sensitive analysis with explicit attention to historical meaning, institutional authority, heterogeneous value, and normative evaluation.

The relationship is consequently close but non-identical. Complexity economics supplies powerful tools for distributed and nonlinear generation; GRE adds a wider methodological repertoire and makes the generation of rules, subjects, meanings, and evaluative conditions available as research objects where evidence permits.

3.16.6 GRE and Evolutionary Economics

Evolutionary economics offers another close interface because it treats economic systems as historically changing populations of technologies, routines, organizations, practices, and institutions. Innovation, variation, selection, retention, path dependence, learning, and coevolution provide important resources for analyzing processes that cannot be reduced to static optimization.

GRE shares the historical and processual orientation while avoiding an automatic translation of every generative process into evolutionary terms. Generation can occur through variation and selection, but it can also arise through deliberate institutional design, legal reclassification, collective interpretation, negotiated coordination,

education, care, public investment, conflict, or sudden technological recombination. Evolutionary mechanisms are therefore important members of a broader generative repertoire.

The distinction is also useful for normative analysis. Persistence or selection does not demonstrate efficiency, justice, desirability, or superior adaptive value in every relevant sense. Institutions can survive because alternatives are suppressed, switching costs are high, incumbents control infrastructure, or vulnerable groups bear the costs of persistence. GRE therefore treats selection outcomes as explanatory objects that may require separate normative evaluation.

Coevolution provides particularly fertile common ground. Firms and technologies, institutions and practices, infrastructures and habits, or policies and expectations can change in mutually conditioning ways. GRE extends the question when the process changes the kinds of subjects, capacities, value forms, or relations that can exist in the next period. The interest lies not only in reciprocal adaptation but in transformation of the conditions under which later adaptation occurs.

GRE can thus use evolutionary models and concepts whenever variation, selection, retention, innovation, and coevolution explain the empirical process. Its boundary lies in refusing to make those mechanisms exhaustive. The programme remains open to generative processes whose historical logic is interpretive, institutional, juridical, ecological, political, or deliberately designed rather than primarily evolutionary.

3.16.7 GRE and Capability Approaches

Capability approaches and GRE share a concern with what people and other relevant subjects are substantively able to do and to become. This creates a natural interface between the evaluation of resources and the analysis of conversion conditions. Equal resources can produce unequal capabilities when subjects face different institutions, environments, social relations, embodied conditions, or access structures.

GRE adopts this insight without treating capability as its sole evaluative language. Capability is one dimension of generative consequence. Economic relations can generate or erode capabilities, but they can also transform dependency, recognition, institutional participation, relational quality, ecological conditions, symbolic orientation, and the possibility of collective action. Some of these effects can be translated into capability terms; others may be better preserved as distinct analytical objects.

The temporal orientation also differs in emphasis. Capability analysis can evaluate the substantive opportunities available at a given time. GRE places particular attention on how those opportunities were generated, how they are maintained, and how present relations alter the capability-generating conditions of the future. This makes capability formation, reproduction, concentration, and erosion central dynamic questions.

Capability asymmetry further enters the analysis of power. A difference in capability does not automatically create domination, but it can become leverage when one subject controls an infrastructure, knowledge resource, legal permission, computational system, or exit option required by another. GRE therefore connects capability analysis to relational conversion mechanisms without reducing capability to power.

The boundary is normative as well as analytical. GRE can use capability-oriented evaluation without claiming to settle the philosophical questions that capability theories address concerning freedom, human flourishing, lists of central capabilities, or the justification of public priorities. Those debates remain neighboring normative resources. GRE's contribution is to investigate how economic relations generate and distribute the conditions under which capabilities become possible, durable, or foreclosed.

3.16.8 GRE and Ecological and Regenerative Economics

Ecological and regenerative economics provide essential resources for any GRE analysis in which economic generation depends on material, energetic, ecological, or more-than-human conditions. Production cannot be understood solely through monetary circulation when it depletes soils, water, biodiversity, climate stability, or other conditions required for future activity. Conversely, economic relations can sustain and regenerate ecological capacities under some institutional arrangements.

GRE shares the emphasis on stocks, flows, throughput, ecological limits, interdependence, and long-horizon reproduction. It also shares the concern that apparent short-term gain can undermine the conditions of later possibility. Generative foreclosure has a direct ecological meaning when present extraction damages the ecological capacities through which future livelihoods or social systems could otherwise be sustained.

The boundary again concerns scope and normativity. GRE uses "generative" in a broader sense than ecological regeneration. A process can generate institutions, subject positions, knowledge, technological capacities, dependencies, or symbolic values while degrading ecological conditions. Conversely, ecological regeneration can occur within social arrangements that distribute benefits or burdens unjustly. The descriptive fact of regeneration therefore requires separate social and normative evaluation.

GRE also avoids treating circularity, resilience, regeneration, and generativity as synonyms. A circular material flow can preserve an unjust labor relation. A resilient system can stabilize harmful dependence. A regenerative ecological practice can impose burdens on communities whose knowledge or land is appropriated. The relevant analysis must specify what is being regenerated, for whom, through which relations, and with what consequences elsewhere.

The relationship is therefore strongly complementary. Ecological and regenerative economics prevent GRE from treating future possibility as socially generated in isolation from biophysical conditions. GRE contributes a wider account of how ecological and economic processes interact with institutions, power, subjects, value forms, and the distribution of future generative capacity.

3.16.9 GRE and Generative Justice

Generative justice is one of the closest normative neighbors of GRE because it directs attention to the circulation and return of generative value and to the conditions under which communities retain control over the processes that produce value. Earlier in the book, this lineage was treated as an established theoretical resource rather

than as a retrospective expression of GRE. That distinction remains important at the disciplinary boundary.

GRE shares the concern that evaluation should extend beyond the immediate allocation of outputs. A relation can appear distributively acceptable at one moment while extracting the capacities, knowledge, infrastructures, or ecological conditions that enable future generation. Conversely, an arrangement can strengthen future capability by returning value, knowledge, authority, or productive infrastructure to the subjects and communities involved.

The two programmes nevertheless have different scope. Generative justice is explicitly normative. GRE combines descriptive, explanatory, causal, historical, formal, computational, normative, and intervention-oriented modes. A GRE study can analyze how value recirculates or is extracted without concluding that a particular pattern is just. Normative judgment requires additional premises concerning participation, domination, capability, harm, ecological sustainability, procedural legitimacy, plural values, and future possibility.

GRE also uses a wider conception of what may be generated. Material wealth and productive capacity are central, but economic relations can also generate subject positions, representations, institutional authority, dependencies, expectations, knowledge, ecological conditions, and future option structures. Return of value is therefore one important pattern among several possible generative trajectories.

The boundary preserves attribution and conceptual clarity. GRE can learn directly from generative justice while maintaining a broader economic research programme whose normative analysis remains open to several theories of justice and to the neighboring work of GREthic. The overlap is substantive, but theoretical identity would obscure differences in purpose and scope.

3.16.10 GRE and General Generative Relational Theory

The final boundary is internal to the wider research programme. General Generative Relational Theory provides the broader conceptual space in which relations, generation, ontological emergence, epistemic mediation, historical transformation, power, normativity, and praxis can be studied across domains. GRE is the economic instantiation of that wider framework. The distinction is necessary because not every generative-relational problem is an economic problem.

GRE therefore adopts only the amount of general GR required to investigate economic objects. It studies production, allocation, circulation, exchange, extraction, capability, scarcity, institutions, economic subjecthood, value, power, ecological dependence, and the transformation of future economic possibility. General GR may address analogous structures in law, politics, education, science, aesthetics, knowledge, culture, or other domains where the primary research problem is not economic.

This distinction prevents disciplinary expansion by analogy. A relational pattern discovered in economic analysis should not automatically be generalized to every social domain. Conversely, a concept developed in another GR domain may require translation before it becomes economically meaningful. The relevant mechanisms, evidence, units of analysis, institutions, and normative stakes can differ substantially

across domains.

The relation is nevertheless recursive. GRE can contribute concepts and findings back to general GR. Economic studies may reveal new mechanisms of generative foreclosure, recursive power, value conversion, subject formation, or cross-scale transformation that later become useful outside economics. Other GR domains can likewise correct GRE by showing that an apparently economic process depends on legal, political, epistemic, cultural, or ecological structures that GRE alone cannot adequately explain.

General GR should therefore function neither as a doctrinal authority over GRE nor as a collection of metaphysical propositions that economic research is expected to confirm. It is a broader, revisable framework that can coordinate comparison among domains while remaining open to correction from domain-specific work. GRE retains disciplinary responsibility for the quality of its economic evidence and explanation.

The boundaries established across this section give GRE a position that is open without being unlimited. The programme can use mainstream economic models, political-economic accounts of power, relational and sociological analyses, complexity and evolutionary methods, capability concepts, ecological and regenerative analysis, and generative-justice insights. None of these interfaces requires GRE to become identical with the neighboring field. The criterion is whether the borrowed resource helps explain how economic relations generate, reproduce, distribute, transform, or foreclose later capacities and possibilities.

This boundary-setting also prepares the next task of disciplinary constitution. Once GRE's neighboring interfaces have been identified, a further question becomes unavoidable: what would make a particular study count as a contribution to GRE rather than merely a study that uses relational language? The following section therefore turns from external boundaries to internal research standards, specifying the criteria by which a GRE contribution can state its relational problem, generative claim, evidence, boundary conditions, normative commitments, and cumulative contribution with sufficient clarity to be evaluated and revised.

3.17 Criteria for a GRE Research Contribution

The preceding sections have defined the problem-space, analytical objects, scales, modes of inquiry, epistemic commitments, praxis orientation, normative concerns, and disciplinary boundaries of Generative Relational Economics. A research programme, however, also requires internal standards by which particular studies can be recognized, criticized, compared, and accumulated. The role of this section is to state those standards. Its objective is neither to create a rigid checklist nor to police disciplinary membership through terminology. It is to specify the minimum analytical work required for a contribution to make a recognizably GRE claim. The discussion proceeds through ten criteria: specification of the relational problem; explicit scale and boundary conditions; identification of the generative claim; evidence appropriate to that claim; distinction between representation and relational reality; attention to downstream effects; consideration of alternative generative mechanisms; normative transparency; reproducibility and interpretive traceability; and contri-

bution to cumulative knowledge. The method is constitutional and methodological. These criteria are intended to make GRE research more contestable, revisable, and cumulative rather than more doctrinal.

A study need not satisfy every criterion with the same intensity. A conceptual paper may contribute primarily through category formation and theoretical clarification. A historical study may establish a generative mechanism through archival reconstruction. An econometric study may identify a restricted causal relation while leaving wider ontological questions open. A simulation may explore the consequences of a specified generative mechanism without claiming empirical completeness. An intervention study may generate evidence about relational change that could not be obtained through detached observation alone. The relevant standard is proportionality: the claims made should be supported by an appropriate combination of analytical specification, evidence, and methodological transparency.

GRE therefore treats disciplinary contribution as a relation between a problem, a claim, a representation, evidence, and a cumulative research context. Relational vocabulary alone does not establish that relation. A paper that describes a network, invokes emergence, or discusses downstream effects is not thereby a GRE contribution. The GRE character becomes substantive when the research shows how a specified economic relation contributes to the generation, reproduction, transformation, distribution, or foreclosure of later capacities, values, subjects, constraints, structures, or conditions of possibility, and when that claim is made in a form that other researchers can examine and revise.

3.17.1 Specification of the Relational Problem

A GRE contribution begins by specifying the relational problem under investigation. This requirement is stronger than stating that the topic is "relational." The study should identify which subjects, entities, institutions, infrastructures, representations, ecological conditions, or other analytically relevant configurations are connected, what kind of relation is at issue, and why that relation matters to the economic problem being studied.

The relation may involve exchange, production, financing, employment, ownership, access, dependence, coordination, classification, care, information, legal recognition, infrastructure use, platform participation, resource extraction, ecological dependence, or another economically consequential connection. Its empirical form may be contractual, informal, symbolic, technical, organizational, institutional, spatial, ecological, or distributed across several of these forms. GRE does not require a single taxonomy of relations. It requires enough specification for the researcher and reader to know what is being claimed to connect what.

Relational specification should also identify the economically relevant incidence of the relation. The administrative recipient of a resource, policy, payment, model, or intervention may be only one locus within a wider relational field. A subsidy to a firm can affect workers, suppliers, competitors, financial institutions, local communities, infrastructure demand, and future investment. A credit decision can affect households, landlords, employers, insurers, and later access to other services. A platform rule can alter users, complementors, advertisers, content producers, and labor

conditions. The research problem becomes relational when these connections are treated as analytically constitutive rather than as residual externalities added after the main analysis.

The study should further clarify whether the relation is itself the principal object or whether it mediates another object of interest. A paper may examine the formation of a labor relation, the consequences generated through that relation, or the way the relation transforms its own future conditions. These are different research problems. Stating the relation precisely prevents a general language of interdependence from substituting for explanation.

Relational specification does not require exhaustive mapping. Every inquiry selects some relations and leaves others outside the active representation. The contribution lies partly in justifying why the selected relations are sufficient for the local question and in making visible which important relations have been bracketed. A study that names its relational problem clearly can later be extended, challenged, or re-scaled. A study that leaves the relation implicit is harder to evaluate because disagreement about evidence can conceal disagreement about what the object actually is.

3.17.2 Explicit Scale and Boundary Conditions

Every GRE contribution should state the scale and boundary conditions within which its claims are intended to hold. Economic relations change character across temporal, organizational, spatial, institutional, ecological, and analytical scales. An apparent entity at one scale can decompose into heterogeneous relations at another. A mechanism visible in a household, firm, or platform may operate differently at sectoral, juridical, ecological, or transnational scales. Explicit scale selection therefore belongs to the substance of the analysis rather than to a technical appendix.

Boundary conditions specify what is treated as inside the active system of analysis, what is treated as an environment or background condition, and what is excluded. These boundaries can be geographical, institutional, temporal, jurisdictional, organizational, technological, ecological, or representational. They can also be nested. A study of a labor platform may define the platform ecosystem as the primary boundary while treating labor law, payment infrastructure, and macroeconomic conditions as surrounding systems that enter through specified interfaces.

Temporal boundaries require particular care because generative effects can be delayed. An intervention that raises income over six months may reduce a productive or ecological capacity over five years. A technology that expands access in one period can create dependence on proprietary infrastructure later. A relational configuration that appears stable during one institutional regime may dissolve when law, prices, expectations, or political authority change. A GRE contribution should therefore identify the temporal horizon of the claim and, when appropriate, distinguish immediate effects from slower structural or generative transformations.

Explicit boundary conditions also constrain generalization. Evidence from one sector, jurisdiction, historical period, or technological architecture does not automatically establish the same mechanism elsewhere. A GRE study can make a narrow claim and still be theoretically important if it states the conditions under which the

mechanism is expected to operate. Conversely, broad claims require correspondingly broad evidence or a carefully justified theoretical argument.

Scale and boundary transparency creates a path for cumulative research. Later studies can test whether a mechanism persists under different institutional arrangements, whether a relation changes when the scale is expanded, or whether a boundary previously treated as external should become endogenous to the analysis. Boundary choice is therefore both a limitation and a research instrument.

3.17.3 Identification of the Generative Claim

A GRE contribution should identify its generative claim explicitly. The generative claim states what the specified relation is proposed to generate, reproduce, transform, distribute, or foreclose, through which mechanism, and over what temporal horizon. This is the criterion that most clearly distinguishes a GRE contribution from a study that merely uses relational language.

The generated object can take many forms. It may be a capability, resource, institutional position, subject identity, expectation, dependency, value form, knowledge structure, ecological condition, network topology, bargaining position, classification, infrastructure, norm, or future option. It may also be a change in the conditions under which further generation occurs. The generative claim should therefore name the analytical object rather than relying on the generic statement that a relation "creates value" or "produces effects."

The mechanism also matters. A relation may generate later capacity through learning, investment, access, network reinforcement, institutional recognition, technological complementarity, legal stabilization, reputational accumulation, ecological regeneration, coordination, or another process. It may generate foreclosure through extraction, depletion, lock-in, exclusion, deskilling, dependency, displacement, institutional erosion, or destruction of alternatives. Different mechanisms can produce similar observed outcomes, and the same mechanism can have different consequences under different conditions.

Generative claims can vary in strength. A descriptive contribution may show that a relational configuration is systematically associated with later capacity formation. A historical contribution may reconstruct a plausible mechanism across a sequence of institutional changes. A causal contribution may identify the effect of a specified relation on a downstream outcome under defined assumptions. A formal contribution may demonstrate that a mechanism can generate a class of patterns within a model. A simulation may explore the conditions under which a proposed mechanism becomes sufficient or insufficient. These claims should be distinguished rather than compressed into one category of proof.

A strong GRE contribution also clarifies whether the mechanism concerns generation within an existing structure or transformation of the structure itself. Creating additional productive capacity under stable rules differs from changing ownership, classification, institutional authority, or the effective rules by which future capacities are generated. The distinction helps prevent ordinary output expansion from being mislabeled as deep generative transformation.

The purpose of requiring an explicit generative claim is therefore diagnostic as well as disciplinary. It enables readers to ask whether the claimed generated object actually changes, whether the proposed mechanism is observed or inferred, whether alternative mechanisms fit the evidence, and whether the effect persists beyond the immediate horizon. Generativity becomes a researchable proposition rather than an honorific description.

3.17.4 Evidence Appropriate to the Claim

Evidence in GRE should be appropriate to the epistemic form and strength of the claim. No single evidential hierarchy governs every generative question. Historical reconstruction, ethnography, interviews, administrative records, experiments, quasi-experiments, surveys, network data, financial records, ecological measurements, computational traces, legal documents, formal proofs, and simulations can each support different kinds of inference. Methodological pluralism therefore requires disciplined matching between claim and evidence.

A claim about lived dependency may require qualitative or interpretive evidence that cannot be replaced by aggregate transaction data. A claim about population-level incidence may require quantitative evidence that interviews alone cannot establish. A claim about historical institutional transformation may require archival evidence and temporal reconstruction. A causal claim about an intervention may require an identification strategy capable of distinguishing the effect from confounding processes. A formal claim requires internally valid derivation under stated assumptions. A simulation establishes consequences of modeled rules and parameters rather than direct observation of the empirical target.

The evidence should also correspond to the downstream object named in the generative claim. If a paper claims that a financing relation generates capability, it should observe or defensibly proxy the relevant capability rather than infer it solely from the initial allocation of finance. If a platform intervention is claimed to increase autonomy, measures of throughput or usage alone are insufficient unless the relation between those measures and autonomy is theoretically and empirically justified. If an ecological practice is claimed to regenerate future production conditions, evidence should reach beyond current output toward the ecological capacities that support future activity.

Mixed evidence can be especially valuable when the generative mechanism crosses representational levels. Quantitative data may reveal a distributional pattern while interviews clarify how the relation operates. Institutional documents can establish formal authority while observed practice reveals its implementation. Simulation can explore whether a proposed mechanism is sufficient to produce an observed macro-pattern while empirical data constrain the plausible parameter range. Such combinations should be integrated through a stated inferential logic rather than accumulated as decorative methodological diversity.

Evidence appropriateness also includes negative evidence and failed expectations. When a proposed generative mechanism predicts downstream change that does not occur, the absence can narrow the mechanism, reveal a missing condition, or indicate that the representation is wrong. GRE should therefore retain evidential structures

that permit a generative claim to be weakened or rejected. A programme that can only reinterpret every outcome as evidence of hidden generativity would cease to be empirically corrigible.

3.17.5 Distinction between Representation and Relational Reality

A GRE contribution should distinguish the representation used in analysis from the relational reality the representation is intended to illuminate. Networks, graphs, categories, state spaces, fields, equations, indicators, taxonomies, maps, legal classifications, interview codes, and computational models are analytical constructions. They can disclose important structure while also suppressing, aggregating, or transforming aspects of the target.

The distinction is particularly important because relational analysis often makes structure visually or mathematically compelling. A network diagram can make nodes and edges appear ontologically given even when node identities, tie definitions, missing relations, and temporal aggregation are products of the data-generating process. A scalar indicator can make heterogeneous value appear commensurable. A field representation can suggest continuity where the empirical system contains discontinuities or institutionally discrete categories. A model can hold agents or rules fixed even when historical change in those objects is part of the substantive problem.

GRE does not therefore require researchers to distrust representation. Representation is unavoidable and productive. The requirement is reflexive specification. A contribution should explain what the representation makes visible, what it treats as stable, what it aggregates, what it excludes, and how those choices affect the claim. The more strongly the conclusion depends on a representational choice, the more important sensitivity to alternative representations becomes.

This criterion also applies to institutional representations. Legal categories, accounting classifications, platform metrics, credit scores, productivity measures, and administrative identities can become economically operative representations. They are not merely researcher-created descriptions. Their use can shape access, recognition, risk, resource allocation, and subject positions. A GRE study may therefore analyze a representation both as an epistemic device and as an economic mechanism.

Maintaining the distinction between representation and relational reality supports ontological suspension. Researchers can use network, field, dynamical, or computational language without claiming that the empirical economy literally possesses the complete ontology of the formalism. The analytical question is whether the representation is adequate to the local problem and generative claim. Competing representations can remain simultaneously useful when they disclose different aspects of the same economic configuration.

3.17.6 Attention to Downstream Effects

A GRE contribution should examine downstream effects far enough to evaluate the stated generative claim. This requirement does not demand infinite causal tracing. It requires the researcher to look beyond the immediate administrative output when the theoretical claim concerns later capacities, relations, values, constraints, or pos-

sibilities.

Downstream analysis begins by identifying plausible channels of propagation. A transfer to one organization may alter wages, procurement, investment, debt, market entry, local prices, or political influence. A new classification system may affect eligibility, insurance, credit, employment, or legal recognition. An AI system deployed to increase productivity may alter skill formation, supervision, bargaining power, organizational knowledge, and dependency on technical infrastructure. A conservation intervention may change ecological capacity, land access, community authority, and future livelihood options.

GRE should distinguish propagation from attribution. Observing a downstream change after an intervention does not establish that the focal relation generated it. The contribution should specify the pathway through which the effect is expected to travel and identify evidence consistent with that pathway. Where causal identification is unavailable, the claim should remain calibrated accordingly.

Downstream attention should also include distribution. The same relation can generate gains for one subject while shifting risk, depletion, dependency, or opportunity loss to another. Aggregate improvement can therefore coexist with localized generative foreclosure. A GRE contribution should identify who receives immediate outputs, who gains later capacity, who bears costs, and whose future options become more or less available when these differences are material to the research question.

Temporal depth matters as well. Some generated effects decay quickly; others accumulate or become self-reinforcing. A short evaluation horizon can misclassify a process whose main economic significance lies in later lock-in, learning, institutionalization, ecological regeneration, or erosion. Researchers should therefore justify the chosen horizon in relation to the mechanism rather than treating the observation window as analytically neutral.

The downstream criterion ultimately protects the concept of generativity from collapsing into ordinary output measurement. GRE asks what a relation leaves behind in the capacities and conditions from which later economic processes proceed. The appropriate downstream horizon is the one required to make that question empirically meaningful.

3.17.7 Attention to Alternative Generative Mechanisms

A GRE contribution should consider plausible alternative mechanisms capable of generating the observed pattern. This criterion follows directly from epistemic humility and from the fact that similar outcomes can emerge from different relational configurations. Mechanism identification becomes stronger when the researcher explains why the preferred account fits the evidence better than important alternatives.

Alternative mechanisms can operate at the same scale or at different scales. Increased productivity within a firm may result from worker learning, capital deepening, selection of more productive workers, changes in task allocation, demand expansion, or measurement artifacts. Increased community income after an intervention may reflect genuine local capability generation, temporary transfers, migration, price effects, or extraction from another location. Institutional persistence may arise from

legitimacy, coordination benefits, legal coercion, network lock-in, sunk costs, or the absence of viable alternatives.

GRE should also remain attentive to equifinality: different histories can produce similar configurations. The existence of a stable relation does not uniquely reveal how it was generated. Comparative, historical, and process evidence can help distinguish pathways. In formal or computational research, sensitivity analysis can show whether the result depends on a narrow mechanism or emerges across several model structures.

Alternative mechanisms include representational alternatives. An apparent relation can arise because of measurement, classification, selection, aggregation, or omitted variables. A network pattern can change when edge definitions change. A capability indicator can move because the proxy changes while the underlying capability does not. A historical discontinuity can reflect an archival or institutional change in what was recorded. These possibilities do not invalidate the analysis; they specify additional hypotheses that should be considered where material.

The purpose of this criterion is not to require exhaustive refutation of every imaginable mechanism. It is to prevent a favored generative narrative from becoming insulated from competition. A GRE contribution should identify the most consequential alternatives given the domain, evidence, and claim strength, and state what additional evidence could discriminate among them. Competing mechanisms are part of cumulative research rather than threats to disciplinary coherence.

3.17.8 Normative Transparency

A GRE contribution should make its normative premises transparent whenever evaluative language enters the argument. Terms such as improvement, harm, empowerment, exclusion, justice, sustainability, resilience, capability, autonomy, participation, regeneration, and desirable generation carry normative content that should not be smuggled into a descriptive mechanism claim.

Normative transparency begins by distinguishing what the study observes from how it evaluates what is observed. A relation may generate new productive capacity while also increasing domination. A technology may expand access while weakening privacy or exit. A policy may preserve an institution while reducing the possibility of alternative forms of organization. A regenerative ecological intervention may improve biophysical conditions while distributing burdens inequitably. These cases cannot be evaluated solely by establishing that generation occurred.

The relevant evaluative principles should therefore be stated at the level needed for the claim. A study may adopt a capability perspective, a rights-based standard, a distributive criterion, a relational account of domination, a procedural standard, an ecological constraint, a plural-value framework, or another justified normative basis. GRE does not require one universal normative theory at the level of research contribution. It requires researchers to distinguish the empirical and generative analysis from the premises through which consequences are judged.

Normative transparency is equally important when a study refrains from full evaluation. Researchers may state that a mechanism increases a capability, concentrates

control, or changes future options while leaving the overall justice of the arrangement unresolved. Such restraint can be more informative than forcing heterogeneous effects into a single welfare ranking.

Value plurality further requires explicit treatment of commensuration. If a study aggregates several forms of value into one index, score, monetary measure, or optimization objective, it should explain the justification and consequences of that aggregation. Practical commensuration may be necessary for decision-making without establishing that the underlying values are genuinely commensurable. A GRE contribution should preserve this distinction when it matters.

Normative transparency thus protects both positive and normative inquiry. It prevents descriptive evidence from carrying more evaluative force than it can support, while allowing ethical and political judgments to enter economic analysis openly rather than being hidden in model structure, metric selection, or outcome definition.

3.17.9 Reproducibility and Interpretive Traceability

A cumulative research programme requires other researchers to be able to reconstruct how a conclusion was produced. GRE therefore treats reproducibility and interpretive traceability as complementary standards. Their concrete form varies by method, but the underlying requirement is that the pathway from material or data to claim should remain inspectable.

For quantitative and computational work, reproducibility may involve accessible data where ethically and legally possible, documented preprocessing, variable definitions, code, model specifications, parameter choices, random seeds, robustness checks, and version information. Where data cannot be shared, the study should provide enough procedural detail to clarify what another researcher would need to reproduce the analysis under authorized access.

For qualitative, historical, and interpretive research, exact replication may be impossible or conceptually inappropriate. Interpretive traceability becomes the more suitable standard. The researcher should document source selection, coding or interpretive procedures, archival boundaries, translation choices, interview protocols, contextual assumptions, and the evidential basis for major interpretive moves. Readers should be able to distinguish the source material from the interpretation built upon it.

Formal research requires a related form of traceability. Definitions, assumptions, derivations, propositions, and the relation between formal objects and empirical interpretation should be explicit. A proof can be reproducible while its empirical meaning remains ambiguous; both layers therefore need documentation. Simulation requires the same separation between reproducibility of the computational experiment and validity of the modeled representation.

Traceability also applies to boundary and category revision. If a study changes the definition of a subject, relation, value form, or relevant system during analysis, the change should be visible. Such revision can be intellectually productive, especially in relational research where the empirical material may reveal that initial categories are inadequate. The contribution becomes stronger when readers can see why the

revision occurred and how it affected the result.

These standards are not merely procedural ideals. They distribute epistemic authority. A claim whose evidential path can be inspected is easier to contest, reinterpret, update, and reuse. Reproducibility and interpretive traceability therefore support the broader GRE commitments to revisability, methodological pluralism, and re-epistemization across time.

3.17.10 Contribution to Cumulative Knowledge

A GRE contribution should clarify what becomes more knowable because of the study and how that result can enter a cumulative research programme. Novel terminology alone is insufficient. A contribution may refine a concept, establish a new typology, identify a mechanism, map a relational configuration, provide comparative evidence, develop a formal representation, test an intervention, construct a measure, document a boundary condition, falsify an earlier claim, or expose an unresolved contradiction. These are different forms of cumulative advance.

Cumulative contribution requires relation to prior work. A study should indicate which GRE problem, concept, mechanism, or empirical domain it extends, revises, or challenges. Because GRE is an emerging programme, this relation may initially be internal to the book's preliminary constitution or to a small body of subsequent work. The standard should nevertheless be established early: later research should not repeatedly reinvent the same relational vocabulary without specifying what has changed.

Negative and limiting results are especially important. Demonstrating that a proposed generative mechanism fails under certain institutional conditions can advance the programme by specifying its scope. Showing that two indicators previously treated as proxies diverge can improve measurement. Identifying a case in which downstream generation is negligible can prevent overextension of the framework. Revealing that competing representations yield materially different conclusions can redirect theoretical development. Cumulative knowledge includes disciplined contraction as well as expansion.

A contribution should also preserve reusable analytical objects where possible. Clearly defined categories, documented datasets, mechanism diagrams, typologies, validated measures, formal models, intervention protocols, comparative cases, and explicit boundary conditions can support later synthesis. Reusability does not require standardization of every method. It requires enough conceptual and evidential continuity for results to be compared rather than remaining isolated narratives.

Cumulative knowledge in GRE is expected to remain historically revisable. Concepts adequate to one technological or institutional period may become insufficient as economic subjects, relations, infrastructures, and forms of value change. The purpose of accumulation is therefore not to build an immutable doctrinal core. It is to build a record of concepts, mechanisms, evidence, boundary conditions, disagreements, and revisions from which later inquiry can proceed with greater precision.

Taken together, the criteria in this section provide a practical threshold for recognizably GRE research. A contribution should specify the relation under study, state

its scale and boundaries, articulate the generative claim, match evidence to the claim, distinguish representation from relational reality, trace relevant downstream effects, consider plausible alternative mechanisms, disclose normative premises, preserve reproducibility or interpretive traceability, and explain how the result contributes to cumulative knowledge. The criteria remain proportional to the type of inquiry, but they create a common language for criticism across heterogeneous methods.

These standards also shift Chapter 3 from disciplinary constitution toward research development. Once contributions can be evaluated individually, the next question concerns how they can accumulate across projects into a programme that develops concepts, typologies, maps, mechanisms, formal models, simulations, intervention evidence, measures, and revisions over time. The following section therefore turns from the criteria for a single GRE contribution to the architecture of a cumulative GRE research programme.

3.18 Cumulative Research Programme

The preceding section specified the standards by which an individual contribution can be recognized as part of Generative Relational Economics. A research programme, however, requires more than a sequence of individually competent studies. It requires mechanisms through which concepts can be stabilized and revised, cases can become comparable, mechanisms can be accumulated across contexts, formal and computational representations can become reusable, interventions can generate transferable evidence, measures can be improved, and theoretical claims can contract as well as expand. The role of this section is therefore to specify how GRE can develop cumulatively without converting cumulative development into doctrinal closure. Its objective is to identify several forms of accumulation through which a still-emerging research programme can become more precise, more testable, more comparable across domains, and more corrigible over time.

Cumulative development in GRE is expected to be heterogeneous. Historical reconstruction, conceptual clarification, comparative case analysis, mechanism identification, formal modeling, simulation, intervention research, and indicator construction do not accumulate in identical ways. A concept can become more precise without becoming more universal. A mechanism can recur across cases while remaining conditional on institutional context. A formal model can improve analytical discipline without establishing empirical adequacy. An intervention can generate evidence about a relational configuration that cannot be transferred unchanged to another scale. The programme therefore needs forms of accumulation that preserve local differences while still allowing knowledge to travel.

The central commitment is that accumulation should increase the quality of future inquiry rather than merely increase the quantity of publications. A cumulative programme should make later researchers better able to distinguish objects, specify boundaries, formulate mechanisms, compare cases, identify failed expectations, construct representations, and revise earlier claims. Accumulation is therefore closely related to memory: the programme must preserve not only successful formulations but also boundary conditions, null findings, abandoned distinctions, incompatible

representations, and reasons for revision. This historical record is part of the epistemic infrastructure through which GRE can remain generative without repeatedly rediscovering its own problems.

3.18.1 Conceptual Development

Conceptual development provides one of the earliest forms of cumulative work in an emerging research programme. GRE depends on terms such as relation, generativity, capacity, subject, field, orientation, propagation, conversion, foreclosure, and generative condition. These terms can guide inquiry only when their meanings become sufficiently explicit for disagreement, comparison, and revision. Conceptual development therefore concerns the progressive clarification of what a term denotes, what it excludes, how it differs from neighboring terms, which empirical indicators can bear upon it, and under what conditions the concept ceases to be useful.

Such development should proceed through distinction rather than inflation. A concept becomes stronger when researchers can identify nearby phenomena that it should not subsume. Generativity, for example, should not become a general synonym for causation, productivity, innovation, emergence, or social change. Relationality should not become a label attached to any situation containing more than one actor. Orientation should not become equivalent to intention. Power should not become interchangeable with every asymmetry. Conceptual accumulation therefore requires negative space: a concept is partly stabilized by the cases and mechanisms that researchers agree belong elsewhere.

Conceptual development is also historical. A distinction useful in one institutional or technological period may become insufficient when the object changes. The meaning of economic subjecthood may need revision when artificial systems undertake increasingly consequential operational roles. The concept of resource may change when informational, ecological, infrastructural, or symbolic forms become central to production. The concept of value may require further differentiation when heterogeneous value forms interact without stable conversion ratios. GRE should therefore treat conceptual stabilization as provisional achievement rather than final definition.

A cumulative conceptual record should preserve successive formulations and their reasons. Later versions should make visible whether a term was broadened, narrowed, divided, or replaced. This allows conceptual disagreement to become cumulative rather than repetitive. Researchers can then ask whether a difference arises from incompatible definitions, different empirical domains, different scales, or genuinely competing theoretical commitments. Conceptual development becomes part of research infrastructure when it reduces ambiguity while preserving the possibility of revision.

3.18.2 Typology Development

Typologies allow recurrent heterogeneity to be organized without requiring reduction to a single scalar dimension. They are especially important for GRE because many objects of inquiry are structurally plural: economic subjects can differ in kind, relations can differ in direction and persistence, value can take multiple forms, gener-

ative effects can propagate through different channels, and interventions can create benefits and harms through distinct mechanisms. A typology provides a way to preserve these differences while making comparison possible.

Typology development should begin from analytically relevant distinctions rather than from the desire to populate a classificatory table. A useful typology changes what can be observed or compared. Distinguishing resource asymmetry from capability asymmetry, for example, matters because possession and effective capacity can diverge. Distinguishing relational dependence from domination matters because dependence can exist without one subject acquiring durable control over another. Distinguishing propagation, conversion, recirculation, dissipation, and extraction matters because downstream value trajectories differ even when an initial allocation is identical.

Typologies should also remain open to overlap. GRE objects are frequently multidimensional, and a single case can instantiate several types at once. A platform may be simultaneously an organizational actor, a field-structuring infrastructure, a representational system, and a locus of institutional power. A transfer programme can be allocative, capability-enhancing, dependency-producing, and institution-forming at different stages. Typological clarity therefore does not require exclusive membership unless exclusivity is substantively justified.

Cumulative typology development requires empirical confrontation. Categories should be revised when recurrent cases do not fit, when two categories fail to produce meaningful explanatory differences, or when one category hides internally distinct mechanisms. Cross-case work is especially important because a typology derived from one institutional context may mistake a local classification for a general one. Typologies accumulate when their boundary conditions, empirical uses, exceptions, and revisions are recorded rather than when their labels simply proliferate.

3.18.3 Relational Mapping

Relational mapping concerns the systematic representation of economically consequential connections among subjects, institutions, resources, infrastructures, representations, capacities, and environments. The purpose is not to impose a universal network ontology. It is to make relational structure visible enough that claims about mediation, dependence, propagation, power, or generation can be examined rather than assumed.

Different research problems require different maps. A transaction map may trace flows of money or goods. An authority map may represent legal and organizational powers. A capability map may identify which relations enable access to knowledge, infrastructure, care, finance, or mobility. A representation map may show how classifications and metrics connect institutional decisions to subject positions. A temporal map may represent the order through which one relation conditions a later possibility. Ecological or supply-chain analysis may require several of these layers simultaneously.

Cumulative relational mapping depends on comparability without forced standardization. Researchers should document node definitions, relation types, temporal windows, missing-data assumptions, scale choices, and the meaning of direction or

weight where these are used. When mappings from different studies cannot be directly combined, the reasons should be visible. Differences in mapping conventions can then become substantive evidence about how the object itself is differently constituted across contexts.

Relational maps can also accumulate historically. Repeated mapping can show how a configuration changes, which ties persist, which dependencies become concentrated, where new intermediaries emerge, and whether an intervention alters the topology of opportunity or control. Longitudinal mapping is particularly useful for GRE because generative claims often concern changes in the conditions from which later actions become possible. The cumulative product is not a final map of the economy, but a set of documented representations that can be compared, revised, and linked to mechanism claims.

3.18.4 Mechanism Identification

Mechanism identification provides a central bridge between relational description and generative explanation. GRE is concerned not only with whether two conditions are associated, but with how a relation contributes to the production, reproduction, transformation, or foreclosure of later capacities and possibilities. A cumulative programme therefore needs recurrent mechanism families that can be investigated across settings without assuming that the same mechanism operates universally.

Mechanisms may involve resource access, learning, coordination, institutional recognition, bargaining leverage, infrastructural dependence, feedback, expectation formation, classification, imitation, exclusion, risk transfer, ecological regeneration, or many other processes. What makes such a process a useful GRE mechanism is not its novelty of name but its role in connecting a relational configuration to a downstream change. The mechanism should specify intermediate transformations sufficiently clearly that evidence can support, weaken, or reject the claim.

Cumulative mechanism work benefits from decomposition. A broad claim that an intervention ”builds capability” may contain several distinct processes: it may increase material resources, reduce uncertainty, create social recognition, provide technical knowledge, alter institutional eligibility, or change expectations about future access. Disaggregating these processes allows later studies to test whether the same downstream effect arises through different mechanisms or whether similar interventions produce different outcomes because only some mechanism components are present.

Mechanism accumulation should therefore include enabling conditions, inhibiting conditions, competing mechanisms, and failure modes. A mechanism that appears robust in one setting may depend on trust, legal enforceability, technological infrastructure, social norms, or complementary public goods. Recording these conditions turns isolated explanations into a comparative mechanism library. Such a library remains revisable and context-sensitive, but it gives later researchers a stronger starting point than an undifferentiated appeal to relational complexity.

3.18.5 Comparative Case Accumulation

Cases become cumulative when they are documented in ways that permit meaningful comparison. GRE therefore requires comparative case accumulation rather than a collection of richly described but analytically disconnected examples. The purpose of comparison is not necessarily to produce universal laws. It can identify recurring relational configurations, clarify boundary conditions, distinguish mechanisms, reveal alternative pathways, and show how similar interventions generate different outcomes under different institutional or historical conditions.

Comparison can be organized around cases, mechanisms, trajectories, scales, or interventions. Two regions may receive similar infrastructure investments yet generate different capability effects because institutional access differs. Two platforms may use similar algorithms but create different labor dependencies because ownership and exit options differ. Two ecological restoration projects may produce comparable short-term outputs while diverging in long-run regenerative capacity. A comparative design becomes especially informative when the axis of comparison corresponds to a plausible mechanism difference.

Cumulative case repositories should therefore preserve more than outcome variables. They should record relational boundaries, subject categories, institutional context, temporal horizon, intervention history, relevant value forms, and evidential limitations. Standardized metadata can help without forcing all cases into identical theoretical categories. The aim is to make later synthesis possible while retaining the contextual features through which generative mechanisms may differ.

Negative and anomalous cases are particularly valuable. A case in which a predicted mechanism fails can identify a missing enabling condition or expose an overgeneralized concept. A case that produces an unexpected downstream effect can reveal a propagation channel absent from the original theory. A cumulative programme should therefore preserve cases that resist prevailing formulations rather than treating them as noise to be excluded from the archive.

3.18.6 Formal Model Development

Formal models can contribute cumulative value by making assumptions, relations, and implications explicit. In GRE, formalization may represent dynamics, networks, allocation processes, bargaining relations, value conversion, capability change, field-like influence, institutional rules, or recursive transformations of generative conditions. The purpose is analytical discipline rather than formalization for its own sake.

A cumulative formal programme should preserve model lineage. Later models should indicate which assumptions are inherited, relaxed, extended, or replaced. If one model treats subject identities as fixed while another allows subject formation, the difference should be explicit. If one model uses scalar value while another represents plural value dimensions, the comparison should identify what explanatory capacity is gained and what tractability is lost. Formal accumulation then becomes a sequence of interpretable modifications rather than a disconnected set of mathematical constructions.

Model families can also help identify which conclusions depend on which assump-

tions. Robustness across several formal representations strengthens confidence that a result reflects a structural feature rather than an artifact of one specification. Divergence across models can be equally informative when it reveals sensitivity to boundary conditions, topology, time horizon, or behavioral assumptions. GRE should therefore treat model disagreement as a source of theoretical information rather than merely as a problem to be eliminated.

Formal development remains subject to ontological suspension. A model can establish the consequences of stated relations without proving that the empirical economy possesses the model's ontology. Cumulative formal progress therefore requires empirical interpretation and clear links to the concepts or mechanisms represented. Reusable models, documented assumptions, and transparent derivations can become infrastructure for later studies even when empirical validation remains partial.

3.18.7 Simulation and Computational Exploration

Simulation and computational exploration extend formal development when analytic solutions are unavailable, when interaction structures are heterogeneous, or when researchers want to examine the consequences of alternative rules and parameter regimes. GRE can use agent-based models, network simulations, dynamical systems, optimization procedures, synthetic populations, and other computational methods to explore how local relations may generate larger-scale patterns.

Cumulative computational work requires reproducible experimental design. Code, parameter ranges, initialization procedures, random seeds, stopping rules, and output measures should be documented where possible. More importantly, the relation between computational objects and theoretical concepts should remain explicit. A simulated agent may represent a household, firm, algorithm, institution, or abstract decision unit, but that mapping is a modeling choice rather than an ontological fact.

Computational exploration can support cumulative knowledge by identifying candidate mechanisms, sensitivity regions, threshold behavior, path dependence, or unexpected interactions. It can also help discriminate among theories by showing that some verbal mechanism claims are insufficient to generate the observed pattern under plausible assumptions. Such findings remain conditional on the model, but they can direct empirical work toward the variables and relations most likely to matter.

Simulation results should accumulate together with failed parameterizations and negative results where feasible. If a proposed mechanism produces a target pattern only under implausibly narrow conditions, that fact is theoretically relevant. Computational archives can therefore preserve the history of model development, including abandoned specifications, so that later researchers can distinguish genuine theoretical progress from repeated rediscovery of previously rejected configurations.

3.18.8 Intervention Evidence

Interventions provide a distinctive source of evidence because they modify the relational configuration under study. Policy changes, institutional reforms, experimental programmes, platform redesigns, governance mechanisms, public investments, organizational changes, and community initiatives can reveal how relations respond

when constraints or enabling conditions are altered. GRE treats such evidence cautiously because intervention effects can be path-dependent, scale-specific, and entangled with adaptation.

A cumulative intervention programme should document design, implementation, context, immediate outputs, downstream effects, unintended consequences, and later structural changes. Evidence about failure is as important as evidence about success. An intervention that produces an initial benefit but creates long-term dependency contributes different knowledge from an intervention whose effects persist after external support is withdrawn. An intervention that changes institutional recognition without altering material capacity reveals a different mechanism from one that changes both.

Intervention evidence also benefits from variation in intensity, timing, sequence, and institutional setting. Comparative intervention research can identify whether an effect depends on complementary relations, threshold conditions, or prior histories. Where randomized or quasi-experimental identification is possible, it can strengthen causal claims. Where it is not, careful process tracing, comparative design, and longitudinal evidence can still contribute to mechanism understanding if the limits of attribution are explicit.

Cumulative praxis requires preserving correction histories. Researchers should record when an intervention was modified, suspended, reversed, or repaired and why. These histories provide evidence about the adaptability of both the intervention and the governing institutions. They also help later researchers understand which apparent outcomes were produced by the initial design and which emerged through iterative revision.

3.18.9 Measure and Indicator Development

Measures and indicators allow recurrent GRE concepts to become empirically tractable, but measurement should follow conceptual clarification rather than substitute for it. Possible GRE measures may concern relational dependence, capability access, exit conditions, propagation, concentration of generative control, value conversion, institutional recognition, ecological capacity, or forms of generative foreclosure. Each indicator compresses a more complex concept and therefore requires explicit justification.

Cumulative indicator development should include validity, reliability, sensitivity, and domain restrictions. An indicator useful in one institutional setting may fail elsewhere because the same observable carries a different relational meaning. A measure of platform dependence based on revenue concentration may miss infrastructural lock-in. A measure of capability based on resource possession may ignore conversion constraints. A measure of generativity based on output growth may overlook depletion of future enabling conditions. Indicator accumulation therefore depends on comparison with alternative measures and on documented cases where the proxy fails.

Composite indices require particular caution. Combining heterogeneous value dimensions into one score can aid communication or decision-making, but the weighting rule performs substantive evaluative work. GRE should distinguish between an

index created for practical coordination and a claim that the underlying values are intrinsically commensurable. Sensitivity analysis can show how rankings or conclusions change under alternative weighting schemes.

A mature cumulative programme can maintain indicator families rather than seeking one universal GRE metric. Different measures may be appropriate for different objects, scales, and purposes. The cumulative goal is not metric unification but increasing clarity about what each measure captures, what it omits, and how it relates to the generative claim being tested.

3.18.10 Theory Revision

Theory revision completes the cumulative architecture because accumulation without revision would convert GRE into a repository of additions rather than a research programme. Concepts, typologies, mechanisms, models, indicators, and intervention assumptions should all remain revisable when evidence, comparison, formal analysis, or historical transformation shows that earlier formulations are inadequate.

Revision can take several forms. A concept can be narrowed because it was applied too broadly. A typology can be divided because one category contains distinct mechanisms. A mechanism can be reclassified as conditional rather than general. A formal model can replace a fixed parameter with an evolving relation. An indicator can be abandoned because it tracks a proxy rather than the target concept. A normative criterion can be separated from an empirical one when the two were previously conflated. Revision is cumulative when the reason for change is documented and the consequences for earlier findings are made visible.

GRE should also preserve superseded formulations. Historical traceability allows later researchers to understand why a theory changed and whether an earlier version may still be useful in a restricted domain. Erasing theoretical history would make apparent progress difficult to evaluate because researchers could not distinguish genuine correction from terminological replacement.

Theory revision may also be triggered by transformations in the object of inquiry. New technologies, institutional forms, ecological conditions, legal arrangements, or types of economic subject can make previously adequate categories insufficient. A research programme committed to historical dependence should expect some of its own concepts to age. Revisability is therefore not a weakness added to GRE from outside; it follows directly from the claim that economic relations and their generative conditions are historically transformable.

Taken together, the ten forms of accumulation described in this section define a research programme that can grow without equating growth with theoretical expansion. Conceptual clarification can narrow terms. Typologies can remove distinctions that fail empirically. Comparative cases can reveal boundary conditions. Mechanism research can reject attractive explanations. Formal and computational work can expose contradictions. Intervention evidence can show that a promising design generates harmful dependencies. Indicators can be retired. Theory can contract. Cumulative development is therefore the organized capacity to preserve, compare, test, reuse, and revise knowledge across heterogeneous forms of inquiry.

This cumulative architecture also prepares an important disciplinary problem. As GRE develops, researchers will not necessarily converge on one ontology, one preferred method, one formal representation, one account of value, or one definition of generativity. A cumulative programme therefore requires a way to distinguish productive internal plurality from conceptual fragmentation. The following section turns to internal pluralism and competing formulations, asking how divergent approaches can coexist, criticize one another, and become comparable without forcing premature theoretical unification.

3.19 Internal Pluralism and Competing Formulations

The preceding sections have progressively specified the identity, objects, scales, questions, epistemic commitments, praxis, normative interfaces, power problems, contribution standards, and cumulative structure of Generative Relational Economics. A cumulative research programme, however, cannot remain open merely by permitting new topics to be added. It must also preserve the possibility that several incompatible or partially incompatible formulations of the same problem coexist long enough to be compared, criticized, revised, and sometimes rejected. The role of this section is therefore to specify the place of internal pluralism within GRE. Its objective is to distinguish productive plurality from conceptual indeterminacy: GRE can sustain multiple ontologies, methods, formalisms, evidential strategies, value representations, and accounts of generativity without treating every formulation as equally adequate or every disagreement as irreducible.

Internal pluralism follows from the programme's earlier commitments. Ontological suspension limits the authority of any single representational scheme. Methodological pluralism recognizes that different research questions warrant different modes of access. Heterogeneous subjects and values make premature commensuration hazardous. Scale-relative entityhood means that the same economic configuration can be represented differently at different analytical resolutions. The cumulative programme further requires that alternative formulations remain visible so later work can determine which distinctions travel across contexts, which mechanisms recur, and which representations fail. Pluralism is therefore not an exception to GRE's constitution. It is one of the conditions under which the programme can remain corrigible.

Pluralism nevertheless requires discipline. A research programme becomes weak if incompatible claims are retained merely because they use different vocabularies. It also becomes weak if every disagreement is redescribed as a matter of perspective before empirical or conceptual comparison has occurred. GRE should therefore distinguish plurality of representation from incompatibility of prediction, plurality of method from contradiction in evidence, plurality of value from inconsistency in stated normative commitments, and plurality of ontology from unrestricted metaphysical permissiveness. Competing formulations become productive when their objects, boundaries, assumptions, inferential claims, and failure conditions can be made sufficiently explicit for comparison.

3.19.1 Ontological Pluralism

Ontological pluralism in GRE begins from the recognition that economic inquiry can require several kinds of object-description. A firm can be represented as a legal person, an organization, a nexus of contracts, a hierarchy of authority, a network of relations, a bundle of capabilities, an institutionalized process, or a temporally persistent configuration. These descriptions do not necessarily refer to different empirical worlds. They select different features of the same or overlapping configurations for different analytical purposes.

The earlier principle of ontological suspension therefore does not prohibit ontological language. It restricts the movement from analytical usefulness to ultimate metaphysical commitment. GRE can state that a corporation is treated as an economic subject in one analysis, a relational configuration in another, and an institutional field component in a third. Each formulation must explain what distinctions it preserves, what mechanisms it makes visible, and what questions it suppresses. Ontological pluralism is legitimate when alternative object-descriptions improve inquiry without being silently conflated.

This plurality becomes especially important when objects change historically. A category that functions as a relatively stable entity during one period may later require decomposition because its internal relations become explanatory. Conversely, a dense set of relations may become sufficiently stabilized that entity-level treatment is efficient and empirically adequate. GRE therefore permits movement between entity-centered and relational descriptions as the problem changes. The choice is governed by explanatory and evidential adequacy rather than by a requirement that one level possess permanent ontological priority.

Ontological pluralism does not imply that every proposed object deserves equal standing. Some entities may be administratively convenient yet analytically misleading. Some relational categories may be too broad to identify mechanisms. Some field descriptions may erase important discontinuities. Some claims of emergence may simply rename aggregation. Competing ontological formulations should therefore be assessed by the empirical distinctions they sustain, the mechanisms they clarify, the observations they organize, and the errors they make possible to detect.

A plural programme can also contain genuine ontological disagreement. Researchers may disagree about whether a particular social fact should be treated primarily as an emergent property, an institutional rule, a represented category, a distributed relation, or a relatively autonomous object. GRE need not resolve such disagreements through constitutional fiat. It should require the competing formulations to state their consequences. If two ontologies generate indistinguishable descriptions, predictions, or interpretations for the relevant problem, the dispute may remain underdetermined. If they imply different observations, interventions, or normative diagnoses, the disagreement becomes a substantive research question.

3.19.2 Methodological Pluralism

Methodological pluralism concerns the coexistence of different strategies for producing warranted claims. GRE admits historical, interpretive, qualitative, quantitative,

causal, comparative, formal, computational, and intervention-oriented inquiry because its objects can be only partially accessible through any single mode. The justification for plurality is therefore epistemic rather than diplomatic. Different methods disclose different aspects of relational and generative processes.

A historical reconstruction can identify how categories, institutions, or subject positions came to exist. Ethnographic or interpretive work can reveal meanings, tacit practices, and situated understandings that are unavailable in administrative data. Quantitative analysis can estimate distributions, associations, heterogeneity, and temporal regularities at scales difficult to observe directly. Causal designs can test specific intervention or mechanism claims under stated assumptions. Formal models can expose logical consequences and structural possibilities. Computational models can explore high-dimensional, adaptive, or path-dependent systems. None of these capacities automatically contains the others.

Methodological pluralism therefore requires claim-method matching. A computational simulation cannot by itself establish that its mechanism generated an observed historical outcome. A historical narrative cannot by itself estimate the magnitude of a population-level effect. A statistically identified average treatment effect may not explain the meanings through which the treatment was received or the institutional conditions through which it propagated. An interpretive account may clarify subject formation while leaving distributional prevalence unresolved. The value of a method depends on the claim it is used to warrant.

Pluralism also permits methodological competition. Two studies can approach the same generative claim through different designs and produce conflicting evidence. Such conflict should not be resolved automatically by a fixed hierarchy of methods. The programme should examine differences in population, scale, measurement, boundary selection, intervention timing, model specification, and inferential target. Sometimes one method will expose a limitation in another. Sometimes the disagreement will reveal that the original theoretical claim was underspecified.

The strongest form of methodological pluralism is therefore cumulative correction. Methods become mutually informative when they identify each other's blind spots and help refine the target of inquiry. GRE does not require every project to use mixed methods. It requires the programme as a whole to remain open to correction from methods capable of observing dimensions that another approach leaves unresolved.

3.19.3 Formal Pluralism

Formal pluralism extends the same principle to mathematical and computational representation. GRE has inherited resources from dynamical systems, complexity theory, network science, higher-order and multilayer representations, field formalisms, information theory, computation, and simulation. These formalisms organize different kinds of structure. A dynamical system emphasizes state, trajectory, stability, and transformation through time. A network emphasizes patterned relations among identifiable nodes. A higher-order representation can make irreducibly multi-actor interactions explicit. A field representation can describe distributed conditions that vary across a domain. Agent-based or computational models can explore local rules, heterogeneity, and emergent aggregate behavior.

GRE therefore has no constitutional reason to privilege one formal language as the universal representation of economic relations. Formal choice should follow the structure of the research problem. A model of propagation through contractual dependencies may be naturally network-based. A problem concerning distributed accessibility or exposure may be represented more effectively through a field. A question about transition between regimes may require dynamical analysis. A question about heterogeneous adaptive actors may benefit from simulation. Several representations may be needed for the same empirical system.

Formal pluralism also protects the programme from a recurrent category error: mathematical elegance should not be mistaken for ontological authority. Two mathematically distinct representations can sometimes encode the same empirically relevant relation. Conversely, one formalism can fit several empirical situations whose mechanisms differ. Formal equivalence, approximation, simulation, or mapping therefore needs to be distinguished from substantive equivalence of the represented processes.

Competing formalisms should be compared through their assumptions, representational losses, empirical accessibility, computational tractability, and consequences for inference. A more complex formalism is not necessarily better. Additional dimensions, layers, parameters, or interacting fields can increase expressiveness while reducing identifiability. A simpler model can be preferable when its omissions are explicit and its inferential target is narrow. Formal pluralism is productive when representational choice remains accountable to evidence and purpose.

3.19.4 Quantitative and Qualitative Approaches

Quantitative and qualitative approaches often differ in data structure, inferential form, sampling logic, and the kinds of uncertainty they make visible. GRE treats these differences as analytically important rather than as a division between rigorous and non-rigorous inquiry. Quantitative work can establish patterns across large populations, estimate magnitudes, compare distributions, and model temporal or relational structures. Qualitative work can reconstruct meaning, institutional practice, local causal process, category formation, tacit knowledge, and the situated experience through which economic relations become operative.

The distinction is particularly important for generative analysis. A downstream effect can be quantitatively measurable while its mechanism remains poorly understood. Conversely, an interactional mechanism can be richly documented in a small number of cases while its prevalence, distribution, or aggregate contribution remains uncertain. GRE should therefore resist converting one form of evidence into claims warranted only by the other.

Mixed designs can be valuable when the forms of evidence address complementary parts of the same generative claim. A qualitative study can help identify mechanisms, categories, or boundary conditions that later quantitative work tests across cases. Quantitative anomalies can direct qualitative inquiry toward previously invisible heterogeneity. Administrative or network data can identify patterns of propagation, while interviews or archival evidence reveal why particular pathways existed. Such integration should be designed around a shared research problem rather than

around the ceremonial inclusion of multiple methods.

Qualitative and quantitative approaches can also disagree productively about the object itself. A variable that appears stable in a dataset may combine historically different institutional meanings. A locally salient category may have no reliable population-level measure. A statistically robust association may depend on classifications whose social production requires separate analysis. GRE's relational commitments make these disagreements substantive because measurement categories can participate in the relations they represent.

The programme therefore treats quantitative and qualitative approaches as mutually corrective without requiring symmetry in every project. The relevant question is which claims remain unsupported when only one form of evidence is available and whether the resulting limitation materially changes the argument.

3.19.5 Causal and Interpretive Approaches

Causal and interpretive approaches address different but frequently intersecting questions. Causal inquiry asks whether and through what mechanisms a change in one condition contributes to a change in another under specified assumptions. Interpretive inquiry asks how actors, institutions, representations, and practices acquire meaning within a situated historical and relational context. GRE requires both because economic relations can operate through mechanisms whose effectiveness depends on interpretation.

A legal classification, price signal, credential, ranking, or algorithmic recommendation can alter behavior partly because subjects recognize, contest, trust, misunderstand, or strategically use what the representation means. In such cases, interpretation is not merely commentary after causal analysis. It can be part of the causal mechanism. At the same time, the existence of meaning does not establish the magnitude or distribution of its effects. Interpretive adequacy and causal identification remain distinct epistemic achievements.

The same distinction applies to subject formation. Researchers may interpret how a worker, consumer, creditor, beneficiary, or platform participant is institutionally constituted and how that subject position is experienced. A causal study may then examine whether entering that position changes behavior, income, access, or later opportunities. The two analyses can support each other without collapsing into a single method.

Competing causal and interpretive accounts become especially useful when they disagree about where the mechanism lies. A causal model may attribute an effect to incentives, while interpretive evidence suggests that the intervention changed recognition, legitimacy, or perceived obligation. Rather than treating one vocabulary as necessarily deeper, GRE should ask what observable consequences follow from the alternative mechanism accounts and whether both processes operate at different stages or scales.

Causal and interpretive pluralism therefore requires translation without reduction. Researchers should state when an interpretive category enters a causal model, how it is observed, and what is lost in operationalization. Conversely, causal evi-

dence can constrain interpretations by showing that a proposed meaning-making mechanism does not produce the expected distributional or temporal pattern. Productive integration occurs when each approach can expose conditions under which the other's claims fail.

3.19.6 Network and Field Representations

Network and field representations provide a concrete example of formal pluralism because they organize relational structure differently. A network begins from distinguishable nodes and relations among them. It is well suited to questions concerning adjacency, centrality, brokerage, diffusion, dependence, multilayer connectivity, and evolving topology. A field representation describes conditions distributed across a domain and can be useful when influence, accessibility, exposure, salience, or constraint varies continuously or when pairwise ties provide an incomplete description.

These representations can overlap without being interchangeable. A network of financial obligations can identify who depends directly or indirectly on whom. A field representation may instead characterize how liquidity conditions, regulatory exposure, information availability, or market accessibility vary across positions. The network makes discrete relational pathways explicit; the field can make distributed background conditions visible. A system can contain both.

Choice between network and field representation should therefore follow the mechanism. If transmission occurs through identifiable connections, a network may be the natural first representation. If subjects respond to a spatially, institutionally, or symbolically distributed condition, a field can be more informative. Some problems require hybrid representations in which nodes and edges evolve within fields that also respond to network activity.

The competing representations can generate different intuitions about intervention. Network analysis may suggest altering connections, central nodes, or dependency pathways. Field analysis may suggest changing distributed conditions that shape many interactions simultaneously. GRE should not infer that one intervention is superior from the representation alone. The empirical question is which representation captures the mechanisms through which the relevant generative effects actually propagate.

The plurality also reinforces ontological suspension. Network nodes need not be ultimate entities, and fields need not be literal physical fields. Both are representational devices whose adequacy depends on what they permit researchers to observe, explain, predict, or intervene upon.

3.19.7 Scalar and Non-Scalar Value Representations

Value presents a particularly consequential case of internal pluralism. Some economic questions require scalar representation. Prices, costs, quantities, income, expected returns, or index values can support comparison, optimization, aggregation, and accounting. Other forms of value resist stable reduction to one dimension because they involve heterogeneous goods, rights, relationships, capabilities, ecological conditions, meanings, or obligations whose trade-offs are context-dependent or

normatively contested.

GRE therefore permits scalar and non-scalar representations of value. The choice must be justified by the evaluative task. A scalar representation can be useful when a common unit is institutionally established, empirically meaningful, and relevant to the question. It becomes misleading when the numerical scale hides changes in what is being valued, who has authority to define the conversion, or which losses cannot be represented adequately by the chosen unit.

Non-scalar representation can preserve plurality through vectors, partial orderings, categorical distinctions, threshold conditions, lexicographic priorities, narrative evaluation, or explicit statements of incommensurability. Such representations do not eliminate the need for decisions. Institutions frequently must act even when values cannot be reduced to a common metric. The analytical task is to distinguish practical commensuration from demonstrated commensurability and to make visible who establishes the conversion rules.

Competing value representations can lead to different judgments about the same intervention. A project may generate positive monetary returns while degrading ecological resilience, increasing dependency, or reducing future option sets. A multidimensional representation can reveal this divergence. Conversely, retaining every value dimension without prioritization can make decision procedures indeterminate. GRE therefore treats value representation as part of the problem rather than assuming that either scalarization or irreducible plurality is universally preferable.

Comparison among value representations should examine what each includes, excludes, weights, converts, and renders visible. It should also ask how the representation itself affects institutional action. An indicator that becomes a target can reorganize behavior; a price can alter the relation it measures; a ranking can generate new incentives and subject positions. Value representation is therefore both epistemic and potentially generative.

3.19.8 Competing Accounts of Generativity

Generativity is the organizing concept most likely to produce internal theoretical disagreement within GRE. The term can refer to several related but distinct phenomena: production of downstream capacities, emergence of new entities or relations, transformation of subject positions, expansion or contraction of future possibilities, creation of new value forms, alteration of institutional pathways, or modification of the effective rules through which later change occurs. These processes can coexist, but they should not be treated as interchangeable by definition.

One account of generativity may emphasize the creation of capacities. Another may focus on the reproduction and transformation of relational structures. A third may treat generativity primarily as alteration of future possibility spaces. A fourth may emphasize recursive change in the mechanisms that produce subsequent outcomes. GRE should allow these accounts to compete because their differences can clarify what exactly is claimed to be generated.

Competing accounts should state their unit of analysis, temporal horizon, baseline, mechanism, and observable consequences. A claim that a relation generates capa-

bility requires evidence different from a claim that it generates institutional persistence. A claim that an intervention expands future possibility requires a specification of whose possibilities, over what horizon, under which constraints, and relative to which counterfactual or historical baseline. A claim that a rule transforms its own conditions of reproduction requires evidence beyond ordinary downstream effects.

The programme should also permit the possibility that generativity is not a single natural kind. Different domains may contain several mechanisms that share a family resemblance but cannot be reduced to one formal definition. In that case, cumulative research should develop a typology of generative mechanisms rather than force premature unification. Conversely, if apparently different mechanisms can be shown to instantiate a common structure, theory can become more parsimonious.

Internal competition around generativity is therefore desirable when it increases discriminability. A successful formulation should make it easier to determine when a process is merely productive, causal, adaptive, or reproductive and when a stronger generative claim is warranted. The concept becomes weaker when it absorbs every form of change and stronger when competing accounts specify different empirical commitments.

3.19.9 Productive Disagreement

A plural research programme depends on disagreement that can change what researchers subsequently do. Productive disagreement is therefore more demanding than the coexistence of opinions. It requires disagreement to be localized sufficiently that evidence, argument, or comparison can alter the standing of competing claims.

Researchers can disagree about concepts, boundaries, mechanisms, measurements, formal representations, empirical generalization, normative premises, or intervention implications. These forms of disagreement should be distinguished because they require different responses. A definitional disagreement may be resolved through conceptual clarification. A measurement disagreement requires validity evidence. A mechanism disagreement may require process tracing, experiments, comparative cases, or temporal data. A normative disagreement may persist even after empirical questions are settled because the disagreement concerns values or justificatory principles.

Productive disagreement also requires preserving losing formulations long enough to understand why they failed. If a model is rejected because its mechanism does not fit observed timing, that reason should become part of programme memory. If a concept is narrowed because it collapsed several distinct phenomena, the earlier broader usage should remain traceable. If two formulations apply at different scales, the outcome is not necessarily victory of one over the other but clarification of boundary conditions.

Disagreement becomes unproductive when formulations shift whenever evidence challenges them, when different vocabularies hide identical claims, when claims are insulated from possible counterevidence, or when normative and empirical disagreements are repeatedly confused. A plural programme therefore needs conventions for making commitments explicit enough that revision is possible.

The social organization of disagreement also matters. Dominant institutions, disciplines, languages, data infrastructures, or publication norms can determine which formulations are visible enough to be contested. GRE's own commitment to pluralism therefore includes attention to the conditions under which alternative formulations can enter the research programme. Inclusion of alternatives, however, does not suspend standards of evidence or argument. Productive pluralism widens the space of contestation while preserving the possibility of criticism.

3.19.10 Conditions for Theory Comparison

Internal pluralism becomes cumulative only when competing formulations can be compared under explicit conditions. Theory comparison in GRE should therefore begin by determining whether the formulations address the same object, scale, temporal horizon, and inferential target. Apparent disagreement can disappear once researchers recognize that one theory describes short-run adjustment while another describes long-run institutional transformation, or that one concerns individual behavior while another concerns field-level conditions.

Where the targets overlap, comparison should examine at least six dimensions: conceptual clarity, empirical scope, mechanism specification, evidential support, representational cost, and capacity for revision. Conceptual clarity concerns whether the theory distinguishes its principal objects and mechanisms from neighboring concepts. Empirical scope concerns the domains and boundary conditions within which the theory is expected to apply. Mechanism specification concerns what processes connect conditions to outcomes. Evidential support concerns whether available observations discriminate the theory from alternatives. Representational cost concerns the assumptions, data, computation, and abstraction required to use the formulation. Capacity for revision concerns whether failure can lead to identifiable modification rather than indefinite accommodation.

Predictive accuracy can be important but should not become the sole criterion. Some GRE problems concern historical explanation, interpretation, institutional constitution, normative evaluation, or intervention design where prediction is only one dimension of adequacy. Conversely, conceptual richness should not excuse a formulation from empirical consequences when it makes empirical claims. The criteria for comparison should therefore track the kind of contribution being evaluated.

Theories can also be compared by their generative usefulness for further research. A formulation can be valuable because it produces new measurable distinctions, suggests discriminating cases, clarifies a previously vague mechanism, or exposes a class of interventions whose consequences can be studied. Such usefulness does not establish truth, but it can justify continued investigation when direct adjudication remains incomplete.

Some competing formulations may remain partially incommensurable because they begin from different objects, values, or explanatory purposes. GRE should not manufacture a single ranking when the comparison lacks a common criterion. It should instead identify the dimensions on which comparison is possible and preserve the residual disagreement. Partial comparability is preferable to either false unification or premature declaration of complete incommensurability.

The constitutional role of internal pluralism can therefore be stated compactly. GRE should remain open to multiple formulations while requiring each formulation to expose enough of its objects, assumptions, mechanisms, evidence, values, and failure conditions to permit criticism. Pluralism protects the programme from premature closure; theory comparison protects it from indiscriminate accumulation. Together they allow disagreement to become part of cumulative inquiry.

The existence of a plural and revisable research programme also means that several difficult questions remain unresolved even after its disciplinary constitution has been specified. The following section turns from the permitted diversity of formulations to the substantive open problems that future GRE research must address.

3.20 Open Problems

The preceding sections have specified the preliminary identity, objects, scales, modes of inquiry, epistemic commitments, praxis, normative interfaces, contribution standards, cumulative structure, and internal pluralism of Generative Relational Economics. A research programme becomes more credible, however, when its unresolved problems are stated with comparable precision. The role of this section is therefore to identify several problems that remain open after the current constitution of GRE has been articulated. Its objective is neither to close those problems through definition nor to convert uncertainty into a rhetorical virtue. The aim is to distinguish questions for which GRE already has an analytical vocabulary from questions for which the mechanisms, measurements, evidential strategies, or normative criteria remain materially underdeveloped.

The open problems considered here concern identification, attribution, measurement, boundary selection, changing transformation rules, heterogeneous value, justice, symbolic reification, governance under persistent asymmetry, and long-horizon evaluation. These problems are connected, but they should not be collapsed. Better identification of a generative relation does not by itself solve downstream value attribution. A useful indicator of generativity does not establish normative desirability. A formally specified transformation rule does not guarantee that the relevant rule remains stable through the period being studied. A governance mechanism that mitigates one asymmetry can create another. The purpose of separating the problems is therefore to make future progress discriminable.

Open problems also differ in the kind of resolution they permit. Some may yield to better data, identification strategies, historical reconstruction, or formal representation. Others arise because economic relations are reflexive, boundaries are purpose-dependent, values are only partially comparable, and future possibilities cannot be observed before they are realized. GRE should therefore allow for the possibility that some uncertainty can be reduced while other uncertainty remains structural to the object of inquiry. A mature research programme needs both ambitions: to improve what can be known and to specify what remains underdetermined.

3.20.1 Identification of Generative Relations

The first open problem concerns the identification of generative relations. GRE frequently asks whether a relation contributes to the production of later capacities, institutions, subject positions, value forms, or conditions of possibility. Such claims are stronger than statements that two variables covary or that one event precedes another. They also exceed the observation that a relation participates in ordinary causal production. A relation becomes generatively relevant when its operation changes what can subsequently be produced, sustained, accessed, recognized, or transformed. The empirical difficulty lies in demonstrating that stronger claim.

Identification requires a specification of the relation, the object said to be generated, the time horizon over which generation occurs, and the mechanism that connects them. These elements can be difficult to observe simultaneously. Some relations operate through repeated interaction rather than singular events. Some produce latent capacities that become visible only when later conditions activate them. Some operate through institutional recognition or symbolic classification rather than directly observable material transfer. Some are distributed across several actors or infrastructures, making bilateral attribution misleading.

A further difficulty is that generative relations may be constitutive rather than merely productive. A worker's access to a professional network, for example, can affect opportunities while also contributing to the formation of recognized expertise, identity, or standing. A credit relation can transfer purchasing capacity while simultaneously generating dependency, reputational records, or future exclusion. In such cases the relation changes properties of the participating subjects and the environment in which later action occurs. Identification must therefore distinguish immediate output from transformation of later possibility.

Progress on this problem will require multiple forms of evidence. Longitudinal observation can reveal whether capacities persist beyond the originating relation. Comparative cases can test whether similar relational configurations produce similar downstream structures under different contexts. Process tracing can identify intermediate mechanisms. Experiments or quasi-experiments can help isolate particular pathways when intervention is possible. Formal or computational models can clarify what observations would discriminate generative mechanisms from ordinary transmission. Interpretive evidence can be necessary when generation operates through meaning, recognition, or institutional classification.

No single identification strategy is likely to cover the full range of GRE objects. The open task is therefore to develop a disciplined family of identification standards. Such standards should make it possible to distinguish a plausible generative hypothesis from a demonstrated mechanism, and a demonstrated local mechanism from a general claim about generativity across contexts.

3.20.2 Attribution of Downstream Value

A second open problem concerns attribution once value has propagated beyond an initial relation or intervention. Economic processes commonly produce effects through chains of mediation. Training can alter later employment, organizational

practice, peer learning, and household security. Infrastructure can generate uses that were not anticipated by its designers. Knowledge can be recombined by actors distant from its original producer. Institutional reforms can change incentives, expectations, classifications, and later policy capacities. GRE needs ways to analyze such downstream value without converting every remote benefit into a claim of credit for the initial source.

Attribution becomes difficult because downstream effects are usually co-produced. Later value can depend on complementary resources, independent decisions, institutional environments, accumulated knowledge, ecological conditions, and subsequent interventions. A generative relation can be necessary without being sufficient. It can raise the probability of an outcome without determining it. It can create an enabling condition whose significance varies strongly across contexts. A later actor can transform an inherited resource so substantially that simple origin-based attribution becomes conceptually misleading.

The problem therefore has at least three dimensions. Causal attribution asks whether the earlier relation materially contributed to the later outcome. generative attribution asks whether it altered the conditions from which later value could emerge. Distributive attribution asks how recognition, return, responsibility, or claims on value should be allocated among contributors. These dimensions should remain distinct because evidence for causal contribution does not settle the distributive question, and normative entitlement cannot be inferred directly from causal ancestry.

Future GRE work requires methods for tracing contribution without assuming additive decomposition. In some domains, contribution analysis may be approximately scalar. In others, interaction effects, complementarities, threshold behavior, or non-substitutable roles make scalar shares unstable or arbitrary. Network and process representations may help locate pathways without requiring a single attribution percentage. Counterfactual analysis can identify whether a contribution changed the set of feasible trajectories. Historical reconstruction can reveal how later actors transformed inherited conditions.

The objective should therefore be calibrated attribution. GRE should become better at saying that an upstream relation enabled, constrained, amplified, redirected, or conditioned later value while preserving uncertainty about the exact share attributable to that relation. Such calibrated language is important both for explanation and for later questions of return, compensation, responsibility, and justice.

3.20.3 Measurement of Generativity

The measurement of generativity presents a related but distinct problem. The concept is attractive because it directs attention toward effects on later productive and transformative possibilities. Yet the concept can become analytically weak if every beneficial downstream effect is redescribed as generativity. Measurement therefore requires a more discriminating account of what is being measured and at which scale.

Several candidate dimensions are possible. One study may measure new capabilities acquired by participants. Another may measure the diversity of subsequent activities enabled by an intervention. A third may examine persistence of effects after

direct support ends. A fourth may study whether new actors can enter a domain, whether dependence on a central provider declines, or whether local reproduction becomes possible. A fifth may examine changes in the range of feasible future states. These measures capture different aspects of generativity and should not automatically be aggregated.

The temporal horizon also changes the result. An intervention can generate high short-run activity while degrading future ecological or institutional capacity. Another can impose substantial near-term cost while creating durable infrastructure or knowledge. A third can generate options that remain unused for years. Measurement therefore requires explicit time horizons and, where possible, sensitivity to delayed activation and depreciation.

Baseline selection is equally important. Generativity can be expressed relative to a prior state, a plausible counterfactual, an alternative intervention, or a historically available possibility set. These baselines answer different questions. A project can be generative relative to local past conditions while remaining less generative than another feasible arrangement. A technology can expand one actor's possibilities while narrowing those of another. A scalar score that suppresses these distinctions can obscure more than it reveals.

GRE should therefore resist the premature construction of a universal generativity index. The more promising direction is a family of measures tied to explicit objects: capability generation, institutional reproduction, option expansion, relational diversification, knowledge recombination, ecological regeneration, or transformation of future constraints. Some domains may support quantitative indicators; others may require ordinal, categorical, historical, or qualitative evidence.

The open problem is to determine when these heterogeneous measures can be compared and when they should remain separate. Measurement should increase discriminability while preserving the multidimensional character of generation. A measure becomes useful when it makes a claim more testable or comparable, not merely when it assigns a number to a concept.

3.20.4 Relational Boundary Selection

Every relational analysis requires a boundary, yet the boundary can materially determine the result. A firm can be analyzed through internal employment relations, supply chains, financial dependencies, legal institutions, ecological inputs, community effects, or global infrastructures. A household can be treated as a unit or decomposed into members with different resources, vulnerabilities, and bargaining positions. A platform can be bounded by formal ownership or expanded to include complementors, users, data providers, moderators, advertisers, and regulatory institutions. Each choice creates a different relational object.

Boundary selection is therefore more than a technical preprocessing decision. It affects which mechanisms are visible, which costs are externalized, which subjects count as participants, and which downstream effects are attributed to the focal process. A narrow boundary can produce apparent efficiency by excluding displaced burdens. An excessively broad boundary can make explanation indeterminate by treating nearly everything as part of the system.

GRE currently has principles that help discipline boundary choice: explicit scale selection, ontological suspension, claim-relative objecthood, and attention to downstream effects. These principles do not yet provide a general procedure for deciding how far a relational analysis should extend. The appropriate boundary depends on the claim. A study of contractual propagation may require one boundary; a study of ecological regeneration may require another; a study of institutional recognition may require several overlapping boundaries.

One direction for future work is sensitivity analysis across relational boundaries. Researchers can ask whether the principal inference changes when adjacent actors, longer time horizons, or additional infrastructures are included. Another direction is boundary justification through mechanism: include relations that participate materially in the mechanism under investigation and distinguish them from contextual conditions whose role is secondary. A third is normative boundary review, especially where exclusion from the analytical boundary also removes affected populations from evaluation.

The deeper problem is that boundaries can themselves be generated and contested. Legal categories, accounting rules, administrative jurisdictions, platform architectures, and disciplinary conventions determine what appears internal or external. GRE therefore needs methods for studying boundary formation while still selecting workable boundaries for empirical research. This is an inherently reflexive task: the researcher must construct a boundary without mistaking that construction for a natural edge of the economic world.

3.20.5 Dynamics of Changing Transformation Rules

GRE places particular emphasis on situations in which the effective mechanisms of change are themselves transformed. This possibility is analytically important because many models assume that states change under a rule that remains sufficiently stable for the period of analysis. Economic history repeatedly presents harder cases: technologies alter feasible production processes, institutions modify incentives and classifications, learning changes decision procedures, political settlements alter property and authority, and adaptive systems modify the relations through which later adaptation occurs.

The open problem is empirical representation of these changing transformation rules. It is relatively straightforward to estimate changing states under a fixed model. It is harder to determine whether parameter drift is sufficient, whether the structure of interaction has changed, whether new variables have become relevant, or whether the model class itself must be revised. A sudden forecasting failure can indicate structural transformation, measurement change, omitted context, or ordinary stochastic variation. The observation alone does not identify rule change.

Different forms of rule transformation should therefore be distinguished. Parameters can change while the functional structure remains stable. Network topology can evolve while node types remain fixed. Agents can learn and alter local decision rules. Institutions can redefine available actions or recognized categories. New technologies can introduce previously unavailable operations. Symbolic changes can alter how subjects interpret the same formal option. More radical transformation can

make earlier state variables inadequate because the kinds of economically relevant entities have changed.

Future GRE work requires diagnostics for these levels. Change-point methods, time-varying parameter models, adaptive networks, institutional process tracing, computational learning models, and historical comparison can each contribute. None should be treated as a universal representation. The important question is what evidence warrants movement from a claim of state change to a claim of structural change, and from structural change to transformation of the effective rule of change.

This problem also concerns anticipation. If governance relies on models whose rules can change in response to the intervention itself, policy evaluation becomes recursively difficult. Agents can adapt to incentives, classifications, metrics, and regulatory thresholds. Institutions can learn from being measured. Artificial systems can modify decision environments at high speed. GRE therefore needs forms of intervention design that monitor the stability of the assumed transformation rule rather than merely updating parameter estimates within it.

3.20.6 Heterogeneous Value Comparison

GRE's commitment to heterogeneous value creates an unresolved problem of comparison. Economic decisions frequently require choices among outcomes expressed through different value languages: income, time, health, dignity, ecological integrity, autonomy, knowledge, cultural continuity, security, care, or future option value. Practical governance cannot always defer choice until a complete theory of commensurability is available. Yet forcing these values into a single metric can erase the distinctions that motivated plural evaluation in the first place.

The problem is therefore to determine which forms of comparison are legitimate under partial commensurability. Some values may be monetizable for a specific administrative purpose while retaining dimensions not captured by price. Some can be ordered ordinally without meaningful cardinal distances. Some can be compared only within a domain. Some are subject to thresholds or rights that constrain trade-offs. Some are held by different subjects whose evaluative frameworks do not share a common scale.

GRE needs a vocabulary for these cases because generative effects often cross value domains. A policy can increase income while reducing ecological resilience. A technology can increase productivity while weakening autonomy or interpretive control. An institution can expand access for one population while eroding cultural continuity for another. The analytical challenge is to preserve these transformations without treating every trade-off as either fully aggregable or completely incomparable.

Several approaches are available for future development: vector-valued representation, partial ordering, threshold constraints, lexicographic priorities, multi-criteria analysis, deliberative comparison, qualitative matrices, and domain-specific indicators. Each imposes assumptions. The important task is to state those assumptions and to distinguish practical decision procedures from claims about underlying value equivalence.

Comparison also has a political dimension. Institutions that control the conversion interface between value forms can determine which values become legible enough to enter allocation decisions. Measurement systems, accounting rules, markets, legal standards, and algorithmic ranking can all privilege particular value representations. GRE should therefore study value comparison both as an analytical problem and as an object of economic power.

The open problem is not to eliminate heterogeneity. It is to make decision-relevant comparison possible while preserving residual differences that remain normatively or empirically meaningful.

3.20.7 Generativity and Justice

Generativity and justice intersect without being identical. An arrangement can generate substantial new capacity while distributing access, control, risk, or return unjustly. A restrictive intervention can reduce some forms of generation while protecting vulnerable subjects or preserving future ecological conditions. A relation can be locally reciprocal while depending on historical structures that shape who possesses the capacity to participate. GRE therefore needs a more developed account of how generative analysis and theories of justice constrain, inform, and revise one another.

One unresolved issue concerns the object of justice. Evaluation can focus on resources, capabilities, recognition, participation, relations, procedures, generated opportunities, or future conditions of generation. These objects can point in different directions. Equal resource distribution can coexist with unequal conversion capacities. Broad participation can coexist with domination inside the participatory process. Expansion of future possibilities for one group can depend on ecological or social foreclosure for another.

A second issue concerns temporal distribution. Generative interventions often move value across time. Present actors can bear costs that create future capacities, while future actors can inherit both benefits and constraints without having participated in the original decision. Justice therefore requires attention to who pays for generation, who controls the generated capacity, who receives later return, and who inherits the risks of failure or lock-in.

A third issue concerns agency and authorship. When value is co-produced through distributed relations, justice cannot rely only on a simple producer-recipient distinction. Contributors can include maintainers, caregivers, communities, infrastructures, knowledge traditions, ecosystems, and future institutions. Attribution uncertainty makes distributive claims more difficult but does not remove the normative problem.

GREthic provides a neighboring domain for deeper normative theory, while GRE retains responsibility for describing the economic relations through which capacities, dependencies, returns, and foreclosures are produced. The open problem is to build interfaces between these domains without allowing normative vocabulary to substitute for economic mechanism or economic description to settle normative judgment automatically.

Progress will likely require multiple justice criteria rather than a single principle centered on generativity. Generativity can become one object of justice—especially

where institutions systematically capture others' capacity to generate—but justice also constrains which forms of generation are permissible and how risks, participation, recognition, and future possibilities should be distributed.

3.20.8 Symbolic Reification

GRE relies heavily on analytical concepts such as relation, field, subject, capability, generativity, value, constraint, and possibility. These concepts are necessary for inquiry, yet repeated use can create symbolic reification: a representation introduced to organize observation begins to be treated as if it were the stable object itself. This problem is especially significant for a programme that explicitly distinguishes relations from their representations.

Reification can occur through ordinary scholarly language. A network diagram can encourage researchers to treat nodes as naturally bounded entities even when the nodes are administrative constructions. A capability measure can become identified with capability itself. A field representation can be spoken of as if the measured scalar were literally the distributed social condition. A generativity score can transform a multidimensional hypothesis into an apparently objective property. Institutional categories can become research variables and then return to practice with the authority of scientific classification.

The danger increases when representations become operational. Metrics influence funding, rankings, eligibility, regulation, and organizational behavior. Models can therefore participate in generating the reality they purport to describe. Subjects adapt to categories, optimize against indicators, and reorganize behavior around algorithmic classifications. A representation can acquire causal power through institutional uptake without becoming ontologically complete.

GRE needs practices that keep this reflexive relation visible. Researchers can document category construction, preserve alternative representations, test sensitivity to operational definitions, distinguish latent constructs from measured proxies, and monitor how measures alter behavior after institutional adoption. Historical work can show how categories change. Interpretive inquiry can reveal meanings lost in standardized representation. Formal work can state which properties are assumed rather than observed.

The open problem extends beyond avoiding conceptual error. Symbolic reification can become a mechanism of power when institutions control the categories through which subjects are recognized, evaluated, funded, or excluded. The study of representations therefore belongs within the economic analysis of generative conditions. GRE must remain capable of using symbols and models decisively while keeping open the possibility that its own categories become objects of later revision.

3.20.9 Governance under Persistent Asymmetry

Section 81 treated asymmetry as a durable feature of many economic relations and distinguished it from power. The open governance problem begins where complete equalization is unavailable, undesirable, or itself generative of new dependencies. Differences in expertise, capital, institutional authority, computational

capability, ecological exposure, time horizon, or exit capacity can persist even under well-designed institutions. Governance must therefore operate in conditions where symmetry cannot be treated as the endpoint.

One challenge is preventing asymmetry from becoming unreviewable domination. Transparency, contestability, exit, representation, auditing, countervailing institutions, liability, redistribution, and public infrastructure can each constrain conversion of asymmetry into power. Their effectiveness depends on context. Transparency is weak where subjects lack capacity to interpret information. Exit is weak where alternatives are costly or unavailable. Counter-power can create another concentration. Redistribution can reduce resource asymmetry while leaving institutional or epistemic asymmetry intact.

A second challenge concerns dynamic asymmetry. Capabilities change at different speeds. Artificial systems, financial institutions, states, and large platforms can update or coordinate more rapidly than individuals or local communities. Governance mechanisms designed for a slower environment can become ineffective before formal rules change. Persistent asymmetry is therefore partly temporal: the ability to learn, respond, litigate, coordinate, or revise can itself be unequally distributed.

A third challenge concerns productive asymmetry. Some differentiation enables specialization, expertise, delegation, and coordination. Governance that attempts to eliminate every asymmetry can destroy useful capacities or impose high administrative cost. GRE therefore requires criteria for distinguishing asymmetries that are functionally productive from asymmetries that generate dependency, exclusion, capture, or foreclosure. The distinction is empirical and normative rather than definitional.

Future work should compare governance architectures by how they affect conversion mechanisms. Which institutions prevent expertise from becoming unaccountable authority? Which infrastructures reduce dependence without eliminating specialization? Which rights preserve contestability when exit is impossible? Which forms of public or cooperative capacity alter bargaining structure? Which monitoring systems remain revisable when the powerful actors being monitored can adapt strategically?

The open problem is governance that remains effective under durable difference. GRE should study how relations can remain productive and heterogeneous while limiting the recursive accumulation of asymmetry into structures that remove others' capacity to participate, contest, exit, or generate alternatives.

3.20.10 Long-Horizon and Intergenerational Evaluation

The final open problem concerns effects that extend beyond ordinary observational and political horizons. Generative analysis often directs attention toward future capacities, institutional trajectories, ecological conditions, knowledge infrastructures, and path-dependent constraints. These objects can persist for decades or generations. Evaluation therefore faces a fundamental difficulty: the most important consequences may occur after the period in which evidence can be directly collected or the relevant decision-makers remain accountable.

Long-horizon evaluation raises familiar forecasting problems and additional generative-relational problems. Future subjects may possess different preferences, technologies, institutions, vulnerabilities, and value languages. Interventions can change the categories through which later outcomes are evaluated. The relevant counterfactual can also evolve. A policy that appears option-expanding under present technology can become restrictive under a later technological regime, while an apparently conservative intervention can preserve ecological or institutional capacities whose future uses are presently unknown.

Discounting provides one way to compare temporally separated effects, but discount rates encode substantive assumptions and cannot resolve all intergenerational questions. Some future losses concern irreversible ecological damage, destroyed knowledge, institutional lock-in, or loss of option-generating capacity. These may be poorly represented as ordinary delayed consumption effects. GRE therefore needs temporal representations that distinguish delayed value from changes in the capacity to generate future value.

Uncertainty compounds the problem. Forecast distributions may widen with horizon; structural transformation can invalidate the model generating those distributions; unknown future innovations can alter feasible trajectories; and future actors cannot participate directly in present deliberation. Evaluation must therefore combine prediction with robustness, precaution, reversibility, preservation of options, and explicit treatment of model uncertainty. Different domains will justify different combinations.

Intergenerational analysis also requires attention to inheritance. Future subjects inherit infrastructure, institutions, debts, ecological conditions, knowledge, classifications, and unresolved conflicts. These inheritances shape both their opportunities and the costs of changing course. A generative intervention should therefore be evaluated partly by what kinds of revision it leaves possible for those who come later.

This problem may retain irreducible uncertainty. Future possibility spaces cannot be observed in full, and the values through which future actors judge inherited conditions cannot be completely known. GRE should not treat this uncertainty as a reason to ignore long horizons. It should instead make the uncertainty explicit and examine which interventions preserve enough diversity, reversibility, capacity, and institutional corrigibility to support later adaptation and re-evaluation.

The ten problems in this section define a research frontier rather than a list of defects awaiting simple repair. Some require better measurement and identification; some require new formal or empirical methods; some concern interfaces with normative theory; and some arise from reflexivity, historical change, and the openness of future possibility. Progress in one area can also alter another. Better generativity measures can intensify symbolic reification if their institutional use is poorly governed. Broader relational boundaries can improve downstream attribution while increasing uncertainty. Stronger governance of asymmetry can change the mechanisms whose effects were initially being measured.

GRE should therefore preserve open problems as active components of its cumulative research programme. An unresolved question becomes productive when competing formulations, evidence, failed approaches, and revisions remain trace-

able. The next section turns from these substantive open problems to the architecture through which the wider GRE programme can organize their investigation across epistemology, methodology, praxis, formalization, governance, knowledge, artificial intelligence, and domain-specific applications.

3.21 Architecture of the GRE Research Programme

The preceding sections have specified the provisional identity, problem-space, objects, scales, modes of inquiry, epistemic commitments, praxis, normative interfaces, contribution criteria, internal pluralism, and open problems of Generative Relational Economics. The role of the present section is different. It organizes those commitments into a research architecture that can support the remainder of the book and, more importantly, a cumulative programme extending beyond this book. Its objective is to identify the principal domains of work that GRE requires, clarify their relations, and show how movement among them can remain coordinated without collapsing them into one method, one ontology, or one normative theory. The architecture is therefore neither a linear sequence nor a departmental division of labor. It is a set of connected research components whose outputs can constrain, revise, or redirect one another.

The programme can be understood as having several recurrent movements. Epistemological work asks what kinds of relational and generative claims can be warranted. Methodological work develops procedures for observing, reconstructing, comparing, and testing those claims. Praxis links explanation to intervention under incomplete knowledge. Substantive economic work specifies economic objects, allocation processes, value trajectories, temporal organization, power, knowledge, artificial intelligence, and domain-specific mechanisms. Formal work provides representations that can clarify structure or generate implications without acquiring automatic ontological priority. Normative and governance work evaluates how generated capacities, dependencies, harms, and possibilities should be judged and governed. None of these components is sufficient by itself. Their interaction is what gives GRE the possibility of becoming a research programme rather than a vocabulary.

This architecture also gives the later chapters a disciplined relation to Chapter 3. The chapters that follow do not merely expand terms introduced here. They test whether the constitutional claims made in Part I can survive more demanding epistemic, methodological, formal, substantive, and applied development. A concept that proves unusable under empirical inquiry should be revised. A formal representation that cannot preserve relevant historical or interpretive distinctions should be limited. A normative framework that obscures economic mechanisms should not replace explanation. An intervention methodology that generates unanticipated dependency should feed back into the theory of power and praxis. The architecture is therefore recursive: later work is expected to modify the preliminary constitution from which it begins.

3.21.1 Epistemology of Relations

A GRE research programme requires an epistemology capable of supporting claims about relations without assuming that relations are directly given to observation. Economic inquiry usually encounters traces: transactions, documents, prices, classifications, narratives, institutional records, behavioral responses, network data, legal categories, measurements, and model outputs. From such traces, researchers infer relations of dependence, recognition, exchange, authority, mediation, constraint, influence, and generation. The first architectural component therefore concerns the conditions under which these inferences are warranted.

The epistemology of relations must keep at least four layers distinguishable. There is the relation or relational process posited as part of the target situation; there are the observations through which researchers gain partial access to it; there are the categories and representations used to organize those observations; and there are the claims made on the basis of those representations. Confusion among these layers produces many characteristic errors. A network edge can be mistaken for the relation itself. A legal category can be treated as a complete description of social participation. A repeated correlation can be interpreted as a stable generative relation even where the mechanism changes historically. GRE therefore requires explicit accounts of how observations become relational claims.

This epistemic component also has to accommodate different kinds of relational evidence. Some relations are materially instantiated through contracts, infrastructures, ownership, payment, or legal authority. Others are reconstructed from repeated interaction, dependence, interpretation, or institutional practice. Still others concern counterfactual or generative effects that cannot be observed directly because they refer to capacities, alternatives, or future conditions. Evidence sufficient for one kind of relation may be inadequate for another. The programme should therefore resist a single criterion of relational observability.

Epistemology of relations also includes reflexivity. Economic categories can alter the relations they represent. Credit scores change access to credit; rankings alter institutional behavior; classifications determine eligibility; models influence expectations; and public descriptions can reshape coordination. The object of knowledge can therefore respond to the means of knowing. This makes epistemology an economic problem as well as a philosophical one. The programme must study how knowledge practices participate in the relational field whose properties they attempt to establish.

The output of this component is not a final theory of knowledge. It is a set of standards for relational claims: how objects are identified, how boundaries are selected, how observations are linked to relations, how representations are validated, how uncertainty is expressed, and how claims remain open to correction. Those standards provide the epistemic ground on which the methodological components of the programme operate.

3.21.2 Methodology of Relational Inquiry

Relational methodology concerns procedures for studying configurations in which the properties or effects of an object depend materially on its relations with other ob-

jects, institutions, environments, or representations. Its central task is to move analysis beyond isolated-unit description without treating every connection as equally significant. A relational study must identify which relations matter, how they are evidenced, what scale they operate at, and which consequences follow from their organization.

The methodological repertoire is necessarily plural. Historical reconstruction can identify how a relation formed and changed. Comparative inquiry can examine why similar entities occupy different relational positions. Network analysis can represent patterned connectivity. Institutional analysis can identify rules that stabilize or authorize relations. Ethnographic and interpretive work can reconstruct how participants understand obligations, identities, and meanings. Econometric and causal designs can estimate effects generated through specified relational exposures. Qualitative process tracing can examine mechanisms that are difficult to reduce to stable variables. None of these methods is intrinsically more relational merely because of its technique. Relationality enters through the structure of the research question and the specification of the object.

A developed relational methodology should make boundary construction explicit. Researchers need criteria for deciding which actors, institutions, ecological conditions, infrastructures, classifications, and temporal histories belong inside the analysis. Because boundaries are analytical choices with substantive consequences, sensitivity to alternative boundaries should become part of methodological practice where feasible. The same transaction can look efficient within a firm boundary and extractive within a regional labor system; a technological intervention can look productive over one year and capability-destroying over a decade.

Relational inquiry also needs procedures for distinguishing direct from mediated effects. Economic outcomes often travel through chains of institutions, expectations, infrastructures, and social recognition. A transfer to one subject can alter bargaining conditions for another; a platform rule can change incentives through ranking systems; a legal reform can transform behavior through expectations before enforcement occurs. Methodological work must therefore support the reconstruction of mediation rather than stopping at the administrative point of intervention.

The programme should accumulate relational methods through reusable design patterns rather than prescribe one canonical protocol. Useful patterns may concern boundary selection, multi-source evidence, relation typing, temporal reconstruction, counterfactual comparison, cross-scale mapping, or identification of institutional mediation. These patterns become a methodological library that later studies can adapt while preserving transparent assumptions and limits.

3.21.3 Methodology of Generative Relational Inquiry

Generative relational inquiry adds a further question to relational analysis: what later capacities, structures, values, subjects, constraints, or possibilities are produced through a relation, and through what mechanism? This shift changes both the temporal horizon and the object of explanation. The researcher is no longer concerned only with what a relation currently connects or distributes. The inquiry follows how participation in the relation changes the conditions from which subsequent economic

processes can occur.

This methodological component therefore requires explicit generative claims. A study should state what is alleged to be generated, over what period, for which subjects or systems, and through which mediating process. Generation may concern skills, trust, dependency, infrastructure, market access, organizational capacity, knowledge, subject positions, ecological resilience, future options, institutional lock-in, or the capacity to generate further value. These are heterogeneous objects, so no single metric can stand in for generativity across domains.

Generative inquiry also requires attention to counterfactual trajectories. The relevant comparison is frequently not simply between treated and untreated units at one time. It may concern how different relational configurations alter later pathways. This creates methodological difficulty because the treatment can change the variables, categories, or institutional environment through which later outcomes are measured. Longitudinal designs, historical comparison, mechanism-based simulation, qualitative reconstruction, and adaptive experimentation may therefore complement conventional causal identification.

A further methodological problem concerns recursion. Generated capacities can alter the relation that generated them. New knowledge changes bargaining power; institutional learning changes governance; accumulated infrastructure shifts future allocation; successful coordination changes expectations; artificial systems can alter the speed and scale of subsequent production. Generative relational methodology must be capable of tracing such feedback without assuming that the original mechanism remains fixed.

The programme should therefore develop a family of generative research designs rather than one universal method. Their common requirement is disciplined movement from relation to mechanism to generated consequence to altered future condition. Where the chain cannot be established, the study should say so. Where several mechanisms remain plausible, competing explanations should remain visible. This methodological restraint protects generativity from becoming an all-purpose label for any downstream change.

3.21.4 Praxis and Intervention

Praxis connects GRE's explanatory programme to purposive attempts to alter economic relations. The architectural function of praxis is to prevent theory from ending at diagnosis while also preventing intervention from outrunning knowledge. GRE therefore treats intervention as an iterative research and governance process in which action generates new evidence, changes the relational field, and may require revision of both the intervention and the theory that justified it.

A GRE praxis architecture begins with relational and generative diagnosis. The analyst identifies the relevant subjects, institutions, dependencies, constraints, capacities, value trajectories, and asymmetries. Intervention design then specifies which relation or enabling condition is to be changed, what effects are expected, which subjects may bear risks, and what indicators or qualitative observations can reveal downstream consequences. Implementation becomes part of inquiry because it tests assumptions under conditions that may differ from those represented in the initial

model.

Adaptive feedback is therefore central. Interventions should include monitoring capable of detecting effects beyond the intended recipient, changes in dependency, emergent exclusion, shifts in power, unexpected conversions of value, and damage to future options. Revision can concern intensity, targeting, institutional design, representation, or even the original diagnosis. Where harm or failure becomes sufficiently probable, withdrawal, reversal, and repair need to remain available.

Praxis also requires institutional design for learning. Organizations often collect data for accountability but not for theoretical correction. GRE would instead treat intervention records, failed mechanisms, participant interpretations, unexpected effects, and reversal attempts as cumulative research materials. This creates a bridge between application-dominant work and research-dominant work. Interventions become sites in which the adequacy of relational and generative hypotheses can be examined.

The praxis component does not imply that every GRE project must intervene. It specifies the architecture required when explanation is translated into action. Its standards are proportional to stakes and uncertainty. The more irreversible, asymmetric, or long-horizon the intervention, the stronger the need for monitoring, contestability, staged implementation, reversibility, and repair capacity.

3.21.5 Economic Objects and Relational Architecture

Substantive GRE begins by reconstructing the architecture of economic objects. Firms, households, platforms, markets, contracts, currencies, technologies, infrastructures, public agencies, communities, and ecological systems can all function as economic objects, but their economic significance depends on relations that constitute access, authority, dependence, recognition, exchange, coordination, and reproduction. The programme therefore needs systematic accounts of how economic objects are stabilized and connected.

Relational architecture concerns more than mapping connections. It asks which relations are constitutive, which are enabling, which are extractive, which are substitutable, and which create dependence or future capacity. It also examines how objects change when their relational architecture changes. A firm can retain a legal identity while its productive relations, knowledge base, ownership, labor dependence, and technological infrastructure transform substantially. An apparently stable object can therefore contain changing generative conditions.

This component also organizes scale. Economic architecture can be reconstructed within organizations, across supply chains, among institutions, between human and artificial subjects, or across economic and ecological systems. At one scale a platform is an entity; at another it is a field of relations among users, advertisers, workers, algorithms, legal authorities, and infrastructures. GRE should be able to move between these representations without presuming that one scale is ontologically final.

A mature programme would accumulate relational architectures comparatively. Which configurations support distributed capability? Which concentrate dependency? Which are resilient to shocks? Which permit exit and revision? Which

externalize ecological or social costs? Which generate durable learning? Comparative architectural work can provide intermediate theory between highly local case description and universal claims about markets or institutions.

This substantive component prepares several later programme domains. Allocation changes relational architecture; value moves through it; generative spacetime records its historical and temporal organization; formal models represent selected features of it; governance attempts to alter its asymmetries. Economic architecture therefore functions as a central integrative object without becoming the sole object of GRE.

3.21.6 Relational Allocation

Allocation is conventionally concerned with who receives which resources under specified constraints. GRE retains that question but expands the analytical unit. An allocation also enters a relational configuration and can change bargaining positions, dependencies, recognition, coordination capacity, expectations, and future productive possibilities. Relational allocation is the programme component that studies these mediated effects systematically.

The relevant object is therefore not merely the resource transferred. It includes the route, institutional conditions, attached obligations, timing, visibility, substitutability, and relations through which the allocation is received and used. The same monetary amount can produce different consequences depending on whether it arrives as wage, grant, debt, benefit, prize, investment, family transfer, or platform payment. The relational form can influence autonomy, stigma, risk, reciprocity, and future access even when nominal quantity is identical.

Relational allocation also widens incidence analysis. Effects can propagate beyond the administrative recipient through households, markets, organizations, networks, and institutions. A subsidy can change prices, a training programme can alter labor-market competition, a public infrastructure investment can change land values, and access to computation can reshape research capacity. GRE therefore asks which relations mediate the allocation and how those relations redistribute later opportunities or constraints.

The programme should develop both descriptive and intervention-oriented allocation research. Descriptive work can reconstruct relational incidence and downstream transformation. Formal work can model how allocation changes network positions or dynamic constraints. Comparative work can examine alternative institutional forms for delivering similar resources. Normative work can evaluate whether an allocation expands capability while generating dependency elsewhere. Application-dominant praxis can use these findings to redesign allocation mechanisms.

Relational allocation is thus a bridge between conventional economic analysis and the generative programme. It retains scarcity, incentives, incidence, and trade-offs while extending attention to how allocation changes the relational conditions under which later value and capability are generated.

3.21.7 Generative Value

Generative value concerns value that arises through the capacity of a relation, resource, institution, or process to enable further valuable activity. The concept does not replace exchange value, use value, welfare, capability, social value, ecological value, or other established categories. Its programme function is to make the production of future value-generating capacity an explicit economic object.

Generative value may appear through learning, infrastructure, trust, institutional competence, scientific knowledge, ecological restoration, network access, organizational routines, or the creation of new possibilities for participation. Its effects can be delayed, distributed, and difficult to attribute to one original intervention. The same process can generate several forms of value while also producing harm, dependence, or exclusion. The programme therefore requires plural representations rather than assuming that generative value is one scalar quantity.

Research in this component should address propagation and conversion. Value generated in one domain can move into another: knowledge can become productive capability, social recognition can become market access, infrastructure can become bargaining power, ecological conditions can enable future production, and data can become organizational advantage. Conversion can also be blocked or asymmetrical. Subjects may contribute to a generative process without capturing the value that later emerges from it.

This creates questions of return and distribution. Who receives the benefits of generated capacity? Which relations permit value to recirculate to those who sustained its emergence? Which institutional arrangements enable extraction by actors positioned downstream? How should delayed or diffuse contributions be recognized? These questions connect generative value to political economy and justice without making one normative rule part of the definition of value itself.

A cumulative research programme should develop typologies of generative mechanisms, methods for tracing value trajectories, domain-specific indicators, and comparative institutional studies. It should also preserve cases in which apparently generative investments fail to create durable capacity or create capacity that later becomes harmful. Generative value becomes analytically useful only if it remains distinguishable from the general fact that economic processes have consequences.

3.21.8 Generative Spacetime

Generative spacetime provides the programme's architecture for analyzing how economic relations are organized across heterogeneous spatial and temporal conditions. The term does not imply that social reality literally possesses the geometry of physical spacetime. It identifies a research problem: economic processes unfold through histories, delays, path dependencies, spatial distributions, institutional boundaries, and differently paced subsystems whose relations shape what can be generated later.

Time in GRE cannot be reduced to a neutral index. The order of events can matter. Early access to capital can alter later bargaining power; institutional sequencing can determine which reforms become feasible; technical standards can lock in infrastructure; educational investments can affect capabilities years later; ecological

degradation can create long recovery periods. Identical quantities introduced at different moments can therefore have different generative effects.

Spatial organization is similarly relational. Geographic distance interacts with infrastructure, jurisdiction, logistics, language, data access, mobility, and ecological conditions. Digital mediation can reduce some distances while creating new forms of concentration in computation, platforms, standards, or data centers. A generative-spacetime analysis asks how locations become connected or separated through these economic relations rather than treating space as a passive container.

The programme also needs to study heterogeneous temporalities. Humans, firms, financial markets, states, ecosystems, infrastructures, and artificial systems can operate at very different speeds. Their coupling can generate asymmetry. A platform can change an algorithm faster than workers can reorganize; financial capital can exit faster than communities can replace employment; ecological recovery can be slower than investment cycles. Temporal mismatch therefore becomes an economic mechanism rather than merely a descriptive feature.

Generative spacetime should support historical reconstruction, dynamic modeling, spatial analysis, and long-horizon evaluation. Its contribution is to preserve the ordering, location, duration, and temporal coupling of generative processes. It thereby links historical analysis to formal dynamics without reducing one to the other.

3.21.9 Formal Models

Formal modeling provides GRE with tools for making assumptions explicit, deriving implications, comparing mechanisms, and exploring trajectories that are difficult to reason about verbally. The programme can draw on dynamical systems, networks, multilayer structures, agent-based models, optimization, game theory, probabilistic models, field-like representations, simulation, and other mathematical or computational techniques where they are appropriate to the object.

The architectural principle is representational pluralism under ontological restraint. A network model emphasizes connectivity; a dynamical model emphasizes state evolution; a game-theoretic model emphasizes strategic interaction; an agent-based model emphasizes local rules and emergent aggregate patterns; a field representation emphasizes distributed conditions. These models need not be translated into one universal formal language. Their adequacy depends on which features of the economic problem they preserve and which they suppress.

Formal work in GRE should state the status of each construction. Some models are descriptive summaries. Some identify structural possibilities. Some generate comparative statics or trajectories. Some serve as counterfactual laboratories. Some are fitted to empirical data; others are heuristic. A mathematically precise model can remain empirically weak if its variables or mechanisms lack adequate correspondence to the target system. Formal rigor therefore complements rather than substitutes for evidential warrant.

Generativity creates particular formal challenges. The variables, interaction structures, or effective rules may themselves change. Models can represent some forms of adaptation, network rewiring, rule learning, or changing parameters, but the pro-

gramme should distinguish represented transformation from genuinely unforeseen category change. Where the formal state space excludes relevant novelty, model revision may be more appropriate than adding complexity to preserve a fixed representation.

The cumulative aim is a library of transparent formal models tied to clearly stated empirical and conceptual problems. Comparability should depend on assumptions, mechanisms, observables, and failure conditions, not on adherence to one mathematical paradigm. Formal models should remain instruments through which GRE sharpens explanation, tests implications, and explores possibilities.

3.21.10 Justice, Power, and Governance

Power and justice form a programme component because generative economic relations distribute more than current resources. They shape who can participate, who can exit, whose knowledge counts, who bears vulnerability, which alternatives remain feasible, and who captures value generated through collective processes. Governance concerns the institutional organization of these relations under persistent asymmetry and uncertainty.

Power research in GRE studies conversion mechanisms. Resource, capability, knowledge, institutional, vulnerability, and exit asymmetries become economically consequential when they can be converted into durable influence over others' options or future conditions. The programme should identify the institutional arrangements that enable or constrain these conversions. Ownership, standards, law, infrastructure, platform design, intellectual property, credit, public authority, and organizational hierarchy can all mediate conversion.

Justice enters as a neighboring evaluative problem rather than a property automatically inferred from generativity. A highly generative arrangement can still distribute participation unequally, impose dependency, externalize harm, or foreclose alternatives. GRE therefore needs interfaces with distributive, procedural, relational, capability-oriented, ecological, and generative approaches to justice while remaining explicit about which normative principles are being used.

Governance research then asks how institutions can organize relations under conditions in which asymmetry cannot simply be eliminated. Relevant mechanisms include contestability, transparency, rights, public capacity, collective organization, auditing, representation, interoperability, liability, redistribution, and preservation of exit or voice. Each can itself generate new dependencies or concentrations. Governance must therefore be evaluated recursively.

This component connects explanation, normativity, and praxis. Its success should be judged not by whether it yields one constitutional ideal but by whether it improves the ability to diagnose power, compare governance architectures, evaluate their generated consequences, and revise institutions as relational conditions change.

3.21.11 Knowledge and Epistemic Economy

Knowledge is simultaneously an input, output, resource, relation, institution, and source of asymmetry. A GRE research programme therefore requires a substantive

epistemic economy concerned with how knowledge is generated, validated, stored, circulated, priced, restricted, translated, forgotten, and converted into other forms of value or power.

The economic organization of knowledge affects who can generate further knowledge. Access to education, archives, computation, laboratories, data, journals, languages, expert communities, and institutional recognition shapes future epistemic capability. Knowledge production can therefore exhibit cumulative advantage and generative inequality even when individual information goods are non-rival. Ownership, paywalls, classification, secrecy, data governance, and platform control can influence the relational conditions of inquiry.

Epistemic economy also concerns recognition. Some observations become evidence, some questions become fundable, some methods acquire authority, and some speakers become credible. These processes are partly scientific and partly institutional. They can generate epistemic injustice when subjects are systematically excluded from contributing, being understood, or influencing the categories through which their situations are represented. At the same time, standards of evidence remain necessary; inclusion cannot mean suspension of criticism.

Artificial intelligence intensifies these questions by reducing some costs of synthesis, drafting, search, modeling, and content generation while increasing dependence on data, computation, model access, evaluation infrastructure, and epistemic filtering. Abundance of generated text can make provenance, attention, verification, and question formation scarcer. The economic object is therefore not knowledge alone but the relational infrastructure through which epistemic capability is distributed.

The programme should study knowledge capital, epistemic labor, archive power, verification, provenance, scientific institutions, open infrastructure, education, and the generative conditions of inquiry. It should also examine how its own research practices distribute epistemic participation and authority.

3.21.12 Artificial Intelligence and Radical Asymmetry

Artificial intelligence provides a contemporary domain in which several GRE problems become unusually visible at once: heterogeneous subjecthood, rapid capability change, concentration of infrastructure, epistemic abundance, organizational transformation, power conversion, temporal mismatch, and uncertainty about future generative trajectories. The programme should therefore treat AI neither as a peripheral application nor as an all-explanatory paradigm. It is a demanding empirical case for testing GRE's concepts.

The central economic problem is not simply automation or substitution. AI systems can alter the cost and speed of cognition-like tasks, reorganize knowledge work, modify decision processes, enable new forms of coordination, and change who can produce valuable outputs. The consequences depend on ownership, access, interface design, labor relations, education, regulation, data, compute, and organizational capacity. Similar model capabilities can therefore produce different economic structures under different relational architectures.

Radical asymmetry refers to cases in which capability differences become large

enough to transform bargaining, monitoring, production, or institutional response. Such asymmetry can occur among firms, states, workers, consumers, or human and artificial operational subjects. It does not establish moral or ontological equality among those subjects. The research problem concerns how capabilities are converted into economic power and how other subjects retain participation, contestability, learning, and exit under rapidly changing conditions.

AI also complicates the generative horizon. Systems that participate in research, design, education, administration, or cultural production can alter the rate at which new possibilities are generated. They can also narrow possibility through standardization, dependence, concentrated infrastructure, or recursive optimization around existing metrics. Evaluation must therefore attend to both capability expansion and generative foreclosure.

This component should integrate empirical labor economics, industrial organization, innovation studies, political economy, governance, epistemic economy, and technical understanding of AI systems. GRE contributes by coordinating these perspectives around relational and generative mechanisms rather than by replacing their specialized expertise.

3.21.13 Domain-Specific Applications

The final architectural component concerns domain-specific application. A research programme becomes substantive only when its concepts survive contact with cases in which institutions, evidence, values, scales, and mechanisms differ. GRE should therefore be tested across domains rather than developed indefinitely at the level of general vocabulary.

Candidate domains include labor, education, scientific research, health, finance, development, migration, humanitarian systems, urban infrastructure, digital platforms, ecological transition, public administration, innovation, culture, and international economic relations. Each domain brings specialized literatures and methods that GRE must respect. Domain application should begin from the empirical problem and available knowledge, then ask whether relational and generative analysis adds explanatory or practical value.

Applications serve several programme functions. They test concepts against heterogeneous evidence. They expose hidden assumptions imported from one domain into another. They identify mechanisms that may travel across cases and mechanisms that remain local. They provide intervention evidence. They reveal where value categories differ and where normative conflict becomes unavoidable. They can also demonstrate that GRE adds little to an already adequate established analysis, which is itself useful boundary knowledge.

Cross-domain comparison should therefore be careful. Similar labels can conceal different mechanisms. Dependency in finance, caregiving, digital infrastructure, and ecology need not be structurally identical. Generativity in education may concern capabilities and inquiry; in ecological restoration it may concern system resilience and future option spaces; in science it may concern knowledge and question formation. Comparative GRE should look for structural correspondence without presuming equivalence.

Domain-specific work also provides the main route through which the architecture remains corrigible. If concepts repeatedly fail in applied settings, they should be narrowed or abandoned. If new objects or mechanisms recur across domains, the programme can revise its typologies. If governance approaches generate predictable secondary harms, praxis should change. Application is therefore not the terminal stage of the programme. It is one of the principal sources through which the architecture itself evolves.

Taken together, these thirteen components define a preliminary architecture for GRE research. They do not form a pipeline in which epistemology is completed before methodology, methodology before substantive economics, and substantive economics before application. Work can begin in any component and move among several. An empirical anomaly can force epistemic revision; an intervention can reveal a new mechanism; a formal model can expose an ambiguous concept; a domain-specific case can require new governance categories; a normative conflict can reveal that a value representation is too coarse.

The architecture therefore functions as a coordination device. It indicates where a research question sits, which neighboring components are likely to constrain it, what forms of evidence or representation may be required, and how results can return to the wider programme. It also gives the remaining parts of the book a common orientation: ontology and epistemology, research praxis and methodology, application-dominant intervention, substantive economic foundations, power and knowledge, artificial intelligence, domain applications, and the later disciplinary return are connected components of one revisable research programme rather than independent theoretical excursions.

The following section condenses this architecture into a preliminary constitution of GRE. That constitution does not close the field. It states, in compact form, what GRE studies, what it does not need to presume, what it attempts to explain and change, what can count as evidence and contribution, and which questions remain deliberately open to historical and theoretical revision.

3.22 A Preliminary Constitution of GRE

The preceding sections have developed Generative Relational Economics from a provisional disciplinary identity into a structured research programme. They have specified its problem-space, methodological primitives, objects and scales of inquiry, characteristic questions, analytical sequence, account of economic subjecthood, orientation of generation, modes of inquiry, epistemic commitments, praxis, normative interfaces, analysis of power and heterogeneity, disciplinary boundaries, contribution criteria, cumulative programme, internal pluralism, open problems, and wider research architecture. The role of the present section is to condense those commitments into a preliminary constitution. The term *constitution* is used here in a limited methodological sense. It denotes a compact statement of the conditions under which GRE can presently recognize its own objects, claims, evidence, interventions, contributions, and limits. It does not denote a final doctrine, a metaphysical settlement, or a fixed disciplinary code.

The objective of the section is therefore both consolidating and restrictive. Consolidation is needed because a research programme can become diffuse when its concepts expand faster than the criteria governing their use. Restriction is needed because GRE should remain distinguishable from any study that happens to mention relations, emergence, complexity, value, or future possibility. A preliminary constitution states what kinds of questions GRE takes responsibility for, which assumptions it withholds, what forms of explanation it seeks, how intervention enters the programme, what can count as evidence and contribution, and which questions remain deliberately unsettled. The method is synthetic rather than genealogical. No new lineage is introduced here. The section reorganizes the commitments already established in Chapters 1–3 into eight constitutional dimensions: domain, restraint, explanation, praxis, evidence, contribution, openness, and historical revisability.

The constitution is preliminary for a substantive reason. GRE studies processes in which relations, subjects, capacities, value structures, institutions, and conditions of generation can themselves change. A research programme directed toward such objects would contradict its own subject matter if it treated its present categories as permanently settled. Constitutional stability is therefore functional rather than absolute. The programme needs enough continuity for researchers to disagree about the same problems, compare findings, and accumulate knowledge, while retaining enough revisability to alter its categories when empirical, historical, formal, or normative work reveals that they have become inadequate. The constitution presented below should be read in that spirit.

3.22.1 Domain and Objects of Study

GRE studies economic relations insofar as those relations help generate, reproduce, distribute, transform, or foreclose later capacities, constraints, values, subjects, institutions, trajectories, and fields of possibility. This domain statement is intentionally broader than the study of transactions and intentionally narrower than a general theory of social reality. GRE remains economic because its questions concern allocation, production, circulation, valuation, work, capability, institutional organization, economic power, dependence, resources, infrastructures, knowledge, and the conditions through which subjects participate in material and symbolic economies. It becomes generative-relational when those objects are examined through the consequences of their relational organization for what can subsequently exist, act, acquire value, coordinate, persist, or change.

The programme therefore treats the immediate recipient of an allocation or intervention as only one possible locus of effect. A subsidy may alter supplier capacity, household bargaining, regional infrastructure, expectations, or political legitimacy. An educational resource may change knowledge, confidence, social connection, question formation, institutional recognition, or later opportunity. A platform rule may change not only prices or matching efficiency but also visibility, dependence, subject formation, and the viability of alternative organizational forms. GRE asks which of these downstream effects are materially connected to the original relation and through which mechanisms they are generated. The downstream horizon is empirical and selective rather than indefinitely expansive: a GRE analysis is responsible

for tracing consequences where plausible generative pathways and evidential access make them analytically relevant.

The objects admitted to this domain are correspondingly plural. Relatively stabilized entities, subjects, relations, resources, capacities, values, constraints, fields, processes, events, trajectories, institutions, social facts, and symbolic representations can each become objects of GRE inquiry. Their analytical status depends on the local problem. A firm may be treated as an entity in one study, as a field of internal relations in another, as an institutional rule complex in a third, and as a node within a wider production ecology in a fourth. GRE does not require one of these descriptions to exhaust the firm's reality. It requires the researcher to state which object construction is being used, at what scale, for which explanatory purpose, and with what evidential consequences.

The domain also includes heterogeneous subjects. Human persons, households, organizations, public bodies, communities, ecological systems, hybrid arrangements, and artificial operational agents may participate in economically consequential relations under different descriptions and with different normative statuses. Their inclusion within a common analytical field does not establish ontological or moral equivalence. It means only that their interactions can affect allocation, value, capability, dependence, coordination, and future possibility in ways that economic inquiry may need to represent. The constitution therefore permits heterogeneous participation while reserving questions of personhood, consciousness, legal personality, moral status, and ecological standing for the appropriate neighboring domains and normative arguments.

A GRE study is consequently identified less by a proprietary object than by a characteristic relation between object and question. The same labor market, school, AI system, household, ecological project, financial institution, or humanitarian intervention can be studied through many legitimate economic approaches. It becomes a GRE problem when the inquiry asks how relational organization changes the capacities and conditions from which later economic and social possibilities are generated. This criterion preserves disciplinary openness while preventing the label GRE from becoming synonymous with any broad interest in complexity or interdependence.

3.22.2 Constitutive Restraints

GRE proceeds under several restraints that are constitutive rather than merely cautious. The first is ontological suspension. The programme can use entities, relations, processes, fields, networks, trajectories, categories, and generative structures without declaring any one of them the final metaphysical furniture of reality. Analytical usefulness establishes neither ontological priority nor completeness. A network representation may clarify connectivity; a field representation may clarify distributed conditions; a process description may clarify temporal transformation. Their value depends on the problem and the evidence. GRE therefore permits ontological commitment at the level required for a particular inquiry while withholding stronger closure.

The second restraint concerns explanatory universality. GRE does not presume that every economically relevant outcome requires a generative-relational explana-

tion. Standard price theory, causal estimation, accounting, institutional description, optimization, historical narrative, or domain-specific expertise may already explain the relevant problem adequately. The programme earns analytical relevance where relational mediation, downstream generation, changing capabilities, path dependence, heterogeneous value, shifting subjecthood, power conversion, or transformation of future possibility materially improve understanding. The GRE label should therefore be unnecessary when a narrower account is sufficient.

A third restraint concerns generativity itself. Generation is not presumed to be beneficial, innovative, progressive, emancipatory, or just. Relations can generate dependency, exclusion, vulnerability, ecological degradation, epistemic closure, concentrated power, or the destruction of alternative futures. A highly generative system can reproduce harm more effectively than a weakly generative one. Evaluation must therefore remain separable from description. GRE can identify that a relation generates new capacities or reorganizes a field while leaving open whether that transformation should be encouraged, governed, limited, repaired, or reversed.

A fourth restraint concerns representation. Variables, categories, network edges, model states, indicators, simulations, legal classifications, and textual interpretations mediate access to the object; they are not automatically identical with it. GRE therefore distinguishes relational reality from its representation and treats boundary choice, measurement, coding, scale selection, and model specification as substantive parts of inquiry. This restraint is especially important where categories can become performative. Rankings, credit scores, eligibility classifications, productivity metrics, and AI-generated representations may alter the relations they purport to describe. The research instrument can become part of the generative field.

A fifth restraint concerns scalar and historical invariance. GRE does not assume that an object retains the same analytical identity across scale or historical transformation. A configuration that is stable enough to be treated as an entity at one level may decompose into changing relations at another. Categories such as worker, household, capital, platform, intelligence, capability, value, or market can change their institutional content over time. The constitution therefore requires explicit scale, boundary, and historical conditions whenever they materially affect the claim.

These restraints make the programme deliberately non-totalizing. They protect methodological pluralism, disciplinary interfaces, and corrigibility. They also impose costs: GRE must often carry more uncertainty, specify more boundaries, and resist attractive universal formulations. Those costs are accepted because a programme concerned with changing relations and future possibility requires a disciplined distinction between useful analytical commitment and premature closure.

3.22.3 Explanatory Commitments

GRE attempts to explain how economic outcomes and future possibilities arise through relations that mediate allocation, interaction, interpretation, institutional recognition, capability, and value. Its characteristic explanatory move is from a local intervention or observed configuration toward the mechanisms through which effects propagate and reorganize later conditions. This move does not replace causal inference. It expands the range of causal and generative questions that may need

to be asked when the object cannot be understood adequately as an isolated unit responding to fixed incentives or constraints.

A generative explanation should identify more than temporal succession. It should specify a plausible mechanism connecting relational conditions to later changes. The mechanism may involve resource transfer, learning, coordination, reinforcement, institutional authorization, recognition, imitation, network exposure, expectation formation, technological complementarity, legal change, ecological feedback, symbolic classification, or another documented process. Claims of generation should remain proportionate to the degree to which such mechanisms can be evidenced. Where mechanism is uncertain, GRE should state the uncertainty rather than substituting the vocabulary of emergence for explanation.

The programme is especially interested in recursive transformation. Economic processes can change the conditions under which later processes operate. A policy can alter not only behavior but institutional trust; a technology can alter not only productivity but the skills and infrastructures required for participation; a market can alter not only allocation but the kinds of actors able to survive within it; an AI system can alter not only task performance but the organization of expertise, attention, and decision authority. In such cases, the effective rule governing later change may differ from the rule that characterized the earlier system. GRE therefore treats transformation of generative conditions, and where warranted transformation of effective rules, as explanatory objects in their own right.

Explanation also requires attention to propagation, conversion, recirculation, dissipation, and extraction. Generated value can move among subjects and institutions, change form, accumulate, decay, or be captured. Knowledge can become capability; capability can become bargaining power; symbolic recognition can become access; ecological capacity can become economic resilience; public infrastructure can become private rent; care can sustain labor capacity without appearing in market price. GRE does not presume that these conversions are complete or commensurable. It seeks to identify the relations through which they occur and the losses, exclusions, and asymmetries that accompany them.

Power enters this explanatory programme as the conversion of asymmetry into durable influence over others' options, vulnerabilities, representations, exit conditions, or future generative possibilities. Resource asymmetry, capability asymmetry, knowledge asymmetry, institutional authority, vulnerability, and exit conditions can each contribute to power when relational conditions allow them to be converted into leverage. This formulation avoids treating all difference as domination while making the reproduction of asymmetry economically analyzable.

GRE also attempts to explain orientation. Economic systems do not only produce outputs; they distribute attention, visibility, curiosity, legitimacy, funding, search capacity, and institutional recognition. These processes influence which possibilities receive the conditions required for further development. An account of generation is therefore incomplete when it describes capacity while ignoring the mechanisms that direct capacity toward some questions, designs, values, or futures rather than others. Orientation can be intentional, institutional, market-mediated, algorithmic, cultural, or emergent. Its explanation belongs within the economic problem-space when it affects resource allocation and future generative capacity.

The constitutional explanatory commitment can therefore be summarized without reducing it to one model: GRE seeks mechanisms linking relational organization to the emergence, persistence, transformation, distribution, or foreclosure of later economic possibilities. Different studies may instantiate that commitment through historical reconstruction, causal inference, formal modeling, computational exploration, qualitative mechanism tracing, comparative inquiry, or combinations of these modes. The explanatory standard lies in the clarity of the claim and its warrant, not in adherence to one technique.

3.22.4 Praxis and Transformative Orientation

GRE is not constituted only as a descriptive programme. It also includes praxis: the disciplined movement from explanation toward intervention under incomplete knowledge. This practical orientation follows from the object of inquiry. If economic relations shape later capacities, dependencies, values, and possibilities, then allocation and governance decisions participate in the generation of future conditions. The research programme should therefore be capable of informing intervention while remaining explicit about the uncertainty and normative judgment that intervention introduces.

Praxis begins with diagnosis rather than prescription. A relational diagnosis identifies the relevant subjects, institutions, infrastructures, dependencies, boundaries, and scales. A generative diagnosis asks which of those relations reproduce present conditions and which enable or foreclose change. Intervention design then specifies what is being altered: resources, constraints, access, recognition, information, rights, infrastructure, incentives, coordination mechanisms, or other conditions. This sequence prevents the language of generativity from becoming a license for indiscriminate experimentation.

Allocation is treated within this praxis as a relational intervention. The economic significance of allocating money, rights, infrastructure, education, information, or computational capacity depends on the relations into which the allocation enters. Identical resources can produce different effects under different conversion factors, institutional rules, recognition structures, ecological conditions, and power relations. GRE therefore asks how an intervention changes the field through which resources become capabilities and how those new capabilities affect other subjects and future options.

Intervention generates evidence as well as effects. Feedback, implementation failure, unanticipated dependence, unequal uptake, symbolic reinterpretation, ecological response, and strategic adaptation can reveal relations that were poorly represented in the initial model. GRE praxis should therefore preserve mechanisms for revision during and after intervention. Adaptive governance is valuable where it institutionalizes learning without turning affected populations into uncontrolled experiments. The practical requirement is not endless flexibility but explicit conditions under which evidence triggers continuation, modification, scaling, suspension, or termination.

Withdrawal, reversal, and repair form part of this constitutional praxis. Interventions can become harmful, obsolete, captured, or self-reinforcing in ways that diverge

from their original aims. A programme concerned with generative effects must ask whether the conditions produced by an intervention can be undone and what restoration would actually mean after the system has changed. Repealing a rule may fail to recreate the earlier state because capabilities, expectations, infrastructures, relationships, and subject positions have already been transformed. Reversibility is therefore an empirical property, not an administrative assumption.

The transformative orientation of GRE remains normatively open in a specific sense. The programme can analyze which interventions expand participation, capability, resilience, plurality, or future possibility, but it does not derive a complete moral ordering from generativity alone. Normative appraisal can draw on justice theory, ethics, law, democratic processes, domain-specific standards, and the neighboring GREthic programme. Praxis is thus constituted by an obligation to connect explanation with action where useful, paired with an obligation to keep empirical mechanism and normative justification distinguishable.

3.22.5 Evidential Admissibility

GRE adopts evidential pluralism constrained by claim-specific standards. Evidence is admissible when it bears materially on the claim being made and when the path from observation or representation to inference is sufficiently explicit for criticism. The constitution therefore does not privilege one evidential form in advance. Administrative records, prices, transactions, experiments, quasi-experiments, surveys, interviews, ethnography, archives, legal materials, organizational documents, ecological measurements, network data, computational traces, comparative cases, formal implications, simulations, and intervention records can all contribute, but they warrant different kinds and strengths of claims.

Descriptive evidence can establish patterns without identifying mechanisms. Causal designs can estimate specified effects without exhausting interpretation or historical formation. Historical evidence can reconstruct sequence, contingency, and institutional development without producing a universal parameter estimate. Interpretive evidence can establish how categories, meanings, or obligations are understood by participants without by itself identifying every material consequence. Formal models can show what follows from specified assumptions without demonstrating that the target system satisfies those assumptions. Simulations can explore implications, sensitivity, and possible dynamics without becoming observations of the world merely through computational complexity. These distinctions are constitutional because GRE depends on combining modes without conflating their warrants.

Evidence for generative claims requires particular care. A downstream change occurring after an intervention is insufficient by itself to establish generation. Researchers should specify a mechanism, consider alternative pathways, examine temporal ordering, identify relevant mediators, and state the boundary over which the claim is intended to hold. Where direct identification is impossible, triangulation among historical, qualitative, quantitative, formal, or comparative evidence can strengthen the claim while preserving residual uncertainty. The programme accepts graded evidence; it does not require false certainty before relational mechanisms

can be studied.

Counterfactual reasoning is often unavoidable. Claims about capability, foreclosure, resilience, opportunity, or future possibility concern alternatives that may never be fully observed. Evidence can include comparison across cases, natural experiments, historical alternatives, participant knowledge, structural models, simulation, sensitivity analysis, or explicit scenario construction. The relevant standard is transparency about which counterfactual is being invoked and why it is credible enough for the intended claim. Counterfactual richness should not be confused with evidential freedom.

Negative and disconfirming evidence also belongs within GRE. Failed interventions, absent downstream effects, unstable mechanisms, measurement failure, non-transportable cases, and situations in which a simpler established theory outperforms a GRE formulation should be retained as programme knowledge. Such evidence narrows the field's domain and improves theory comparison. A research programme that records only successful generative narratives would systematically exaggerate its own explanatory scope.

Finally, evidence is historically situated. Data availability, categories, archives, measurement systems, institutional visibility, and computational capacity change over time. Some subjects leave extensive traces while others remain under-recorded; some value forms are priced while others are rendered administratively invisible. GRE therefore treats the evidential environment itself as potentially structured by power and institutions. Evidential admissibility includes attention to whose relations can be observed, which histories can be reconstructed, and which absences may reflect the organization of recording rather than the absence of the phenomenon.

3.22.6 Criteria of Contribution

A contribution to GRE is constituted by the structure of its research claim rather than by the presence of GRE terminology. At minimum, a recognizable contribution should specify the relational problem, the relevant scale and boundary, the generative or relational claim being advanced, and the evidence or representation that bears that claim. It should distinguish the modeled or represented relation from the target relation, calibrate its inference to the available warrant, and identify material alternative mechanisms where they are plausible.

A contribution may be conceptual. It can clarify a category, distinguish previously conflated mechanisms, develop a typology, or revise the programme's ontology under suspension. It may be empirical, identifying a generative relation or demonstrating a boundary condition. It may be historical, reconstructing how an economic subject, institution, value form, or generative condition emerged. It may be formal, providing a model that clarifies a mechanism or reveals implications. It may be computational, exploring dynamics inaccessible to analytic derivation. It may be normative, identifying evaluative conflicts or consequences that existing frameworks obscure. It may be practical, producing intervention evidence or governance procedures. No one form is constitutively superior.

GRE contribution also requires downstream discipline. A study need not trace every consequence of an intervention or relation, but it should explain why the chosen

horizon is adequate to the research problem and acknowledge plausible effects excluded by that boundary. Where a claim concerns generativity, the analysis should identify what is being generated, for whom or for what system, through which mechanism, over what time horizon, and under what conditions. The term *generative* should carry analytical content rather than function as a general synonym for productive, innovative, or beneficial.

Normative transparency is another criterion. Researchers should distinguish descriptive claims, explanatory claims, forecasts, evaluations, and recommendations. If a contribution favors participation, capability, equality, resilience, pluralism, ecological integrity, autonomy, or another normative objective, the evaluative premise should be stated rather than embedded invisibly in the language of system improvement. GRE can support normatively engaged research while preserving the difference between evidence about consequences and judgment about their desirability.

Contribution further requires reproducibility or interpretive traceability appropriate to the method. Quantitative and computational work should expose data construction, assumptions, code, parameters, and sensitivity where feasible. Historical and qualitative work should make source selection, interpretive steps, category construction, and evidential tensions sufficiently visible for another researcher to understand how the conclusion was reached. Formal work should state assumptions and domains of applicability. Traceability is the general constitutional requirement; exact replication is one method-specific realization.

The final criterion is cumulative relevance. A GRE contribution should leave the programme better able to inquire afterward. It may supply a reusable concept, map, dataset, mechanism, comparative case, formal model, indicator, intervention record, negative result, or theory revision. Cumulative relevance includes contraction. Demonstrating that a concept is too broad, a mechanism fails outside a narrow domain, an indicator systematically distorts value, or an intervention generates recurrent harm is a positive research contribution because it improves the programme's capacity to avoid error.

3.22.7 Open Constitutional Questions

The preliminary constitution deliberately leaves major questions open. The first concerns identification. Generative relations are often distributed, mediated, and historically formed, making it difficult to determine which relation produced which downstream capacity or constraint. Better causal designs, process tracing, comparison, formalization, and computational methods may improve identification, but some relations remain reflexive or multiply realized. The programme does not assume that every generative effect can eventually be assigned to a single source.

A second open question concerns measurement. Generativity can refer to capability formation, relation formation, value propagation, diversification of future possibilities, resilience, subject formation, institutional transformation, or changes in the effective rules of change. These may require different measures and may resist reduction to one scalar index. Measurement research should therefore explore domain-specific indicators, multidimensional representations, and comparative procedures without presuming a universal generativity metric.

A third concerns value. Economic relations can generate several forms of value simultaneously and can convert value across domains imperfectly. Monetary price, capability, symbolic recognition, ecological capacity, care, knowledge, institutional trust, public infrastructure, and future option value cannot be presumed fully commensurable. GRE requires practical ways to compare and govern heterogeneous values while preserving information about what is lost through commensuration. The relation between such comparisons and normative justification remains open.

A fourth concerns boundaries and scale. Relational systems rarely arrive with uniquely given analytical borders. Expanding a boundary can reveal hidden dependencies while making causal identification harder; narrowing it can improve tractability while externalizing relevant effects. Scale changes can also alter what counts as an entity, mechanism, or outcome. GRE therefore needs stronger procedures for boundary sensitivity, multiscale inference, and the comparison of explanations constructed at different resolutions.

A fifth concerns changing transformation rules. When institutions, technologies, categories, expectations, or subject capacities evolve, the model adequate to an earlier period may cease to describe the later system. Some of this can be handled through time-varying or adaptive models; some may require changes in variables and model classes themselves. Distinguishing parameter change from structural change, and structural change from the emergence of new relevant categories, remains a central theoretical and empirical problem.

A sixth concerns justice and governance under persistent asymmetry. Economic relations often depend on differences in capability, information, authority, vulnerability, and exit. Equalization can be desirable in some dimensions while infeasible or counterproductive in others. Counter-power can reduce domination while creating new gatekeepers. Governance must therefore organize asymmetry while preserving participation, contestability, learning, and repair. The programme leaves open which institutional forms achieve those aims under different material and cultural conditions.

A seventh concerns heterogeneous subjects and artificial intelligence. Operational agency, legal personality, moral status, consciousness, accountability, and economic capability can diverge. AI systems can become economically consequential without resolving philosophical questions about machine subjecthood. GRE needs analytical conventions that allow such systems to be studied as participants or mediators where appropriate while preventing capability measures from silently determining ontological or normative status.

An eighth concerns long horizons. Generative effects can unfold across careers, institutions, ecosystems, and generations. Evidence weakens as horizons extend, while path dependence and rule change make extrapolation increasingly uncertain. Yet short-horizon evaluation can systematically favor interventions that consume the conditions of future possibility. Developing responsible long-horizon analysis without manufacturing spurious precision remains one of GRE's most important open problems.

These questions are constitutional because their unresolved status shapes how the programme should behave. Openness does not imply that anything is permitted. It

means that GRE should preserve competing formulations, record uncertainty, compare methods, and allow evidence from later chapters and future research to revise the present constitution. A preliminary constitution identifies the space of legitimate disagreement as much as it identifies present commitments.

3.22.8 Historical Revisability of the Programme

GRE is constituted as a historically situated research programme. Its emergence is connected to changes described in Chapter 1: expanded relational production, globalization, digital mediation, artificial intelligence, ecological constraint, changing scarcity, capability asymmetry, new scientific and computational capacities, and altered conditions of evidence and governance. These conditions make certain relational and generative questions more visible and more tractable. They do not make GRE historically inevitable, universally necessary, or permanently adequate.

Historical situatedness has two implications. First, GRE concepts should be expected to change as the economy changes. Categories useful for contemporary platform economies, AI-mediated production, or ecological transition may require revision under future institutional and technological arrangements. New forms of subjecthood, coordination, property, value, or infrastructure may emerge. Existing distinctions may lose relevance. A theory of historically changing economic reality should preserve the capacity to revise the categories through which it recognizes that reality.

Second, standards of inquiry can also evolve. New measurement technologies, archives, computational methods, legal institutions, participatory procedures, and epistemic practices can change what relations are observable and what interventions are ethically or practically possible. Methods and evaluative procedures therefore possess histories of their own. GRE should record those histories and remain capable of re-evaluating earlier findings when the epistemic resources available to later inquiry change. Revisability applies to methods and standards as well as to substantive theory.

Revision should nevertheless remain disciplined by programme memory. The replacement of one concept by another should preserve the reasons for the change; abandoned indicators, failed models, negative cases, and superseded mechanisms should remain accessible where possible. Otherwise a field can mistake forgetting for innovation. Cumulative knowledge requires both inheritance and correction. A historically revisable constitution therefore needs archives of its own revisions.

The present constitution can be revised through several routes. Empirical anomalies can show that a proposed relation does not operate as expected. Comparative work can reveal that a mechanism is culturally or institutionally specific. Formal work can expose inconsistency or hidden assumptions. Intervention can reveal unanticipated dependence or harm. Normative inquiry can show that an apparently desirable generative process rests on unjust relations. Historical analysis can demonstrate that a category treated as natural is institutionally recent. Domain applications can reveal objects that the existing typology cannot adequately represent. Each route provides a legitimate basis for constitutional amendment when the evidence is strong enough.

Revisability also protects GRE from disciplinary self-insulation. The programme should remain in dialogue with mainstream economics, political economy, economic sociology, complexity and evolutionary economics, capability approaches, ecological economics, legal and institutional analysis, philosophy, computer science, and other relevant fields. GRE has no constitutional entitlement to retain a concept merely because it originated within the programme. Where neighboring theories explain a problem better, GRE should borrow, narrow its own claim, or withdraw it. The integrity of the programme depends more on its capacity for correction than on the preservation of a proprietary vocabulary.

A preliminary constitution therefore combines continuity with amendability. GRE presently studies economic relations through their role in generating, distributing, transforming, and foreclosing later capacities and possibilities. It proceeds under ontological suspension, evidential pluralism, boundary and scale transparency, methodological pluralism, normative separability, and explicit attention to power, heterogeneity, historical dependence, and recursive change. It seeks explanations that identify mechanisms, praxis that remains revisable under feedback, contributions that are traceable and cumulative, and a programme architecture capable of learning from failure as well as success. These commitments are strong enough to coordinate inquiry while remaining open to revision.

Chapter 3 thereby completes the preliminary constitution of Generative Relational Economics and closes Part I. Chapter 1 reconstructed the historical conditions under which the programme becomes intelligible; Chapter 2 reconstructed the intellectual lineages that make its conceptual vocabulary possible; Chapter 3 has stated the provisional research programme that follows from those conditions and inheritances. Part II now turns from constitution to deeper theoretical development. Chapter 4 examines the ontological view of Generative Relational Theory, beginning with the degree and form of ontological commitment that relational and generative inquiry requires. The constitution established here should therefore be treated neither as an endpoint nor as a summary detached from what follows. It is the provisional compact against which the later ontology, epistemology, methodology, formalization, political economy, governance, and applications of the book can be tested and revised.

Chapter 4

The Ontological View of Generative Relational Theory

Chapter 4 begins Part II by making explicit the ontological view that underlies Generative Relational Theory (GR) and, through it, Generative Relational Economics (GRE). Part I established the historical conditions under which GRE becomes salient, reconstructed the intellectual lineages from which it draws, and formulated its preliminary disciplinary constitution. Those tasks repeatedly relied on distinctions among objects, relations, processes, representations, subjects, values, institutions, and emergent forms of reality. The present chapter develops the ontological architecture required to use those distinctions with greater precision. Its purpose is neither to establish a final metaphysics nor to reduce heterogeneous domains to a single relational vocabulary. It is to clarify what kinds of reality GR and GRE can speak about, under what commitments, and with what degree of ontological restraint.

The central architecture developed in this chapter distinguishes three registers: *ontological reality*, *relational reality*, and *manifestational reality*. The distinction is analytical rather than a division of the world into three independent substances or three successive stages. Ontological reality concerns the question of what obtains or occurs at the level of reality whose ultimate constitution may remain partly or wholly outside the commitments required by a particular inquiry. Relational reality concerns objects that emerge within generative-relational systems and acquire sufficient persistence and stability over some region or interval of spacetime to exercise causal efficacy within those systems. Manifestational reality concerns the conditions under which something becomes available in a mode of appearance, experience, articulation, measurement, classification, symbolization, or other manifestation. These registers identify different questions concerning reality and thereby allow existence, relational efficacy, manifestation, knowledge, and representation to remain analytically distinguishable.

Relational reality occupies a particularly important position in GR. An object can become relationally real without the framework first establishing that it possesses an independent or fundamental ontological existence. Money, legal status, institutional authority, socially sustained identities, forms of trust, experienced continuity of self, and objects embedded in religious or cultural relations may acquire persistence, stability, and causal efficacy through the systems in which they emerge. Their relational

reality concerns how they are generated and sustained within those systems and how, once stabilized, they participate in the generation of subsequent relations. This claim leaves their ultimate ontological status open where stronger commitment is unnecessary. Relational reality is therefore neither weakened reality nor a synonym for collective belief. It names a distinct analytical status grounded in generative emergence, persistence, stability, and causal participation.

Relational reality also need not await perception. A relational-generative structure may already persist and exercise causal efficacy before a subject becomes aware of it, before it acquires perceptual salience, or before a symbolic vocabulary has been developed through which it can be articulated. This feature becomes important for later GR inquiries into contingency, aesthetic judgment, subjectivity, historical emergence, and the formation of meaning. A contingent configuration, for example, may possess a relational and historical structure before its contingency becomes manifest to a subject and before an aesthetic judgment concerning it occurs. Manifestation can therefore disclose something whose relevant generative conditions precede the event of disclosure. Neither conscious recognition nor symbolization is a general precondition for relational reality.

The distinction between relational and manifestational reality nevertheless does not establish a one-directional sequence. Manifestations can themselves enter generative-relational systems. Once an appearance, judgment, classification, measurement, declaration, image, symbol, institutional record, or other manifestation becomes operative within a system, it may alter expectations, practices, classifications, capacities, constraints, and subsequent relations. Manifestation may thereby contribute to the stabilization, transformation, or dissolution of relational realities. A declaration of trust can alter the relation through which trust continues to develop; a monetary inscription can participate in reproducing monetary relations; a legal classification can reorganize the institutional relations to which it refers; and a manifested self-description can affect later recognition, conduct, and self-formation. Manifestational reality therefore participates in generation rather than occupying only an observational surface outside it.

For this reason, the three registers are better understood through a graph of heterogeneous relations than through a chain of successive layers. Ontological conditions may participate in the emergence of relational structures. Relational structures may condition what can become manifest. Manifestations may reorganize relational structures and, through historically accumulated effects, alter the conditions encountered by later processes. Relations between the registers can be recursive, many-to-many, temporally extended, and partly non-invertible. No universal sequence from ontology to relation to manifestation is presupposed. Particular trajectories may exhibit such an ordering locally, but the architecture itself permits feedback, mediation, historical transformation, and multiple paths among the registers.

A limited heuristic analogy can be drawn with the three-register architecture associated with Lacanian thought. Ontological reality can recall some of the problems posed through the Real, relational reality some functions associated with the Imaginary, and manifestational reality some aspects of the Symbolic. The correspondence is deliberately incomplete. GR's ontological reality is not equivalent to the Lacanian Real; relational reality extends beyond image and identification; and manifestational

reality includes perceptual, affective, bodily, material, institutional, statistical, and technological manifestations that cannot be reduced to symbolic inscription. The useful analogy lies principally in refusing a linear hierarchy among registers and in attending to their mutual mediation. The relation among the registers matters more here than any attempted one-to-one identification among their names.

A further consequence concerns comparison. The fact that two objects satisfy the conditions for relational reality does not establish that their generative structures are commensurable. They may occupy a common metric space, different metric spaces connected through an explicitly constructed mapping, non-metric spaces admitting another form of structural comparison, or relational domains for which no warranted common comparison structure has yet been established. Shared reality-status therefore does not imply shared structure. A perceptual object generated under conditions ordinarily described as hallucinatory and a perceptual object associated with an independently physical object may both become relationally real within relevant systems while differing substantially in their generative organization. The ontological, relational, and manifestational questions concerning them remain distinguishable, and comparison between their structures requires additional justification.

This point becomes consequential when the chapter turns to manifestation mappings and their possible non-invertibility. Similar manifestations may arise from different relational configurations, while similar relational configurations may yield different manifestations under changing bodily, historical, institutional, cultural, technological, or symbolic conditions. Reverse inference from manifestation to relational structure therefore requires explicit epistemic assumptions. Manifestational similarity alone provides insufficient grounds for relational identity, just as relational comparability does not by itself establish ontological identity. These distinctions provide part of the ontological basis for the epistemological problems developed in Chapter 5.

The chapter proceeds by stages. Section 90 states the ontological position of GR and develops the principle of methodological restraint. The subsequent sections introduce the three registers of reality and clarify ontological suspension before returning to change, structure, constraint, and difference as minimal primitives through which stable configurations can be analyzed. The chapter then develops relational reality and manifestational reality in greater detail, examines the generative emergence of manifestation, and studies the mappings through which relational configurations become manifest. Later sections address non-invertibility, symbolization, recursive relations among manifestation and subsequent relational formation, subjecthood, value, meaning, social facts, institutions, process, events, and becoming. Category-theoretic and scale-relative views are introduced where they offer useful formal or structural clarification, while their ontological interpretation remains deliberately limited. The final movement historicizes ontological categories, clarifies the methodological status of relational-generative analysis, considers compatibility with alternative ontological commitments, and states the boundaries of the chapter's claims.

The resulting ontology is intentionally open. GR requires enough ontological articulation to distinguish kinds of reality, analyze their relations, and prevent epistemic or representational categories from silently replacing the realities under study. It

does not require those distinctions to culminate in a closed metaphysical system. The three-register architecture instead provides a disciplined space within which heterogeneous realities can emerge, persist, act, manifest, mediate one another, and transform historically while questions of ultimate ontology remain open where the inquiry does not require their resolution. This ontological view prepares the transition from the reality of generative-relational systems to the epistemic problem of how such realities can be known through necessarily situated manifestations, traces, representations, and interventions.

4.1 Ontological Position

This section establishes the ontological position from which the remainder of Chapter 4 proceeds. Its role is preparatory: before GR distinguishes ontological, relational, and manifestational reality, it must clarify what kind of ontological commitment an open generative-relational research programme actually requires. The argument proceeds in five steps. It first specifies the function of an ontological position in GR, then examines why economic analysis cannot avoid ontological commitments simply by leaving them implicit. It next distinguishes commitments made for a local explanatory task from stronger claims about the ultimate constitution of reality. The final two subsections formulate methodological restraint and explain how GR can make substantive ontological commitments without converting those commitments into a closed metaphysical system. The mode of argument is conceptual and methodological. The aim is to establish conditions for disciplined inquiry rather than to settle the ultimate furniture of reality.

4.1.1 Ontological Position in Generative-Relational Inquiry

Every inquiry presupposes some account of what kinds of objects, processes, relations, differences, events, or structures can enter explanation. A study of prices presupposes that prices can be identified with sufficient stability for the purposes of the analysis. A study of institutions presupposes that institutions can persist through changes in personnel and individual acts. A study of subjects presupposes some basis on which actions, memories, capacities, or recognitions can be attributed to a subject over an analytically relevant interval. A study of causal effects presupposes that differences in the world can be related to subsequent differences under stated conditions. These presuppositions need not constitute a complete metaphysics, yet they carry ontological content because they determine what the inquiry treats as sufficiently real, persistent, and efficacious to bear explanatory weight. (Quine 1948; Fraassen 1980)

GR makes this background explicit because its principal objects are often emergent, historically variable, multiply realized, reflexive, or only partially accessible through observation. The framework studies how objects and capacities arise through generative relations, how stabilized forms participate in later generation, how manifestations mediate subsequent relations, and how the relevant units of analysis can change with scale and history. Such questions become confused when the status of an analytical object is left unspecified. A relation represented in a model, a relation inferred

from evidence, a relation stabilized in a social system, and a relation posited as part of ultimate reality are different claims even when the same word is used for each of them.

Definition 4.1 (Ontological position)**.** An *ontological position* is the explicit set of commitments through which an inquiry specifies what kinds of entities, relations, processes, differences, structures, or events it treats as real enough to enter explanation, together with the scope and strength assigned to those commitments.

Definition 4.1 treats an ontological position as more than a list of objects. Scope and strength matter equally. A claim that money is real for the analysis of exchange, obligation, accounting, and institutional action differs from a claim that money is a fundamental constituent of reality. A claim that a relational configuration has causal efficacy within a particular generative-relational system differs from a claim that relation is the ultimate substance from which all reality is composed. A claim that a self persists with enough stability to organize action differs from a claim that the self possesses an invariant metaphysical essence. GR therefore requires an ontological vocabulary capable of supporting local explanatory commitments while preserving distinctions among different strengths of claim.

This position also separates ontology from immediate observability. Some structures relevant to explanation may be indirectly inferred, historically reconstructed, experimentally perturbed, or manifested only through partial traces. Their ontological status cannot be reduced to whether a subject currently perceives them. Conversely, something may be vividly perceived or symbolically articulated while its underlying ontological status remains unsettled. Chapter 4 will later formalize this distinction through the three registers of reality. At this stage, the important point is methodological: a theory of reality must distinguish the conditions under which something becomes available to inquiry from the conditions under which it becomes causally or structurally relevant to the system being studied.

GR consequently adopts an ontological position because generative explanation needs objects that can persist, interact, constrain, enable, transform, and become historically consequential. At the same time, the framework resists extending each local explanatory success into a general metaphysical conclusion. This combination provides the starting orientation for the chapter: explicit commitment where explanation requires it, explicit suspension where the evidence and analytical task do not warrant further closure.

4.1.2 Ontology and Economic Analysis

Economic analysis makes ontological selections whenever it decides what counts as an economic object, a relevant relation, a unit of action, a form of value, a resource, an institution, a constraint, or a consequence. These selections can remain implicit because many categories are inherited from established practice. Households, firms, states, markets, prices, contracts, preferences, assets, skills, debts, and technologies can appear sufficiently familiar that their status as analytical constructions receives little attention. Yet each category compresses a field of heterogeneous relations into an object that can be compared, measured, modeled, regulated, or acted upon. (Giere 2004)

The ontological significance becomes clearer when categories change. A platform can function simultaneously as a firm, infrastructure, market organizer, data environment, contractual authority, and technological mediator. An artificial system can participate in production, recommendation, bargaining, classification, and coordination while questions of agency, subjecthood, legal personality, and responsibility remain separately unsettled. Knowledge can appear as a private asset, a shared capacity, an institutional memory, a public resource, or a relation embodied in practices and networks. Care can be treated as labor, relation, capability formation, social reproduction, or a mixture whose relevant ontology varies with the research question. Such cases reveal that economic analysis does not merely observe a world already partitioned into self-identifying economic units. It also selects and stabilizes objects for inquiry.

GRE requires particular care because its central questions concern generation across time. An economic relation can alter the capacities of subjects, the availability of future actions, the structure of institutions, the distribution of recognition, the meaning of categories, and the conditions under which later value can be generated. The object relevant at the beginning of a process may therefore differ from the object relevant at its end. A training relation can alter the capabilities through which a worker later participates in production. A credit relation can change both material capacity and future bargaining conditions. An institutional classification can reorganize eligibility and thereby reshape the population to which the classification is subsequently applied. The ontology of the analysis must accommodate objects that are partly constituted through the histories in which they participate.

This historical mutability does not imply that economic objects are analytically arbitrary. An object can be historically generated and still become stable enough to constrain action, coordinate expectations, carry obligations, or produce measurable consequences. The relevant question is therefore not whether an object is timeless, but how its stability is generated, over what interval it persists, through which relations it is reproduced, and what causal difference its presence makes. This is one reason relational reality becomes important later in the chapter: many economically consequential objects derive their practical reality from sustained generative relations without requiring an immediate claim about their ultimate metaphysical status.

Economic representations also participate in the realities they describe. Prices, rankings, credit scores, accounting categories, legal forms, forecasts, and classifications can become inputs into later action. Once institutionalized, a representation may influence resource allocation, access, expectations, strategy, or identity. The economic analyst therefore encounters a reflexive environment in which manifestational and representational forms can become causal components of subsequent relational organization. This feature gives ontology a practical significance. Treating a category as merely descriptive can obscure the process through which its use contributes to reproducing or transforming the object under analysis.

Claim 4.2 (Ontological relevance of economic categories)**.** *An economic category acquires ontological relevance for GRE when its stabilization, transformation, or disappearance makes a causal or structural difference to the generative-relational processes under study.*

Claim 4.2 does not require every economic category to possess the same mode of

reality. A legal corporation, a price, a bodily capacity, an ecosystem, a debt, and an expectation can enter economic explanation through different generative histories and different forms of persistence. Their inclusion in one inquiry does not imply that they share a common substance or a common metric. It establishes only that the analysis has reasons to treat them as causally or structurally relevant within its stated domain.

This pluralism is especially important for GRE because heterogeneous objects can interact without becoming ontologically homogeneous. A legal rule can affect material production; an aesthetic judgment can redirect research attention; a symbolic classification can change access to finance; a bodily limitation can alter bargaining relations; an imagined future can influence present investment. The causal field of economic action therefore crosses domains that may require different descriptive vocabularies. A useful ontology must permit interaction across heterogeneous forms of reality while resisting the inference that interaction proves reducibility to one underlying analytical language.

4.1.3 Locality and Scope of Ontological Commitment

Ontological commitment in GR is local to an explanatory task unless a stronger scope is independently established. Locality here refers to the domain within which a commitment is warranted: a generative-relational system, a historical interval, an analytical scale, a class of mechanisms, or a specified research problem. This principle allows GR to say that an object is real enough to explain a process without requiring the same statement to settle its status across every possible domain of inquiry.

Definition 4.3 (Ontological commitment)**.** An *ontological commitment* is a commitment to treat some object, relation, process, difference, structure, or event as possessing sufficient reality, within a specified domain and for a specified explanatory purpose, that claims about its persistence, efficacy, interaction, or transformation can bear argumentative weight.

Definition 4.3 makes ontological commitment purpose-sensitive without making it arbitrary. The commitment remains answerable to evidence, coherence, explanatory performance, and the consequences of intervention. Its purpose specifies the burden of proof. An analysis of currency circulation may require a robust account of money as an institutionally and relationally stabilized object while remaining neutral about whether monetary value possesses any reality outside such systems. An analysis of subjective continuity may require a stable operational subject over a given interval while leaving open deeper claims about the metaphysics of selfhood. An analysis of religiously organized economic life may need to treat a deity as a relationally real object within the relevant system if the deity organizes obligations, trust, sacrifice, authority, or allocation; that analytical commitment does not itself adjudicate theological claims concerning independent divine existence.

Locality also matters for scale. An object stable at one scale may dissolve into changing components at another. A firm can be treated as a persistent organization in an industry-level analysis while appearing as a changing field of contracts, routines, persons, technologies, and authority relations in an organizational study. A market can function as an analytical object at one scale while a microstructural anal-

ysis resolves it into order books, protocols, matching rules, information flows, and strategic interactions. Neither description automatically invalidates the other. Their adequacy depends on the generative processes each inquiry seeks to explain.

Temporal scope produces a similar effect. Persistence is always persistence over some interval. An institution can be highly stable relative to daily transactions and historically transient relative to centuries. A subject's identity can remain sufficiently continuous for contractual responsibility while changing substantially over a life course. A convention may stabilize coordination for a generation and later disappear. GR therefore avoids treating stability as timeless identity. Stability is a relation between a pattern and an analytical timescale, together with the mechanisms that reproduce the pattern across change.

Proposition 4.4 (Local sufficiency of ontological commitment)**.** *For a generative-relational explanation, the ontological commitment required to support the explanation need extend only as far as the persistence, efficacy, and relations necessary for that explanation, unless additional evidence or argument justifies a stronger claim.*

Proposition 4.4 provides a rule of economy for ontological reasoning. If an account of institutional trust depends on a stabilized relation that changes later action, the inquiry can study that relation without deciding whether trust is reducible to neural states, symbolic structures, expectations, embodied dispositions, or some combination of them at an ultimate level. If a model of knowledge production depends on a research community, shared standards, archives, and infrastructures, those objects can be treated as real components of the explanatory domain without requiring a final ontology of collective entities. Stronger commitments remain possible, but they carry additional argumentative burdens.

Local commitment also protects against a common error in interdisciplinary work. A concept transferred from one domain can be useful without carrying its entire source ontology with it. Field language, network language, dynamical systems, category theory, information, geometry, or computation may disclose structure in an economic problem. Their successful use does not automatically establish that the economic world is fundamentally a field, network, dynamical system, category, informational object, geometric manifold, or computation. The imported representation earns authority over the relations it successfully captures; claims beyond that scope require separate support.

The locality principle prepares the distinction developed in the next sections. Ontological reality, relational reality, and manifestational reality will allow GR to specify different forms of claim without forcing them into a single hierarchy. The present section establishes the prior discipline: the scope of an ontological commitment should remain visible, and movement from a local claim to a stronger claim should be argued rather than assumed.

4.1.4 Methodological Restraint in Ontological Claims

Methodological restraint governs the transition from analytical success to ontological assertion. GR uses strong conceptual resources because generative systems can be difficult to describe with ordinary entity-centered language. Relations can have higher-order structure; constraints can alter the space of possible action; historical

trajectories can produce attractors or path dependence; categories can change the behavior of classified subjects; and manifestations can feed back into the systems from which they emerge. Each of these phenomena may invite formal representations. The quality of a representation, however, does not by itself determine the ultimate ontology of the represented system.

The distinction can be stated through three questions. The first asks whether a representation is useful: does it organize observations, distinguish mechanisms, support inference, or enable intervention? The second asks whether the represented structure is real within the domain: does the structure persist, constrain, enable, or causally alter the system in ways that survive changes in description? The third asks whether the representation identifies the ultimate constitution of what exists. These questions can receive different answers. A network model can be useful even when edges are constructed from imperfect proxies. A relational structure can be causally real even when several mathematical representations capture it equally well. An empirically successful representation can remain silent about ultimate ontology.

Remark 4.5 (Representation and ontological inference)*.* The empirical or explanatory success of a representation can support claims about structures captured by that representation while leaving stronger claims about the ultimate constitution of reality underdetermined.

Remark 4.5 is particularly important for a framework that draws from several formal traditions. A graph can reveal patterns of connectivity, a dynamical system can reveal stability and transition, a field representation can express spatially or relationally distributed influence, and a category-theoretic formulation can clarify mappings among structures. These representations may overlap without being mutually reducible. GR therefore treats formal plurality as evidence that the relation between representation and ontology itself requires analysis.

Methodological restraint also applies to ordinary language. Terms such as "subject," "institution," "value," "power," "relation," and "field" can acquire an apparent solidity through repetition. A concept introduced as an analytical convenience may gradually be spoken of as though its boundaries were discovered rather than constructed. Conversely, a familiar category can appear natural even when its persistence depends on legal, technological, cultural, and historical conditions. Ontological discipline requires the manuscript to mark when a term refers to a stipulated analytical unit, an empirically inferred structure, a relationally stabilized object, a manifestation, or a stronger ontological claim.

Caution 4.6 (Ontological inflation)*.* Ontological inflation occurs when an analytical distinction, representation, measurement, or successful local explanation is extended into a stronger claim about reality without an additional argument adequate to that stronger scope.

Caution 4.6 applies in both formal and qualitative inquiry. Quantification can inflate a proxy into a property; interpretive analysis can inflate a recurrent meaning into a universal structure; historical reconstruction can inflate a contingent lineage into necessity; a relational model can inflate explanatory dependence into a claim that only relations exist. Restraint does not weaken inquiry. It preserves the distinction between what the evidence establishes and what remains open.

The same discipline applies to causal language. GR often studies objects that acquire causal efficacy through relational stabilization. Causal efficacy here means that the presence, persistence, transformation, or disappearance of the object makes a difference to subsequent states or possibilities under relevant conditions. It does not require that the object be fundamental in a reductionist hierarchy. Nor does it imply that causality can always be assigned to a single isolated object. In generative-relational systems, causal contribution may be distributed across configurations, histories, interfaces, and feedback processes. The ontological commitment should match the causal claim being made.

Methodological restraint therefore has a positive function. It makes room for strong local explanation, plural representation, and cross-disciplinary borrowing while protecting the framework from premature metaphysical closure. This discipline will become especially important when relational reality is defined later in the chapter. The fact that an object is relationally real will establish a substantive claim about its emergence, persistence, stability, and causal efficacy within a system. It will not by itself settle whether that object is ontologically fundamental, reducible to another level, or comparable with every other relationally real object.

4.1.5 Ontological Commitment without Closure

GR's ontological position can now be stated more precisely. The framework is committed to the reality of change, difference, constraint, structure, persistence, and causal efficacy wherever these are required and warranted by the inquiry. It is committed to treating generative relations as analytically consequential when transformations in relations alter what objects, capacities, manifestations, or possibilities can emerge. It is also committed to the possibility that some emergent objects become sufficiently stable to act back upon the systems through which they arose. These commitments provide the minimum ontological depth necessary for generative-relational explanation.

The framework simultaneously leaves several stronger questions open. GR does not need to determine whether relations are more fundamental than relata in every domain. It does not need to identify one privileged formal language in which all reality must be represented. It does not need to decide whether every socially consequential object is reducible to physical processes, whether every physical process is best understood relationally, or whether one universal metric can compare heterogeneous forms of reality. These questions can be addressed where a particular inquiry requires them, but the book does not make their settlement a prerequisite for economic analysis.

This openness is compatible with substantive disagreement. Two researchers can share a GRE analysis of the relational generation of money while holding different metaphysical views about social ontology. Two researchers can agree that a self-model becomes relationally stable and causally consequential while disagreeing about consciousness or personal identity. Two researchers can study how a religious object organizes economic action while differing on its ontological status outside the relational domain under investigation. The research programme remains coherent because its shared commitments concern the generative-relational structures re-

quired for the explanation, while stronger metaphysical claims can remain explicit points of divergence.

The position can therefore be summarized through a principle of graded commitment. Claims should become ontologically stronger only when the research question, evidence, and argument require and support the additional strength. Observation may justify a claim about manifestation. Recurrent and causally consequential organization may justify a claim about relational reality. A further claim about ontological reality requires its own warrant. Movement among these registers cannot be inferred merely from vocabulary or intuitive resemblance. Section 91 develops these distinctions directly.

Proposition 4.7 (Open ontological commitment)**.** *GR permits substantive commitments concerning the reality, persistence, efficacy, and transformation of objects within generative-relational systems while keeping stronger metaphysical questions open whenever those questions are not required for the explanatory task.*

Proposition 4.7 expresses the balance sought throughout this chapter. An ontology too thin to distinguish reality from representation would leave GRE unable to explain how emergent objects become causally consequential. An ontology that converts every useful analytical form into an ultimate metaphysical claim would make the programme unnecessarily brittle and would collapse heterogeneous domains into premature unity. Open ontological commitment occupies the intermediate position: reality claims are made where generative explanation requires them, their scope is stated, and further closure remains an additional task rather than an automatic consequence.

This position also preserves historical revisability. The objects recognized by an inquiry can change as institutions, technologies, categories, and relations change. New forms of economic subjecthood may emerge; old classifications may disappear; new infrastructures may create objects that earlier vocabularies could not represent adequately; improved methods may separate structures previously treated as one or reveal continuities previously missed. An ontological position adequate to generative inquiry therefore includes the possibility that its own categories will require revision. Revisability concerns the framework's descriptions and commitments, while the reality under study may exceed any one historical vocabulary used to describe it.

Section 90 thus establishes the ontological discipline for what follows. GR will make reality claims strong enough to support explanation, causal analysis, and historical inquiry. It will distinguish the scope of those claims, preserve the difference between representation and represented structure, and resist the extension of local success into unsupported metaphysical closure. With this position established, Section 91 turns to the chapter's central architecture: ontological reality, relational reality, and manifestational reality as three distinct but mutually mediating registers.

4.2 The Three Levels of Reality

This section introduces the three-register architecture through which GR distinguishes ontological reality, relational reality, and manifestational reality. The inherited outline uses the word *levels*, but the three are not ordered strata in which

one sits above or below another. They are better understood as registers that answer different questions about reality and that can mediate one another through historically situated generative relations. The distinction is necessary because GR repeatedly encounters objects that are causally effective without requiring a settled claim about their ultimate ontology, as well as manifestations that disclose, transform, or even help stabilize the realities to which they relate. Treating these cases within a single undifferentiated category of "reality" would obscure differences among what obtains, what becomes stably effective in a relational system, and what becomes manifest under particular conditions.

The architecture developed here is deliberately minimal. It does not claim that every philosophical problem can be assigned uniquely to one register, nor that each object possesses only one form of reality. The same object may be considered differently according to the question being asked. Money can be examined through the material and institutional conditions that participate in its existence, through the stabilized relational reality by which it organizes exchange and obligation, and through the perceptual, symbolic, legal, or computational forms in which it becomes manifest. A sense of self can likewise be approached through bodily and ontological questions, through the relational processes that stabilize continuity and identity, and through the forms in which selfhood becomes experienced, narrated, classified, or represented. The registers therefore separate analytical questions without requiring the realities under study to be separable in practice. (Whitehead 1929)

4.2.1 Ontological Reality

The first register concerns reality in its ontological status. GR needs this register because an inquiry can refer to what obtains or occurs without claiming that it has already captured the ultimate constitution of what obtains or occurs. The distinction is particularly important when perception, symbolic representation, institutional classification, or model construction provides only partial access to the processes under investigation. Ontological reality marks the fact that the reality of an event, structure, difference, or process cannot be reduced simply to the manner in which it has become available to a particular observer or system of representation. (Husserl 2012; Merleau-Ponty 2012)

Definition 4.8 (Ontological reality)**.** *Ontological reality* denotes what obtains, occurs, or possesses efficacy insofar as its reality is not constituted merely by its being perceived, manifested, represented, measured, classified, or known within a particular epistemic situation. GR may refer to this register while leaving the ultimate constitution of what is ontologically real under ontological suspension.

Definition 4.8 is intentionally compatible with different metaphysical positions. It does not identify ontological reality with matter, physical substance, mind, relation, process, information, or another privileged category. Nor does it define ontological reality as whatever is permanently inaccessible. Some ontologically relevant structures may be directly observable under suitable conditions; others may be reconstructed from traces, inferred through intervention, or remain only partially accessible. The defining distinction concerns the status of the claim rather than the accessibility of the object: ontological reality is not exhausted by a particular manifestation

or representation of it.

This register therefore gives GR a place to formulate questions that exceed what has presently become manifest. A physical process may continue whether or not it is observed. Historical conditions may constrain later possibilities even when no contemporary subject explicitly recognizes those constraints. Differences in biological, ecological, technological, or material organization may participate in generative processes before they acquire a social classification. In each case, an inquiry may have reasons to refer to a reality whose full ontology remains unsettled while resisting the stronger reduction of that reality to what is presently available in experience or representation.

The ontological register also protects GR from an opposite reduction. The fact that a relational or manifestational phenomenon is historically generated does not by itself imply that all aspects of the phenomenon are exhausted by the history through which it has been interpreted. An ontological question may remain open even after a rich account of relational emergence has been developed. This openness is especially important when different ontological interpretations remain compatible with the same relational evidence. The framework can then preserve the difference rather than forcing premature metaphysical closure.

Ontological reality is thus a register of commitment and restraint at once. GR can acknowledge that inquiry addresses realities rather than only descriptions while limiting its claims to what the research problem and evidence support. Section 92 develops this discipline through ontological suspension. For present purposes, the first register provides the background against which relational reality can be distinguished from both ultimate ontological identity and manifest appearance.

4.2.2 Relational Reality

Relational reality is the central technical category through which GR recognizes objects that become real within generative-relational systems. The category was developed to avoid a recurrent false choice. Many consequential objects are difficult to treat as fundamental or independently existing substances, yet treating them as merely fictional, subjective, or representational fails to explain their persistence and causal effects. Money, institutional authority, debt, trust, socially sustained identities, religious objects, and the experienced continuity of a self can organize action and reshape subsequent relations even when their ultimate ontological status is left unsettled. GR therefore requires a criterion of reality grounded in emergence and efficacy within a relational system.

Definition 4.9 (Relational reality)**.** *Relational reality* denotes an object that emerges within a generative-relational system and, over some region or interval of spacetime, persists with sufficient stability to exert causal efficacy upon that system. Its relational reality consists in its generated and sustained participation in subsequent relations rather than in a prior requirement that it possess an independently established ontological identity.

The word *object* in Definition 4.9 is deliberately broad. It can refer to a stabilized relation, configuration, pattern, institution, capacity, identity, process, or other analytically individuated object when the relevant conditions are satisfied. The defini-

tion is not meant to reify every transient correlation or every label introduced by an observer. Emergence alone is insufficient. A relationally real object must acquire persistence or recurrent stability over an analytically relevant spacetime domain, and its presence must make a causal difference within the generative-relational system in which it has emerged. Sections 93 and 94 will develop these conditions more carefully.

The criterion permits GR to treat money as relationally real without requiring a metaphysical substance called money. Monetary reality is sustained through legal recognition, accounting practices, expectations, exchange relations, institutional infrastructures, material and digital inscriptions, and histories of coordinated action. Once sufficiently stabilized, money affects access to goods, contractual possibilities, investment, labor, debt, expectations, and later relations. Its reality within such systems is therefore not adequately characterized by saying that participants merely believe in it. The belief, inscription, institution, and practice form parts of the generative relations through which the monetary object acquires persistence and causal efficacy.

The same logic can apply to a god within a religiously organized generative-relational system without requiring GR to settle the theological question of divine ontological existence. A divine object may become relationally real insofar as it is stably generated through ritual, memory, doctrine, architecture, collective practice, personal experience, authority, and other relations, and insofar as it causally reorganizes conduct, obligation, temporal practice, resource allocation, affect, identity, or institutional life. The relational claim neither establishes nor denies an independent divine ontology. It concerns the reality generated within the relational system and the causal work that this reality performs there.

A similar distinction applies to the experienced continuity of "I." A relatively stable sense of self can emerge through bodily continuity, memory, recognition by others, language, institutional identity, habit, affect, and narrative. Once stabilized, this self-object can organize intention, responsibility, expectation, action, and interpretation. Its relational reality can therefore be studied without requiring GR first to decide whether a metaphysically invariant self exists. The example is especially useful because it shows that relational reality is not confined to conventionally external social objects. A reality can be intimate and subjectively consequential while still being relationally generated and historically sustained.

Relational reality also does not require prior perception. A generative-relational structure can persist and act before any subject recognizes it, before it receives a name, and before it is stabilized in symbolic form. This feature is important for the GR treatment of contingency and aesthetic judgment. The structure through which a contingent conjunction becomes possible can already be historically and relationally real before its contingency becomes salient to a subject. An eventual experience of surprise, beauty, significance, or curiosity is then a manifestation within a structure whose relevant generative conditions did not begin with the experience itself. The relational reality of those conditions is therefore conceptually prior to their recognition, even though later recognition can feed back into the system and change what follows.

Claim 4.10 (Manifestation is not required for relational reality)**.** *An object can sat-*

isfy the conditions of relational reality before it is perceived, consciously recognized, linguistically articulated, symbolized, or otherwise manifested to a particular subject.

Claim 4.10 prevents relational reality from collapsing into phenomenology, discourse, or representation. It also leaves room for a stronger recursive thesis developed later in the chapter: although manifestation is not a general precondition for relational reality, manifestations can become relations within the system and can therefore participate in generating, stabilizing, transforming, or dissolving relational realities. The absence of necessary priority in one direction is precisely why the three-register architecture must be understood as a graph rather than a chain.

4.2.3 Manifestational Reality

The third register concerns the reality of manifestation. Something can become present to a subject, instrument, institution, classificatory system, archive, legal process, market interface, or other relational configuration without the manifestation exhausting either the relational structure from which it emerged or the ontological reality to which it may refer. GR therefore treats manifestation as a positive object of analysis rather than as a transparent window through which an already complete reality is simply observed.

Definition 4.11 (Manifestational reality)**.** *Manifestational reality* denotes reality insofar as something becomes available, differentiated, experienceable, perceptible, recordable, articulable, measurable, classifiable, symbolizable, or otherwise present within a particular relational and historical configuration. A manifestation is conditioned by the relations through which this availability occurs, and its reality does not by itself establish the complete ontological or relational structure of what is manifested.

Manifestation is broader than symbolization. A pain can become manifest affectively and bodily before it is named. A pattern can become manifest statistically through an instrument or dataset without being available to unaided perception. An institutional boundary can become manifest through differential access or treatment before its rules are explicitly articulated. A landscape can become manifest aesthetically through a mode of attention that is partly perceptual and affective. A market condition can become manifest through price movements, queues, shortages, or changes in conduct. Symbolic representation is an especially powerful mode of manifestation because language, categories, diagrams, records, and numbers can stabilize and circulate what has become available, but symbolic inscription does not exhaust the manifestational register.

Manifestational reality should also be distinguished from the referential truth of a manifestation. A vivid perceptual flower generated under pathological or altered perceptual conditions can possess manifestational reality: the flower appears, organizes attention, and may provoke action or affect. An ordinary perceptual flower associated with a physically existing plant can likewise possess manifestational reality. The fact that both are manifestations does not establish that their ontological sources or generative structures are identical. Conversely, a difference in ontological interpretation does not make one of the manifestational events analytically nonexistent. GR can therefore investigate the reality and consequences of a manifestation while

keeping separate the further question of what produced it and what ontological status should be assigned to its apparent object.

This distinction becomes important whenever manifestation itself has effects. A classification printed on a document can alter eligibility. A diagnosis can reorganize self-understanding and institutional treatment. A price displayed on a market interface can change subsequent bids. A public declaration of trust can reshape expectations between participants. A representation of a social category can influence how people act toward those classified by it. In such cases, the manifestation is not merely evidence about an antecedent relational reality. Once incorporated into subsequent interactions, it becomes part of the generative environment.

Claim 4.12 (Manifestational mediation)**.** *A manifestation can enter a generative-relational system as an operative relation or object and thereby participate in the generation, stabilization, transformation, or dissolution of subsequent relational realities.*

Claim 4.12 does not imply that every manifestation substantially changes the system in which it occurs. Its significance is structural: the architecture permits such mediation and therefore cannot treat manifestation as only the terminal output of a prior process. The causal importance of any particular manifestation remains an empirical and historical question. Section 100 will later examine recursive relations among reality, manifestation, and representation in greater detail.

Manifestational reality also has a historical dimension. What can become manifest, to whom, through which medium, and with what resolution depends on available sensory capacities, concepts, institutions, instruments, archives, languages, technical infrastructures, norms, and practices of attention. A relation that was difficult to manifest under one historical configuration can become readily measurable or publicly articulable under another. Conversely, changes in classification or institutional practice can render previously salient realities less visible. Manifestation therefore belongs to history rather than constituting a timeless interface between mind and world.

4.2.4 Distinctions among the Three Registers

The three definitions establish different criteria and therefore resist several common reductions. Ontological reality concerns the status of what obtains or occurs without reducing that status to a particular manifestation. Relational reality concerns stable and causally efficacious emergence within a generative-relational system. Manifestational reality concerns becoming available under a particular configuration of relations and mediation. These registers can overlap in concrete cases, but overlap does not erase the difference among the questions they pose.

A relationally real object does not thereby acquire a settled independent ontology. The social efficacy of money, a legal person, a deity, an institutional role, or a stabilized self does not require GRE to decide that the relevant object exists as a fundamental substance. The relational claim can remain both strong and limited: the object has emerged, persists, and causally matters within the system. Conversely, an ontologically real process does not automatically possess relational reality relative to every generative-relational system. Something may exist yet remain causally disconnected

from the system under study, or it may fail to become sufficiently stabilized within that system to constitute the relational object relevant to the inquiry.

Relational reality likewise does not require manifestation, as Claim 4.10 states. Historical constraints, latent institutional structures, unrecognized patterns of dependence, or the generative conditions of a contingent encounter may operate before they are consciously noticed or symbolically articulated. Manifestation is therefore neither the origin nor the universal criterion of relational reality. At the same time, once a manifestation enters subsequent relations, Claim 4.12 allows it to become one of the conditions through which later relational realities are generated. The distinction between the registers thus supports directional asymmetry in particular cases without imposing a permanent hierarchy among them.

Manifestational reality also does not guarantee that the apparent object possesses the ontological status attributed to it by a subject. A manifestation can be vivid, stable, socially consequential, and repeatedly recorded while the ontological interpretation of its source remains uncertain or contested. Nor does manifestational similarity establish relational identity. Two similar experiences, measurements, classifications, or observable patterns may arise from different generative structures. The inverse problem is equally important: similar relational structures can manifest differently under different bodily, institutional, cultural, technical, or historical conditions. Later sections will develop these many-to-one and one-to-many possibilities more formally.

The distinctions also prevent a further assumption: shared relational reality does not entail comparability. Two objects can each satisfy the criteria of relational reality while lacking a justified common metric, ordering, coordinate system, or structure-preserving comparison. They may inhabit different metric spaces, non-metric relational spaces, or domains for which no warranted mapping has yet been constructed. A hallucinated flower and an ordinarily perceived physical flower provide a simple illustration. Both can be relationally consequential within the systems in which they arise, yet their generative structures need not be treated as instances of the same measurable object merely because the word “flower” is used for both manifestations. Establishing a comparison relation is an additional analytical achievement, not an automatic consequence of assigning the same reality-status.

Claim 4.13 (Non-necessary comparability of relational realities)**.** *The fact that two objects possess relational reality does not by itself establish a common metric, ordering, equivalence relation, structural map, or other justified basis of comparison between them.*

Claim 4.13 has methodological consequences throughout GRE. Comparative analysis must specify what is being compared, through which relation, and under what invariances or losses of information. Isomorphism, homomorphism, simulation, statistical resemblance, functional equivalence, and analogical comparison answer different questions and require different assumptions. Where no warranted comparison structure exists, preserving incomparability can be more rigorous than imposing a common measure for analytical convenience. This point becomes especially important when GRE studies heterogeneous values, forms of life, subjectivities, institutions, and modes of manifestation.

The distinctions among registers should therefore be read as safeguards against premature reduction. Ontological uncertainty need not erase relational reality. Relational efficacy need not establish ultimate ontology. Manifestational vividness need not disclose either register completely. Lack of manifestation need not imply lack of relational structure. Shared reality-status need not imply shared geometry. Each of these distinctions preserves a question that would otherwise disappear if "reality" were treated as a single undifferentiated category.

4.2.5 Relations across the Three Registers

The three-register architecture becomes most distinctive when the relations among the registers are considered. A tempting interpretation would treat them as a sequence: an ontological reality first exists, relational structures subsequently form around it, and a final manifestation presents the result to a subject. Such a trajectory may describe some local cases, but GR does not adopt it as the general architecture. The three registers form a graph of heterogeneous and historically variable relations. Different paths can connect them, and what becomes an effect along one path can become a condition along another.

Ontological conditions can participate in the emergence of relational realities. Material resources, bodily capacities, ecological processes, technical infrastructures, spatial arrangements, and other ontologically relevant conditions can constrain or enable the relations through which an object stabilizes. Yet the resulting relational object need not be reducible to those conditions. A monetary system, for example, requires material and technical supports but acquires causal properties through legal, institutional, symbolic, and practical relations that cannot be read directly from the physical medium of a banknote or database entry.

Relational realities can condition manifestation. What becomes salient, nameable, measurable, experientially coherent, institutionally visible, or symbolically available depends partly on the relations already organizing subjects, instruments, categories, institutions, and environments. A relation of trust can change what conduct is interpreted as reassuring or suspicious. An institutional category can determine which differences enter administrative records. A scientific instrument and its associated practices can make a pattern manifest that unaided perception could not distinguish. The manifestation therefore emerges within a relational field rather than arriving from outside it.

The reverse mediation is equally important. Once a manifestation occurs, it can alter the relational field. A statement, image, classification, measurement, judgment, or public performance can be remembered, circulated, institutionalized, contested, or incorporated into later expectations. Through these processes, manifestation can contribute to new persistence and causal efficacy. A relation may thus help generate a manifestation, while the manifestation becomes one of the relations through which a later relational reality is stabilized. Historical time matters because the system encountered after manifestation need not be the system that preceded it.

This recursive possibility is particularly significant for aesthetic judgment and contingency. The relational-generative-historical structure through which a contingent encounter becomes possible can exist before the encounter is apprehended as con-

tingent. When contingency later becomes manifest through surprise, attention, aesthetic judgment, or conceptual recognition, the manifestation can redirect inquiry, memory, valuation, preservation, or future practice. The recognition therefore neither creates the entire preceding structure nor merely reflects it. It enters the history of that structure and can change what the system subsequently generates.

The architecture has a limited heuristic affinity with Lacan's three registers of the Imaginary, the Symbolic, and the Real. Lacanian register theory itself changed substantially over time, and later formulations emphasize mutual dependence among the registers rather than treating them as a simple developmental sequence (Johnston 2026). GR does not adopt Lacan's definitions or identify its registers one-to-one with his. Ontological reality is not the Lacanian Real; relational reality extends well beyond the Imaginary; and manifestational reality includes forms of appearance and mediation that are not reducible to the Symbolic. The useful analogy lies at the architectural level: a plurality of registers can be mutually conditioning, and the relations among them can be more informative than an attempt to place them in a single hierarchy.

Remark 4.14 (Graph rather than chain)*.* Ontological, relational, and manifestational reality should be treated as registers connected by heterogeneous relations rather than as stages in a universal sequence. Their connections may be recursive, many-to-many, historically changing, and only partially invertible. A path observed in one case does not establish the direction or form of mediation in another.

The graph conception also leaves room for missing edges. A research programme need not assume that every ontological condition is relationally relevant to the system under study, that every relational reality becomes manifest, or that every manifestation permits reliable inference toward its generative conditions. Some relations may be weak, historically absent, technically inaccessible, or analytically unjustified. Treating the architecture as a graph therefore does not mean multiplying connections without discipline. It means that connections are objects of inquiry whose existence, direction, stability, and explanatory importance must be established rather than presumed.

The three registers can now support the rest of the chapter. Section 92 clarifies the methodological status of ontological suspension. Section 93 identifies the primitive vocabulary through which emergence and stabilization can be analyzed. Sections 94 and 95 then return separately to relational and manifestational reality, allowing persistence, stability, causal efficacy, forms of manifestation, and participation in subsequent relations to receive fuller treatment. The later analysis of manifestation mappings, non-invertibility, symbolization, and recursive mediation builds on the architecture established here. The purpose of the present section is therefore not to close the ontology of GR but to preserve three analytically distinct questions and to make their interrelation available for disciplined investigation.

4.3 Ontological Suspension

This section develops *ontological suspension* as a methodological discipline within GR. The preceding sections established that generative-relational inquiry requires ex-

plicit ontological commitments while also distinguishing ontological, relational, and manifestational reality. Ontological suspension specifies how those commitments can remain proportionate to the explanatory task. Its role is neither to weaken reality claims nor to replace ontology with epistemic uncertainty. Rather, it allows inquiry to affirm what has been sufficiently established at one register while withholding stronger claims whose resolution is unnecessary, unavailable, or not yet warranted. The section proceeds by distinguishing suspension from denial and agnosticism, then treats suspension as a disciplined practice, examines its use under ontological disagreement, and concludes by clarifying how suspended questions can remain analytically usable without being prematurely settled. (Fraassen 1980; Quine 1948)

4.3.1 Suspension and Denial

Ontological suspension begins with a distinction between declining to affirm a stronger ontological claim and denying that claim. The distinction is elementary but consequential. An inquiry may have sufficient grounds to establish that an object is relationally real while lacking grounds to determine whether that object possesses an independent ontological status. In such a case, GR does not infer nonexistence from the absence of a stronger commitment. It leaves the stronger question open and continues the analysis at the register for which evidence and explanatory need are available.

Consider money. GRE can study money as a relationally real object because monetary forms can emerge through institutional, legal, material, symbolic, and practical relations; persist with sufficient stability; and causally affect allocation, obligation, expectation, production, and future relations. None of these claims requires GRE to settle whether "money" corresponds to an independently existing ontological kind beyond the relations through which monetary reality is sustained. Suspension therefore preserves the reality relevant to the inquiry while withholding a metaphysical conclusion that the analysis does not need.

The same distinction applies to less conventional objects. A deity can possess relational reality within a religious community when the relevant object is historically sustained, structures expectations and conduct, enters institutional practices, organizes temporal and spatial routines, and causally affects subsequent relations. GR can analyze this relational reality without determining whether the deity also possesses ontological reality independent of those relations. Suspension in this case does not entail atheistic denial, theological affirmation, or the reduction of religious experience to error. It identifies the precise ontological question that the inquiry is not presently resolving.

A similar structure can arise in the analysis of selfhood. The experienced continuity of an "I" may be relationally stabilized through embodiment, memory, recognition, language, institutional identity, habit, and historical continuity. This stabilized self can organize action and therefore possess causal efficacy within the system. The corresponding relational claim does not require GR to affirm or deny an invariant metaphysical self. The inquiry can proceed by studying the generative conditions, persistence, transformations, and consequences of selfhood while suspending stronger ontological commitments about what the self ultimately is.

Definition 4.15 (Ontological suspension)**.** *Ontological suspension* is the disciplined withholding of commitment concerning an ontological claim whose resolution is not presently warranted or required for the explanatory task, while preserving and using those weaker or differently scoped reality claims that the inquiry can support.

Definition 4.15 contains two positive components. First, suspension is directed toward a specified claim rather than toward reality in general. Second, suspension preserves other warranted commitments. It is therefore compatible with strong claims at another register. An inquiry may suspend the ontological status of money while affirming its relational reality; suspend the ultimate nature of consciousness while studying manifestational and relational structures of subjectivity; or suspend the metaphysical status of a social category while examining its institutional stability and causal effects.

This claim-specific character prevents ontological suspension from becoming an indiscriminate refusal to decide anything. GR does not treat uncertainty as an intellectual virtue in itself. Where evidence, argument, or explanatory necessity supports a stronger commitment, suspension can be narrowed or lifted. Where a claim has been sufficiently falsified within the relevant domain, denial may be justified. Suspension therefore occupies a distinct methodological position between unwarranted affirmation and unwarranted negation.

The distinction is particularly important for generative inquiry because the objects of interest may cross registers. A manifestational event can have effects even when the ontological status of what appears remains unsettled. An illusory flower perceived under altered physiological conditions can become relationally consequential through attention, movement, fear, memory, communication, or later interpretation. A physically present flower can likewise become relationally consequential through perception and subsequent action. The fact that both can possess relational reality does not erase differences in their ontological conditions. Suspension allows the inquiry to preserve those differences without requiring an immediate final comparison between them.

Claim 4.16 (Suspension does not imply unreality)**.** *Suspending the ontological status of an object does not entail that the object is unreal at other registers. Relational and manifestational reality remain independently assessable under their own conditions.*

Claim 4.16 is foundational for the remainder of the chapter. It prevents a recurrent collapse in which only ontologically fundamental objects are treated as real, while institutionally, psychologically, culturally, or symbolically mediated objects are relegated to a secondary status. GRE instead asks which reality claim is being made, under which conditions, and with what explanatory consequences.

4.3.2 Suspension and Agnosticism

Ontological suspension also differs from general agnosticism. Agnosticism ordinarily describes a position of non-knowledge or unresolved belief concerning a question. Suspension, as used here, is more local, functional, and methodologically organized. A researcher may personally hold a metaphysical view while suspending it within a particular analysis because the view is not required to establish the argument. Conversely, a researcher may remain personally undecided while the inquiry

itself reaches a sufficiently strong local ontological conclusion. GR therefore treats suspension as a property of an analytical procedure rather than as a report of the researcher's private belief state.

This difference matters because a research programme must coordinate inquiry across people who may hold incompatible metaphysical commitments. If every empirical or theoretical analysis required prior agreement concerning the ultimate ontology of persons, institutions, meanings, values, information, or social facts, large portions of inquiry would become hostage to disputes operating at a different level. Ontological suspension creates a disciplined space in which researchers can identify the stronger question, state that it remains open for the purposes of the analysis, and continue working with commitments that are both sufficient and jointly assessable.

Suspension is also compatible with differentiated confidence. The framework need not divide claims into only affirmed, denied, or suspended categories. A claim can be weakly supported, strongly supported, locally adequate, historically contingent, scale-dependent, or open to revision. Suspension concerns the point beyond which the inquiry refrains from extending its commitments. In this sense, it functions as a boundary on inference. The boundary may move as new evidence, conceptual distinctions, or explanatory requirements emerge.

For example, suppose an analysis establishes that a particular institutional category has persistent effects on eligibility, behavior, and resource distribution. The category can be treated as relationally real within the institutional system. Whether that category tracks a natural kind, a socially constructed kind, a historically contingent administrative device, or some combination may remain unresolved. The inquiry can suspend this further ontological classification while retaining the causal and institutional findings. If later research demonstrates that the distinction among these possibilities is itself necessary to explain the observed dynamics, the suspended question becomes active and must be investigated.

This temporality is important. Suspension is not a permanent exile of difficult questions. It is a way of sequencing inquiry so that questions are addressed when their resolution becomes relevant and when the available methods can bear on them. A suspended claim may later become central; a previously central ontological dispute may later become irrelevant to a more local explanatory task. GR therefore understands suspension as revisable and historically situated.

Remark 4.17 (Suspension is inquiry-relative)*.* The same ontological proposition may be suspended in one inquiry and actively investigated in another. Suspension attaches to the relation between a claim and an explanatory task, not permanently to the object itself.

This inquiry-relative character also prevents the framework from treating ontological suspension as a universal solution. Some questions cannot be responsibly deferred. A study of legal responsibility may require a more explicit account of agency than a study of transaction frequency. A study of machine subjecthood may require ontological distinctions that can be suspended in a narrow analysis of machine-mediated market behavior. A study of hallucination may require distinctions between perceptual generation and external physical objects that are unnecessary in an analysis limited to the subsequent behavioral effects of the experi-

ence. The appropriate degree of suspension therefore depends on what explanatory burden the analysis places on its objects.

A further difference from agnosticism concerns positive use. Agnosticism can leave a proposition untouched. Suspension often permits the object associated with that proposition to remain analytically active under another description. One can suspend whether a deity possesses independent ontological reality while analyzing the relational reality of divine authority; suspend whether the self is ontologically fundamental while analyzing self-continuity; suspend whether value exists independently of valuation while studying value as a historically stabilized relational formation. The suspended question remains visible, but inquiry does not need to stop at it.

4.3.3 Suspension as Methodological Discipline

Ontological suspension becomes useful only when it is practiced with discipline. An unspecified statement that "ontology is suspended" can conceal ambiguity just as easily as an unspecified ontological assertion can. GR therefore requires suspension to identify the claim being withheld, the commitments being retained, the reason for suspension, and the conditions under which the question would need to be reopened.

A minimal procedure can be stated in four steps. First, the inquiry identifies the ontological proposition whose stronger resolution is at issue. Second, it states the reality claims that remain necessary for the analysis. Third, it explains why the stronger proposition is not presently required or not sufficiently warranted. Fourth, it tracks whether later stages of the inquiry silently depend on the suspended proposition. These steps make suspension auditable rather than rhetorical.

Definition 4.18 (Disciplined suspension)**.** A suspension is *disciplined* when the inquiry specifies the suspended claim, preserves the commitments required for explanation, states the reason for withholding further commitment, and prevents later inference from covertly presupposing what has been suspended.

The final condition is especially important. An analysis might claim to suspend whether a category is natural or socially constituted, then later interpret its persistence as evidence of naturalness. It might suspend whether an artificial system possesses subjecthood, then assign responsibility to it in a way that presupposes a particular theory of agency. It might suspend whether a market category reflects intrinsic value, then treat observed price as if it directly disclosed such value. These moves would not constitute ontological suspension. They would amount to concealed reintroduction of the stronger claim.

Disciplined suspension therefore requires attention to language. Terms such as "entity," "agent," "subject," "value," "information," "institution," "identity," and "cause" can carry stronger ontological implications than an analysis intends. GR does not require abandoning ordinary terminology, but it does require sensitivity to when a convenient analytical label begins doing metaphysical work. Local definitions, explicit qualifications, and distinctions among registers can prevent such slippage.

Suspension also has a scalar dimension. An object may be treated as sufficiently

real and stable at one scale while its internal constitution remains suspended. A firm can be analyzed as an organizational actor in a market model even though its internal relations are heterogeneous and contested. A person can be treated as a subject of a legal relation while a theory of personal identity remains open. A currency can be treated as a stable monetary unit for one period while its institutional production, material carriers, and symbolic representations are separately investigated. The relevant question is whether the chosen level of objecthood supports the explanatory task without obscuring transformations that matter to the result.

The same logic applies temporally. A relational object may be stable enough for analysis over one interval and unstable over another. Ontological suspension can prevent the local stability of an object from being mistaken for timeless identity. This is especially important in GRE because many objects of economic analysis are historically generated. Firms change legal form, markets change infrastructure, currencies change institutional backing, identities change classificatory regimes, and technologies alter the relations through which objects acquire causal efficacy. Suspension preserves the distinction between "stable enough here" and "fundamentally invariant."

Methodological discipline further requires that suspension remain compatible with causal explanation. GR does not use suspension to avoid specifying mechanisms. If an object is treated as relationally real because it exerts causal efficacy, the analysis must still investigate the relations through which that efficacy arises. Saying that the object's ultimate ontology is suspended does not permit causal vagueness. On the contrary, the weaker metaphysical commitment increases the importance of showing how persistence, stability, and causal participation are generated within the relevant system.

Claim 4.19 (Suspension and explanatory burden)**.** *Ontological suspension reduces unnecessary metaphysical commitment but does not reduce the explanatory burden associated with relational or manifestational claims. The mechanisms, conditions, and scope supporting those claims remain open to investigation.*

Claim 4.19 prevents suspension from functioning as a refuge from difficult analysis. If GRE claims that trust, money, authority, or identity is relationally real, it must still account for how that reality is generated and maintained. Suspension concerns what need not be claimed beyond that analysis, not what need not be explained within it.

4.3.4 Suspension under Ontological Disagreement

Ontological disagreement is common in the domains GRE studies. Social ontology, philosophy of mind, philosophy of science, religious ontology, theories of value, institutional theory, and theories of agency all contain persistent disagreements concerning what kinds of things exist and what makes them real. Generative-relational inquiry requires a way to work across such disagreement without pretending that the disagreements have disappeared.

Ontological suspension provides one such mechanism. When competing ontologies generate the same commitments required for a local analysis, the inquiry can bracket their stronger divergence and examine the shared relational or manifestational structure. For example, researchers may disagree over whether institutions

possess a reality irreducible to individual action. If both accounts nevertheless recognize a stabilized pattern of rules, expectations, roles, and sanctions that causally affects behavior, a GRE analysis can investigate that relational configuration while leaving the deeper disagreement unresolved for the purposes of that task.

This strategy does not imply that ontological disagreement is always irrelevant. Competing ontologies may produce different explanations, identify different objects, or recommend different methods. A strongly individualist ontology and a strongly structural ontology may disagree not only about metaphysical grounding but also about where causal efficacy should be located. In such cases, suspension of the disagreement would remove precisely what the research needs to test. GR therefore distinguishes *non-operative disagreement*, which can be suspended for a particular task, from *operative disagreement*, which changes the explanatory consequences and must remain visible within the analysis.

Definition 4.20 (Operative ontological disagreement)**.** An ontological disagreement is *operative* for an inquiry when competing ontological commitments alter the identification of relevant objects, mechanisms, causal relations, evidence, or explanatory consequences within that inquiry.

Definition 4.20 gives suspension a limit. If an ontological difference changes what the model predicts, what evidence counts, what mechanism is possible, or what intervention follows, the difference cannot be treated as merely philosophical background. Conversely, when competing metaphysical accounts leave the local explanation unchanged, insisting on prior resolution can add controversy without adding explanatory power.

This distinction also supports pluralism within GRE. Researchers can develop different ontological interpretations of the same generative-relational phenomenon while remaining part of a common research programme, provided the differences are explicitly stated and their consequences can be compared. Ontological suspension therefore does not require theoretical homogeneity. It can create a shared analytical surface on which competing deeper accounts become comparable where comparison is possible.

The possibility of comparison, however, must itself be established. Section 91 emphasized that two relational realities need not inhabit a common metric or even a common comparison space. The same caution applies to ontological theories. Two accounts may use incompatible primitive vocabularies or organize reality at different scales. Suspension can permit local cooperation without forcing artificial commensurability. When translation is possible, the mapping should be stated; when it is partial, the loss should be acknowledged; when no justified mapping exists, the disagreement may remain structurally unresolved.

This point is important for cross-cultural and interdisciplinary inquiry. A phenomenon can be embedded in distinct conceptual, religious, scientific, legal, or experiential ontologies whose categories do not align cleanly. GRE should not assume that one vocabulary can always translate another without remainder. Ontological suspension can preserve analytical openness while allowing researchers to study the relational consequences of each framework within its own domain. The aim is not to declare all ontologies equivalent but to avoid manufacturing equivalence before the

conditions of comparison have been established.

Under disagreement, suspension also has an ethical dimension. Prematurely declaring one ontology to be the sole legitimate description can erase forms of experience or institutional reality that remain causally consequential for the people and systems under study. At the same time, treating every ontological claim as equally warranted would abandon standards of evidence and argument. GR therefore seeks a middle position: stronger ontological judgments remain possible, but they are made only when the inquiry requires them and when the grounds for doing so are explicit.

4.3.5 Suspension and Analytical Usability

The practical value of ontological suspension lies in the fact that analytically useful objects need not wait for metaphysical closure. Economic and social inquiry routinely operates with objects whose ultimate status is contested but whose effects are sufficiently stable to investigate. GRE systematizes this practice by distinguishing analytical usability from final ontological settlement.

An object is analytically usable when it can be specified with enough stability, relational location, and causal relevance to support the explanatory task. This criterion is intentionally weaker than ontological fundamentality. A market index can be analytically useful without constituting a fundamental natural kind. A legal person can be analytically useful without resolving metaphysical theories of personhood. A social identity can be analytically useful without assuming that the category is natural, timeless, or internally homogeneous. A manifestational form can be analytically useful even when the underlying generative structure remains only partially known.

Claim 4.21 (Analytical usability under suspension)**.** *An object whose stronger ontological status is suspended can remain analytically usable when its relevant boundaries, persistence, relations, and causal consequences are sufficiently specified for the explanatory task.*

This principle helps GR avoid two symmetrical errors. The first is ontological inflation: treating analytical usefulness as proof of fundamental existence. The second is ontological paralysis: refusing to analyze an object until every metaphysical question surrounding it has been settled. The former converts models into ontology too quickly; the latter makes inquiry dependent on conclusions it may never need. Suspension preserves a working space between them.

Analytical usability is nevertheless conditional. The object must remain adequate to the task. If a category's internal heterogeneity begins to change the result, the category must be refined. If a boundary that was previously harmless becomes causally consequential, the boundary must be reconsidered. If a manifestation once treated as a proxy ceases to track the relational structure of interest, the proxy must be revised. Suspension therefore works together with the revisability of analytical objects.

This revisability becomes particularly important in recursive systems. A category used for analysis can enter the system and alter what it describes. A risk classification can change credit access; a diagnostic label can alter self-understanding and institutional treatment; an economic forecast can change expectations and investment;

an aesthetic judgment can redirect attention and preservation; a legal designation can reorganize rights and obligations. Once the analytical or manifestational form becomes generatively active, its status may need to be reconsidered as part of the relational reality under study. Suspension does not isolate the analyst from this recursion. It requires the inquiry to notice when its representations have become causal components of the system.

The same principle applies to contingency. A contingent relational configuration may become stable enough to exert causal efficacy before any subject recognizes it as contingent. Its relational reality can therefore be analyzed prior to conscious manifestation. If the contingency later becomes aesthetically salient, symbolically articulated, or institutionally recorded, those manifestations may feed back into the relations through which the object persists. Ontological suspension allows the analysis to follow this history without forcing the pre-manifestational structure, the manifested object, and the ontological substrate into a single category.

The method can therefore be summarized as selective commitment. GR commits to what the explanatory task can support, suspends what lies beyond that support, and reopens suspended questions when they become operative. This practice preserves the reality of emergent and causally efficacious objects while resisting the conversion of local explanatory success into universal metaphysical closure.

Remark 4.22 (Suspension and the three-register architecture)*.* Ontological suspension is one of the mechanisms that keeps the three registers analytically distinct. It permits a researcher to affirm relational or manifestational reality while leaving a stronger ontological claim unresolved, and it permits later evidence or argument to modify that suspension without retrospectively invalidating the earlier local analysis.

Ontological suspension thus completes the methodological groundwork established by Sections 90–92. Section 90 showed why GR requires explicit ontological commitments without ontological closure. Section 91 distinguished ontological, relational, and manifestational reality and treated their relations as a graph rather than a chain. The present section has specified how inquiry can move among those registers without making every local reality claim carry the burden of a final metaphysics. Section 93 can now turn from the status of ontological claims to the primitive analytical vocabulary through which emergent stability becomes describable: change, structure, constraint, and difference.

4.4 Primitive Structure and Ontological Emergence

Chapter 4 requires a vocabulary capable of describing emergence before the analysis presupposes fully constituted entities, subjects, relations, institutions, or values. Chapter 3 introduced change, structure, constraint, and difference as a minimal primitive structure for GRE. The present section develops their specifically ontological role. Its objective is to show how these four methodological primitives can support descriptions of emergence and relative stability while remaining compatible with ontological suspension. The discussion considers each primitive separately, then examines their interaction and the formation of stable configurations. The method is constitutive and deliberately weak: the primitives provide conditions for describing how

determinate objects can become analytically available without being declared the metaphysically fundamental constituents of reality.

Definition 4.23 (Methodological primitive)**.** A *methodological primitive* is a distinction provisionally treated as analytically available before the framework constructs richer objects from it. Its primitive status concerns the organization of inquiry and does not, by itself, establish metaphysical fundamentality, temporal priority, indivisibility, or universal explanatory sufficiency.

Definition 4.23 preserves the restraint developed in Sections 4.1–4.3. Change, structure, constraint, and difference may themselves admit further decomposition under another theory or at another scale. A physical account may redescribe a social constraint through material processes; a phenomenological account may differentiate forms of experienced difference; a mathematical representation may replace ordinary structural language with a more specific formal object. GR does not require those approaches to converge on one final primitive basis. The quartet functions as a minimal analytical grammar within the present research programme.

The order in which the four primitives are presented should likewise be interpreted analytically rather than chronologically. GR does not posit a first moment of pure change followed by the later arrival of structure, constraint, and difference. Each becomes intelligible through the others. Change is identified through differences across configurations; structure supplies organization within which such differences can be tracked; constraints condition accessible transformations; and differences become consequential through structures that preserve, amplify, suppress, classify, or redirect them. Ontological emergence is therefore approached through their interaction rather than through a linear derivation from one primitive. (P. W. Anderson 1972; Simon 1962; Nicolis and Prigogine 1977)

4.4.1 Change

Change provides the minimal temporal opening required for emergence. An analysis of emergence must permit a later configuration to differ from an earlier one, or a process to produce distinctions that were previously absent at the selected resolution. GR therefore uses change in a broad sense: a transformation in state, organization, relation, capacity, boundary, rule, classification, or possibility. This formulation allows the identity of what changes to remain partly open. The object need not be fully constituted before the transformation begins.

This point matters for ontological analysis because many economic and social objects are encountered only after a period of formation. A firm may acquire legal identity after organizational relations have already developed. A monetary practice may stabilize before a standardized representation is established. A collective identity may become causally consequential while its boundaries remain contested. If inquiry requires the object to possess a fixed identity before change can be described, the formative process is partly hidden by the analytical vocabulary. Treating change as primitive permits the analysis to track transformations through which the object itself becomes more determinate.

Change can occur at several levels. A configuration can move among states while its constitutive organization remains relatively stable. Its structure can also change,

altering the pattern through which later states become possible. Constraints can be modified so that transitions previously difficult or unavailable become accessible, while other transitions become costly or foreclosed. Differences that were once negligible can become consequential when a new institution, technology, category, or practice makes them operative. A still stronger transformation can alter the mechanisms through which subsequent change is generated. GR therefore distinguishes change in a configuration from change in the generative conditions of that configuration.

The primitive also includes maintenance. Relative stability frequently depends on continuing activity. A legal status persists through records, procedures, recognition, enforcement, and institutional reproduction. A currency remains usable through repeated practices of acceptance, accounting, settlement, and regulation. A self-description may remain stable through memory, bodily continuity, social recognition, and narrative reproduction. In these cases, stability at one analytical level coexists with ongoing transformations at another. Change and persistence consequently form compatible features of a generative-relational system.

Change alone does not identify emergence. Many transformations dissipate without producing a persistent configuration. Others alter an existing object without generating a new one at the relevant scale. The ontological significance of change depends on the organization through which transformations become patterned, retained, and capable of affecting later processes. Structure supplies that second dimension.

4.4.2 Structure

Structure refers to patterned organization sufficiently coherent for distinctions, transitions, and dependencies to be tracked. Its use in GR is intentionally plural. A structure may be spatial, temporal, institutional, legal, symbolic, computational, ecological, organizational, or relational. Several descriptions may apply to the same configuration at different scales or for different research purposes. The concept therefore identifies organization without requiring one privileged formal representation.

Ontological emergence requires structure because a transient difference becomes analytically significant only within some organization that allows it to persist, recur, combine with other differences, or modify future transformations. A repeated exchange practice, for example, becomes more than a collection of isolated transactions when expectations, roles, records, conventions, enforcement, and material infrastructures organize later exchanges. The relevant structure may remain incomplete and historically variable while already giving the process a degree of continuity.

Structure should therefore be separated from rigidity. A configuration can preserve recognizable organization while its constituents change. An institution can maintain procedural continuity while officeholders, rules, technologies, and interpretive practices evolve. A network can retain a characteristic pattern while particular ties form and dissolve. A person can preserve an experienced continuity of self while memories, relations, capacities, and bodily conditions change. Structural stability is always relative to a selected resolution and timescale.

This relativity is especially important for the three-register architecture. A struc-

ture identified at the manifestational register may differ from the structure inferred at the relational register. Repeated observations can display a stable statistical pattern without uniquely determining the generative configuration that produces it. Conversely, a relational structure can remain sufficiently stable while its manifestations vary across contexts. Structure is therefore register-sensitive: the analyst should specify what is organized, at which register, over what interval, and under which observational or representational conditions.

Structure also enables the preservation of history. Earlier transformations can leave traces in current organization through institutional rules, material infrastructures, learned dispositions, network positions, accumulated resources, classifications, or path-dependent expectations. The resulting configuration carries a history without requiring every historical event to remain explicitly represented. In GR, emergence is therefore commonly historical: a stable object can condense prior transformations into a structure that shapes what happens next.

Treating structure as primitive does not establish that structure exists independently of process. The methodological role is narrower. GR requires a way to describe organized regularity before deciding whether a particular case is best understood through entities, relations, processes, fields, or another ontology. Structure supplies that analytical capacity while leaving its deeper constitution open.

4.4.3 Constraint

Constraint introduces asymmetry into the space of possible transformations. A configuration becomes generatively consequential when some transitions are enabled, favored, stabilized, delayed, made costly, prohibited, or rendered practically unavailable relative to others. Constraint therefore refers to conditions that shape the accessible trajectories of a system. Such conditions can be material, institutional, legal, informational, symbolic, bodily, ecological, computational, or relational, and their mechanisms need not be identical.

This primitive is central to emergence because persistence requires more than repeated occurrence. A configuration that can be displaced by arbitrarily small perturbations may appear momentarily without becoming stable at the timescale relevant to the inquiry. Constraints can help maintain a configuration by limiting departures, supporting repair, directing feedback, preserving boundaries, or making particular responses more probable. They can also prevent an incipient configuration from stabilizing. Emergence and dissolution are therefore both partly intelligible through changing constraints.

Constraint includes enabling conditions. A legal form can restrict certain actions while making others possible by defining authority, ownership, liability, or procedural competence. A technical standard can narrow acceptable formats while allowing coordination among previously disconnected participants. A language constrains expression through grammar and convention while enabling complex articulation. An infrastructure conditions where and how interaction occurs while expanding the range of activities that can be sustained. GR accordingly treats constraint through its effect on accessible possibilities rather than equating it with direct prohibition or coercion.

Constraints are often positional. The same institutional arrangement can enable one subject while restricting another; the same market structure can generate opportunity for one firm while creating dependency for another; the same symbolic classification can confer recognition in one setting and produce exclusion in another. The relevant question is therefore which transitions are conditioned for which subjects or configurations, through which mechanism, and over what scale. A general statement that a system is "constrained" is insufficient without this local specification.

Constraint can itself be historically generated. A practice repeated over time may produce expectations that later function as constraints. A manifestation can be recorded, classified, and institutionalized in ways that reshape subsequent possibilities. Material investments can harden earlier decisions into infrastructure. A legal category can stabilize a distinction and thereby affect later subject formation. In these cases, the outcome of one generative process becomes part of the constraint structure governing another. The graph-like architecture of Chapter 4 is therefore visible already at the primitive level: products of prior emergence can enter the conditions of later emergence.

No normative valence follows from constraint alone. A constraint may preserve a valuable capacity, stabilize domination, prevent harm, sustain cooperation, reproduce exclusion, or combine several of these effects. Normative evaluation requires additional concepts. At this stage, constraint identifies how the space of possible transformation acquires shape.

4.4.4 Difference

Difference provides the minimal condition for distinction. GR uses the term to indicate non-equivalence that becomes analytically or causally consequential within a configuration. Difference may concern state, position, timing, capacity, relation, classification, intensity, direction, accessibility, or another dimension selected by the inquiry. The concept remains weaker than inequality, opposition, hierarchy, or conflict. Those more specific relations can emerge from differences but should not be built into the primitive itself.

Difference is required for change to be identifiable, yet the two concepts remain distinct. A difference can coexist at one time between positions or components without representing a temporal transition. Change can then be described when a relevant difference appears, disappears, increases, decreases, or is reorganized across configurations. Structure determines which differences can be represented as belonging to a common organization, while constraint affects which differences can persist or alter later trajectories.

The significance of a difference is relational. A variation that has no effect under one configuration may become decisive under another. A minor difference in documentation can become institutionally consequential when a legal procedure uses that distinction to allocate status. A small variation in network position can matter greatly under a process that amplifies preferential access. An unarticulated bodily sensation can become salient after a new interpretive category is learned. A price difference can remain irrelevant where exchange is impossible and become operative once an infrastructure connects the relevant markets. Difference therefore becomes genera-

tive through the structures and constraints in which it participates.

This point also guards against equating manifestation with the production of difference itself. A difference can be relationally operative before it is perceived, named, or symbolized. A historical configuration may already contain an asymmetry or contingency that shapes subsequent possibilities before any subject recognizes it. Later manifestation can render that difference salient and can subsequently transform the relational configuration, but the manifestation is not necessarily the origin of the operative distinction. This possibility is especially important for GR accounts of contingency, aesthetic judgment, subject formation, and historical recognition.

Difference also raises the problem of comparability. Two differences cannot automatically be assigned magnitudes on a common scale. Some domains admit a justified metric; others support only ordering, classification, structural correspondence, or qualitative distinction; still others presently lack a warranted comparison map. The primitive of difference therefore establishes distinguishability without presuming commensurability. This restraint preserves the possibility that heterogeneous relational realities can each be real while remaining structurally incomparable under the currently available analytical framework.

4.4.5 Interaction among the Four Primitives

The four primitives acquire their explanatory force through interaction. GR does not treat change, structure, constraint, and difference as independent components that can simply be assembled after separate analysis. Each conditions how the others become meaningful. Structure permits differences and changes to be tracked; difference allows structures and transformations to be distinguished; constraints shape which transformations remain accessible; and change can modify the structures and constraints through which later differences become consequential.

A minimal generative description therefore asks how these dimensions coorganize over time. An initially small difference can be amplified when a structure channels repeated interaction through it. The resulting pattern can generate constraints that preserve the difference and make later trajectories dependent upon it. Conversely, a structural change can weaken an existing constraint, permitting previously suppressed differences to become operative and producing a new configuration. Feedback can stabilize the resulting organization, while another process may destabilize it. Emergence is located in this evolving organization rather than in any one primitive taken alone.

Claim 4.24 (Mutual constitution of the primitive structure)**.** *Within GR, change, structure, constraint, and difference function as mutually conditioning methodological primitives. Their analytical separability supports explanation, while their interaction supplies the minimal vocabulary through which the formation, persistence, transformation, and dissolution of more determinate configurations can be described.*

Claim 4.24 also clarifies why the quartet should not be converted into a universal causal sequence. A local analysis may identify a historically specific trajectory—for example, an initial difference followed by structural amplification and later institutional constraint—but another process can begin from an inherited constraint, a structural rupture, or continuing change that gradually generates a distinguishable

difference. The explanatory order is empirical and historical. The primitive architecture provides the vocabulary within which that order can be reconstructed.

The interaction is likewise compatible with multiple registers. A manifestational difference can alter a relational constraint when an articulated classification changes institutional treatment. A relational structure can condition which manifestations become likely or intelligible. An ontological condition, where warranted, can restrict both relational formation and manifestation. Later sections will develop these cross-register relations in greater detail. At the present stage, the important point is that primitive interactions can occur within a register and across registers, and the mapping among them need not be one-to-one.

This framework also accommodates observer dependence without reducing reality to observation. The analyst chooses boundaries, timescales, and distinctions through which change, structure, constraint, and difference are represented. Those representational choices can alter what becomes visible in the analysis. The causal efficacy of the configuration, however, does not depend on the analyst having represented it correctly. GR therefore separates the methodological primitives used to construct an account from the stronger claim that reality itself is exhausted by those primitives.

4.4.6 Emergence of Stable Configurations

Ontological emergence, in the restrained sense required here, concerns the formation of a configuration that becomes sufficiently organized and persistent to be treated as a determinate object of inquiry. Such a configuration can arise when changes are retained through structure, consequential differences are reproduced or transformed, and constraints support a degree of continuity across further change. Stability is relative to timescale, boundary, and analytical resolution. It does not require immobility, permanence, equilibrium, or immunity to transformation.

Definition 4.25 (Relatively stable configuration)**.** A *relatively stable configuration* is an organized pattern that preserves sufficient continuity across a specified region or interval of spacetime for its identity, effects, or transformations to be tracked at the resolution relevant to an inquiry. Its stability may depend on continuing generative activity and can coexist with substantial internal change.

Definition 4.25 deliberately stops short of defining relational reality. Relative stability is necessary for many relationally real objects, yet stability alone is insufficient. The following section will require the further question of causal efficacy within the generative-relational system. A recurring pattern that remains observationally stable but exerts no relevant causal effect may be descriptively important without satisfying the full GR criterion for relational reality. Section 4.4 therefore establishes the primitive conditions through which candidate objects become available for the stronger analysis that follows.

Stable configurations can be generated through heterogeneous mechanisms. Repetition can reinforce expectations; feedback can maintain a range of states; institutional rules can preserve boundaries; material infrastructures can retain earlier decisions; memory can transmit prior distinctions; legal recognition can stabilize roles; symbolic classifications can coordinate action; repair processes can restore a configu-

ration after perturbation; and dependencies can make departure increasingly costly. GR does not assume that one mechanism explains every case. The ontological architecture should remain broad enough to distinguish different stabilization processes while still asking how they participate in generation.

The emergence of a configuration also does not guarantee a unique level of description. The same process may stabilize an object at one scale while remaining highly variable at another. A market can display stable aggregate patterns while individual relations change rapidly. A person's self-experience can preserve continuity while bodily and social conditions evolve. An institution can remain legally continuous while its practical operation is reorganized. Multiple relatively stable configurations can therefore overlap, nest, or intersect without being reducible to one common metric or hierarchy.

The historical dimension is decisive. Once a configuration stabilizes, it can become part of the conditions under which later emergence occurs. A relational object generated at one time can constrain later action; a manifestation can be institutionalized and become a component of subsequent relational structure; a difference can be preserved in records and reactivated under a later classification regime. Emergence therefore changes the generative field in which future emergence takes place. The result is a recursive historical process rather than a sequence in which completed objects simply accumulate alongside one another.

Claim 4.26 (Primitive structure and ontological emergence)**.** *Change, structure, constraint, and difference provide GR with a minimal methodological grammar for describing how relatively stable configurations can emerge, persist, transform, and dissolve. The adequacy of this grammar is assessed through explanatory use, while stronger claims concerning the ultimate ontology of the primitives or the configurations generated through them remain subject to the local requirements of inquiry and to ontological suspension.*

Claim 4.26 locates the quartet within the broader ontological position of this chapter. GR commits to enough reality for emergence, persistence, and causal organization to be investigated. It refrains from converting its starting vocabulary into a final metaphysics. This combination prepares the next step. Once a relatively stable configuration has emerged, the analysis can ask whether it also satisfies the stronger conditions of relational reality: emergence within a generative-relational system, persistence or stability over a relevant region or interval of spacetime, and causal efficacy within that system. The following section develops that criterion directly.

4.5 Relational Reality

Section 4.2 introduced relational reality as a technical category of GR: an object is relationally real when it emerges within a generative-relational system, persists with sufficient stability over a relevant region or interval of spacetime, and exerts causal efficacy upon that system. Section 4.4 then supplied the weaker primitive vocabulary through which candidate objects can become describable before the full criterion is satisfied. The present section develops relational reality in its own right. Its objective is to clarify the distinct work performed by emergence, persistence, stability, causal

efficacy, and participation in subsequent relations, while preserving the separation between relational reality and ontological identity. The method is constitutive rather than reductive: the section specifies conditions under which GR is warranted in treating an object as real within a generative-relational system without claiming that those conditions provide a final metaphysics of the object.

The criterion is deliberately stricter than the claim that something is related to something else. Almost any object can be placed within a descriptive network, and almost any event can be associated with surrounding conditions. Relational reality instead concerns an object whose generation and continuation depend upon a relational domain in which it becomes sufficiently determinate to participate causally in what follows. A transient correlation, an observer's arbitrary grouping, or a label that leaves the system unchanged does not become relationally real merely because it can be represented relationally. The category therefore joins an ontological claim of limited scope to an explanatory burden: the analyst must specify the relevant system, the object that has emerged, the domain over which it persists, the sense in which it remains stable, and the causal differences attributable to its presence. (Emirbayer 1997; Berger and Luckmann 1966; Searle 1995)

Claim 4.27 (Relational reality is system-relative rather than merely observer-relative)**.** *A claim of relational reality is indexed to a generative-relational system and an analytically relevant spacetime domain. This relativity does not reduce the object to an observer's description: once the relevant conditions are satisfied, the object can constrain, enable, or redirect processes independently of whether a particular subject recognizes or represents it.*

Claim 4.27 is important because the word *relational* can otherwise be misread as subjective or perspectival. GR uses the term differently. The system relative to which an object is real can include human subjects, institutions, technologies, material infrastructures, ecological processes, symbolic practices, artificial agents, or other relevant components. A subject's recognition may participate in the system, but recognition is neither a universal origin nor a universal criterion of relational reality. This allows GR to treat pre-perceptual and pre-symbolic structures as relationally real when they already satisfy the stronger conditions developed below.

4.5.1 Relational Emergence

Relational emergence concerns the formation of an object through the organization of relations rather than its simple discovery as an already individuated unit. The phrase does not imply that nothing existed before the object emerged. Components, processes, histories, constraints, and differences may already be present. What emerges is a relatively determinate object at the scale and register relevant to the inquiry: a monetary form, an institutional office, a trust relation, a collective identity, an experienced continuity of self, a market convention, or another configuration that was not previously available in the same organized form.

Definition 4.28 (Relational emergence)**.** *Relational emergence* is the formation of an analytically individuable object through a generative configuration of relations such that the object's organization and later effects cannot be specified adequately by treating the participating relata as independent of the relations through which the object

is generated.

This definition makes emergence stronger than aggregation. A pile of tokens and a currency system can contain some of the same material objects while differing radically in relational organization. A set of persons and an institution can contain the same persons while the institution introduces offices, expectations, procedures, permissions, records, sanctions, and histories that modify what those persons can subsequently do. The relationally emergent object is therefore not identified merely by listing its components. Its identity depends on the organization through which components, positions, practices, and constraints become mutually consequential.

Relational emergence can be gradual, punctuated, recurrent, or threshold-like. A trust relation may thicken through repeated interaction without a uniquely identifiable first instant. A legal status may acquire a conventional date of creation even though the relational conditions that make it operative developed earlier. A collective identity may emerge unevenly across subgroups and institutions. A digital asset may be technically instantiated at one moment while its economic relational reality develops only as practices of recognition, exchange, custody, valuation, and regulation stabilize around it. GR therefore avoids requiring a universal temporal signature for emergence.

The same caution applies to boundaries. An emergent object can possess fuzzy or contested edges while still becoming causally consequential. Institutional membership may be disputed; the practical boundary of a market may shift; a social category may be internally heterogeneous; the experienced continuity of self may vary over time. Relational reality requires enough individuation for the object's persistence and causal role to be investigated, but it does not require perfectly sharp boundaries. Boundary specification is part of the inquiry and may itself be historically generated.

Relational emergence also need not begin with manifestation. A configuration can develop through material, institutional, ecological, computational, or social relations before any subject recognizes it as a distinct object. This point is especially significant for contingency. A historically specific conjunction may already organize possibilities and causal pathways before its contingency becomes salient, aesthetically judged, or symbolically articulated. Later manifestation can disclose and transform such a configuration, but the event of recognition need not be the origin of its relational reality.

Conversely, manifestation can participate in emergence. A declaration, classification, measurement, ritual, image, diagnosis, price, legal inscription, or self-description can become one of the relations through which an object is generated. The graph architecture developed in Section 4.2 therefore applies within relational emergence itself: the existence of pre-manifestational emergence in some cases does not imply that manifestation is causally external to emergence in all cases. Later sections examine this mediation more directly.

4.5.2 Persistence

Emergence alone is insufficient for relational reality because many configurations appear briefly and disappear without acquiring an enduring role in the system. Persistence identifies the temporal and spatial continuation required for an emergent object to become more than an evanescent event at the chosen scale. The relevant in-

terval need not be long in absolute terms. What matters is whether the object remains available across enough of the system's evolution to participate in the processes under study.

Definition 4.29 (Persistence)**.** For a specified generative-relational system and analytical domain, *persistence* is the continued or recurrent availability of an emergent object's identity across a region or interval of spacetime despite changes in some of its constituents, states, manifestations, or supporting relations.

Persistence is therefore compatible with transformation. A corporation can persist while employees, shareholders, strategies, assets, technologies, and offices change. A currency can persist while notes are redesigned, payment infrastructures change, exchange rates fluctuate, and particular users enter or leave the system. A sense of self can persist through changes in memory, body, social position, and narrative. Treating persistence as invariance would make relational reality unable to describe precisely the historically evolving objects for which the concept is intended.

The criterion instead requires an account of continuity. Such continuity can be maintained through legal succession, memory, records, repeated practices, network position, material infrastructure, reciprocal expectation, reproduction of rules, or other mechanisms. Different objects can therefore persist through different processes. GR does not require one universal substance that remains unchanged beneath all variation. The continuity relation itself is an object of analysis.

Persistence can also be intermittent. A ritual order may become active only at recurrent times; an institutional emergency power may remain latent between invocations; a social identity may become salient in some contexts and recede in others; a market convention may disappear locally and reappear under recurring conditions. If the organization that allows recurrence remains sufficiently preserved, relational reality can extend across periods in which the object is not continuously manifest. Persistence should therefore be evaluated relative to the object's mode of existence rather than by imposing uninterrupted perceptual presence as a universal standard.

This point again separates relational reality from manifestation. An institution does not cease to be relationally real whenever no one is looking at its records. A trust relation does not vanish between encounters merely because it is not presently expressed. A contingency-producing structure can remain operative before anyone recognizes the contingency it affords. Persistence concerns the continuation of the relational organization and its capacity to participate in later processes, not continuous appearance to a subject.

The spacetime domain of persistence must nevertheless be specified. An object can be relationally real locally without possessing the same reality everywhere or indefinitely. A currency can cease to function beyond a jurisdiction or historical period. A deity can organize one community's practices without possessing the same relational status in another community. A classification can be institutionally decisive in one administrative system and irrelevant in another. Locality does not weaken the reality claim; it identifies the domain within which the claim is warranted.

4.5.3 Stability

Persistence and stability are related but distinct. Persistence asks whether the object continues or recurs across a relevant domain. Stability concerns whether its organization remains sufficiently coherent under ordinary variation and disturbance for the object to retain explanatory identity. A pattern can persist statistically while being too unstable to function as a recognizable causal object, while a highly stable configuration can exist only over a short but analytically decisive interval. GR therefore retains both criteria.

Definition 4.30 (Relational stability)**.** *Relational stability* is the capacity of an emergent object to retain sufficient organizational coherence under a specified range of endogenous variation, environmental change, perturbation, or reproduction for its identity and causal role to remain analytically trackable.

The phrase *sufficient organizational coherence* is intentionally contextual. There is no universal numerical threshold at which an object becomes relationally real. Relevant tolerance depends on the system, timescale, question, and kind of object. A high-frequency market convention may be stable over minutes while a constitutional institution is assessed over decades. A transient coalition can be stable enough to determine a vote even if it dissolves immediately afterward. A psychological self-relation may fluctuate affectively while retaining a recognizable organization across a life period. The threshold should therefore be justified by the explanatory task rather than imported from an unrelated domain.

Stability also does not imply equilibrium. Some relational realities persist precisely through continual adjustment. A market-making practice can remain stable through rapid repricing; an institution can preserve authority through repeated reinterpretation; a language can persist through continuous lexical and grammatical change; a trust relation can remain viable because participants repair disruptions rather than because disruptions never occur. Dynamic maintenance is therefore fully compatible with relational stability.

Nor does stability imply desirability. Durable domination, exclusion, debt dependency, stigmatization, and distrust can all become highly stable relational realities. The criterion is descriptive and ontological within GR's limited sense: it asks whether a configuration has acquired sufficient persistence and coherence to act within the system. Normative evaluation remains a separate task. This separation is essential for GRE because some of the most consequential economic realities are precisely those whose stability reproduces harmful or unjust relations.

Stability can furthermore be self-enhancing. Once an object begins to affect expectations and action, those effects can generate relations that increase the probability of its continued reproduction. Trust can induce cooperation that produces shared experience, thereby strengthening later trust. Distrust can induce defensive behavior that is interpreted as evidence for further distrust. Institutional authority can coordinate compliance that makes authority easier to reproduce. Capital can alter access to future opportunities in ways that facilitate further accumulation. GR treats such feedback as a possible mechanism of stabilization rather than as a universal property of relational reality.

The opposite process is equally important. Manifestations, interventions, shocks,

reinterpretations, or changes in supporting relations can destabilize an object. A currency crisis can weaken expectations that previously sustained monetary coordination. A legal judgment can reorganize an institutional category. A new historical archive can transform a collective identity. An aesthetic or epistemic manifestation can redirect attention toward previously unnoticed contingencies. Stability is therefore historically produced and historically vulnerable.

4.5.4 Causal Efficacy

Causal efficacy supplies the decisive condition that prevents relational reality from collapsing into descriptive persistence. A pattern can persist because the analyst repeatedly groups observations in the same way while making no difference to the system itself. GR requires more. The emergent object must participate in producing, constraining, enabling, redirecting, amplifying, suppressing, or otherwise modifying subsequent processes within the relevant generative-relational system.

Definition 4.31 (Causal efficacy in relational reality)**.** An emergent object possesses *causal efficacy* within a generative-relational system when its presence, organization, or state participates in producing differences in subsequent states, relations, capacities, constraints, possibilities, or transformations of that system under a warranted causal account.

This definition is deliberately plural about causal methodology. Causal efficacy may be supported through intervention, counterfactual analysis, process tracing, mechanistic reconstruction, temporal comparison, natural experiment, simulation, ethnographic evidence, historical reconstruction, or another method appropriate to the object. GR does not require every causal claim to be expressed through one statistical formalism. It does require the analyst to distinguish causal participation from mere co-occurrence or interpretive convenience.

The relevant effect also need not be direct. Money alters behavior partly through prices, accounting, law, expectations, infrastructures, and obligations. Institutional authority can act through role recognition, procedure, sanction, habit, and anticipatory compliance. A god that is relationally real within a religious system can affect conduct through ritual, obligation, architecture, collective memory, moral interpretation, or institutional organization without requiring the relational claim to settle independent theological ontology. The experienced continuity of “I” can organize plans, responsibility, avoidance, memory, and future self-interpretation through several mediating processes. In each case, the causal object is relationally constituted while its efficacy is distributed through other relations.

Causal efficacy can also be latent. A legal right may not be exercised during a given interval while its recognized availability changes bargaining and expectation. A credit line may remain unused while altering the decisions available to a firm. An institutional veto can shape proposals precisely because actors anticipate it and avoid triggering its use. An object’s causal reality therefore cannot always be inferred from visible episodes of activation. Capacities, constraints, and expectations can be causally effective through the possibilities they open or foreclose.

At the same time, attribution must remain disciplined. Because relational objects are constituted through networks of supporting relations, it may be difficult to iso-

late their causal contribution. GR does not solve this problem by declaring every surrounding condition part of the object. The analyst must justify the individuation used in the causal account and remain open to competing decompositions. Different inquiries may locate causal efficacy at different but compatible scales; other decompositions may produce genuinely operative disagreements. Section 4.3 provides the framework for preserving such disagreements without forcing premature ontological closure.

The requirement of causal efficacy also clarifies why perception is unnecessary for relational reality. A structure can affect trajectories before it is recognized. Institutional exclusions can shape access before a person becomes aware of the classification producing them. A historical arrangement can make some encounters more likely than others before anyone interprets the resulting event as contingent. A biological or material condition can alter social relations before it is symbolized. Recognition may later become causally important, but the earlier efficacy is enough to establish that manifestation was not the origin of every relevant effect.

4.5.5 Participation in Subsequent Relations

Within GR, the most characteristic expression of causal efficacy is participation in subsequent relation formation. Relationally real objects do not merely produce isolated outcomes; they can alter who or what can enter into relation, which relations become possible or costly, how existing relations are interpreted, what capacities become available, which differences become salient, and how future objects can emerge. The reality of the object is therefore historical and generative: what has emerged can become part of the conditions of later emergence.

Claim 4.32 (Historical recursion of relational reality)**.** *Once an emergent object becomes relationally real, it can enter the generative conditions of subsequent processes. It may thereby participate in producing relations and objects that were not part of the configuration through which it originally emerged.*

This recursive possibility gives relational reality particular importance for GRE. Money generated through prior legal, political, technological, and social relations can later organize labor relations, investment, debt, consumption, taxation, and institutional development. A firm generated through contracts, assets, labor, law, and organizational routines can become a subject of later relations and can itself create positions, technologies, products, obligations, and externalities. A category produced through administrative practice can redirect resource allocation and thereby alter the population to which the category is later applied. A reputation generated from past interaction can change access to future interaction. Relationally real objects can thus become relata in later systems while retaining histories of how they were generated.

This does not require the later system to reproduce the original generative conditions unchanged. An object can migrate across contexts, acquire new supports, or undergo partial reconstitution. A monetary instrument can move from one technological substrate to another. A religious symbol can enter commercial or political relations that differ from those through which its earlier significance formed. A self-description can be taken up by institutions and returned to the subject through clas-

sification. Relational reality can therefore accumulate layers of mediation over time.

Manifestational mediation is one important mechanism in this recursion. Once a relational reality becomes named, measured, pictured, priced, narrated, classified, or publicly performed, that manifestation can become part of the relations through which the object subsequently persists and acts. A trust relation can be altered by an explicit declaration of trust; a market can be changed by the publication of a price index; a person's institutional identity can be changed by the issuance of a document that records it. The manifestation is not merely a passive window onto a completed relational reality. It can become a causal component of the system.

The same logic applies to aesthetic judgment and contingency. A contingent configuration can already be relationally real before it is recognized. Once the contingency manifests as surprising, beautiful, significant, or worthy of attention, the judgment can redirect inquiry, preservation, imitation, funding, teaching, or collective memory. The manifestation then modifies the relational history of the object. GR can therefore affirm both pre-manifestational relational reality and later manifestational mediation without imposing a universal temporal chain between them.

Participation in subsequent relations also makes relational reality vulnerable to path dependence. Early stabilizations can influence which later relations become easier to form and which alternatives become progressively harder to realize. This does not imply deterministic lock-in. New relations, manifestations, shocks, interventions, and reinterpretations can reopen possibilities. The point is rather that a relationally real object can alter the field of later generation and therefore cannot be treated as an inert output of its own origin.

4.5.6 Relational Reality without Ontological Identity

The preceding conditions establish a mode of reality without settling ultimate ontological identity. An object can be generated, persistent, stable, and causally efficacious within a relational system even when competing metaphysical accounts of that object remain unresolved. This is not a concession that the object is somehow less real. It is a restriction on what kind of reality has been established.

Claim 4.33 (Relational reality does not entail ontological identity)**.** *Establishing relational reality does not, by itself, establish that the relationally real object possesses an independent, fundamental, or uniquely specified ontological identity. Conversely, ontological existence does not by itself establish relational reality within every generative-relational system.*

Money again offers a simple example. Its relational reality can be demonstrated through the coordinated practices, institutions, expectations, inscriptions, and causal consequences that sustain monetary relations without deciding that money constitutes an ontologically fundamental kind. The experienced continuity of self can be relationally real because it persists and reorganizes action without requiring an invariant metaphysical ego. A divine object can be relationally real within a religious system because it organizes practice and causally affects subsequent relations while GR suspends the independent theological ontology of divinity. In each case, the relational claim is substantive even though a stronger ontological claim remains open.

This separation also accommodates objects whose manifestational structures differ radically. Consider a flower appearing under hallucinatory conditions and a flower encountered under ordinary physical conditions. Either can become relationally real if, within the relevant generative-relational system, it acquires sufficient persistence or recurrent stability and causally affects attention, action, memory, affect, communication, or subsequent relations. Their common eligibility for relational reality does not imply that the two objects possess the same ontological status, arise through the same generative structure, or admit a justified common metric. Shared reality-status is therefore weaker than structural equivalence.

Remark 4.34 (Reality-status and comparability). Two objects can both satisfy the criterion of relational reality while lacking a warranted metric, ordering, equivalence relation, structure-preserving mapping, or other common comparison framework. Comparability is an additional analytical achievement rather than a consequence of shared relational reality.

Remark 4.34 protects the framework from a hidden homogenization. Money, grief, trust, institutional authority, divine presence, selfhood, market price, mathematical beauty, and physical objects may all become relationally real under appropriate conditions, while the structures through which they emerge remain heterogeneous. Some can be compared quantitatively, some only through partial mappings, some through qualitative or structural relations, and some may presently lack a justified common comparison domain. GR therefore separates the question of reality from the question of commensurability.

The same principle limits causal comparison. The fact that two objects affect a system does not imply that their effects can be placed on one scalar measure. Their causal pathways may differ in kind, scale, timescale, or register. GRE should therefore resist universal measures of "relational reality" unless a particular research problem establishes a defensible comparison structure. The criterion identifies whether an object has become stably and causally real within a system; it does not assign a universal magnitude of reality.

Relational reality consequently occupies a precise position within the three-register architecture. It is stronger than mere appearance because manifestation is not required for its existence. It is stronger than descriptive recurrence because causal efficacy is required. It is weaker than a final ontological identification because the ultimate metaphysics of the object can remain suspended. It is historically generative because objects that satisfy the criterion can become conditions of subsequent relation formation. And it remains heterogeneous because shared relational reality does not erase differences in structure, ontology, manifestation, or comparability.

Section 4.5 therefore provides the central ontological criterion that later GRE analyses will repeatedly use. The next section turns to manifestational reality, where the question changes from how an object becomes stably and causally real within a generative-relational system to how realities become available in particular modes of appearance, experience, articulation, measurement, classification, and symbolization. The distinction prepares the chapter to analyze manifestation without treating manifestation as either a transparent copy of relational reality or the universal condition of its existence.

4.6 Manifestational Reality

Section 4.5 established relational reality through a demanding criterion: an object must emerge within a generative-relational system, persist with sufficient stability over a relevant spacetime region or interval, and exercise causal efficacy within that system. The present section turns to a different register. Its objective is to clarify what GR means when something becomes *manifest*, to distinguish manifestation from perceptual appearance alone, and to specify how manifestation can be real without being treated as transparent disclosure of either relational structure or ultimate ontology. The section also clarifies an asymmetry that is central to the three-register architecture. Relational reality can precede manifestation, while manifestations, once they occur, can enter generative-relational systems and mediate subsequent relational realities. The method is therefore register-specific: manifestation is analyzed according to the conditions of appearing, availability, differentiation, and mediation that make something manifest, rather than by importing the persistence criterion of relational reality into the manifestational register.

The term *manifestation* is used broadly but not loosely. GR does not restrict manifestation to what a human subject consciously sees, hears, or names. A phenomenon can become manifest through bodily sensation, affective salience, institutional classification, a legal record, a measuring instrument, a statistical pattern, a computational output, a material trace, a linguistic expression, or another medium through which a difference becomes available in a determinate form. Conscious perception is one important mode of manifestation, and symbolic articulation is another, but neither exhausts the category. The concept is intended to capture the general problem of how something becomes available *in a mode of appearance* within a historically and relationally structured situation. (Husserl 2012; Merleau-Ponty 2012; Gibson 1979)

Definition 4.35 (Manifestation)**.** A *manifestation* is an event, state, or process through which a difference becomes sufficiently differentiated and available within a particular manifestational configuration to be encountered, registered, expressed, recorded, measured, classified, symbolized, or otherwise operative in a mode of appearance.

The phrase *manifestational configuration* is important. Something does not manifest in an abstract vacuum. Manifestation occurs through conditions that can include bodily capacities, sensory organization, instruments, media, languages, classificatory systems, institutional procedures, technical infrastructures, cultural expectations, temporal position, spatial scale, and prior relational histories. These conditions do not necessarily create ex nihilo whatever becomes manifest. They participate in determining the form, resolution, salience, and availability through which it appears.

Definition 4.36 (Manifestational reality)**.** *Manifestational reality* denotes the reality of something insofar as it becomes manifest within a specified manifestational configuration. A claim of manifestational reality establishes that a manifestation occurs or is available in a determinate mode; it does not by itself establish the ultimate ontological identity of what manifests, the complete relational structure from which the manifestation emerges, or the persistence and causal efficacy required for relational reality.

Definition 4.36 gives manifestation its own reality-status without turning manifes-

tation into an inferior copy of a supposedly more authentic domain. A pain can be manifestationally real as pain even while its physiological, psychological, or social constitution remains under investigation. A recorded market indicator can be manifestationally real as an institutional and statistical object even when the relation between the indicator and the economic processes it is intended to represent is contested. A flower appearing under hallucinatory conditions can be manifestationally real as an appearance without this settling whether its ontological or relational structure is equivalent to that of a physically encountered flower. Manifestational reality therefore protects the reality of appearance while keeping open the question of what kind of reality the appearance discloses.

Claim 4.37 (Manifestation does not require conscious recognition)**.** *A manifestation can occur through a bodily, technical, institutional, material, statistical, or symbolic configuration without having already become the object of a subject's reflective awareness. Conscious recognition is one possible uptake of manifestation rather than its universal condition.*

A sensor can register a signal before a human observer inspects the record. An institution can classify an event through an automated procedure before any individual deliberates about the classification. A bodily change can become affectively or physiologically manifest before it is linguistically identified. A material trace can remain available for later interpretation even though no subject was present when it was formed. Claim 4.37 should not be read as making manifestation independent of every relation of availability. A purely postulated state that makes no difference in any manifestational configuration has not yet been shown to be manifest. The point is narrower: the configuration through which something manifests need not center a conscious human observer.

4.6.1 Manifestation and Appearance

Appearance is one of the most intuitive forms of manifestation, yet the two concepts should remain distinct. *Appearance* usually emphasizes how something presents itself within perceptual or phenomenological experience. *Manifestation* is broader. It includes appearance but also extends to forms whose availability depends on inscription, instrumentation, classification, computation, institutional procedure, or other mediating arrangements. GR uses the broader term because many economically consequential realities become available through mechanisms that are neither immediately perceptual nor reducible to an individual subject's phenomenal field.

A price displayed on a screen is perceptually available, but its economic manifestation also depends on pricing procedures, data infrastructures, currency conventions, temporal updating, and the institutional setting in which the number is treated as a price. An unemployment rate can become manifest through a published statistical series even though no individual can perceive the aggregate directly. A legal status can become manifest through a registry entry, certificate, database record, or institutional response. An affective orientation can become manifest through bodily sensation, conduct, speech, or repeated patterns of attention. These cases differ in medium, yet each involves a transition from conditions that are not fully available in the same form to a determinate mode in which some difference can be encountered or acted

upon.

Remark 4.38 (Appearance is a mode of manifestation)*.* Perceptual appearance is treated in GR as an important subset of manifestation rather than as its general model. This avoids making conscious perception the template against which institutional, technical, symbolic, statistical, and material manifestations must be understood.

The distinction also matters for the relation between manifestation and representation. Some manifestations are explicitly representational: a graph, map, account balance, legal document, or verbal statement purports to stand for or organize something beyond the inscription itself. Other manifestations can occur before any such representational intention is established. Pain, surprise, bodily tension, a sensor spike, an anomalous pattern, or a change in behavioral regularity can become manifest without first being encoded as a representation of a known object. Representation is therefore one important organization of manifestation, but manifestation is analytically prior to the claim that a manifested form successfully represents what produced it.

This distinction is especially useful for contingency. A generative-relational and historical configuration can already exist before a subject recognizes a contingent relation within it. When contingency later becomes salient, striking, surprising, beautiful, troubling, or otherwise available to judgment, the event enters the manifestational register in a new way. The manifestation does not create the entire relational history that made the encounter possible. Yet the manifestational event can redirect attention and later action. GR can therefore distinguish the prior relational conditions of an encounter, the manifestational event through which contingency becomes available, and the subsequent relations generated after the encounter.

4.6.2 Stability of Manifestation

The stability requirement developed for relational reality should not be transferred mechanically to manifestational reality. A manifestation can be brief. A flash of pain, an unexpected image, a transient reading, a momentary affect, or a singular institutional announcement may be manifestationally real even if it disappears quickly. The occurrence of manifestation and the persistence of manifestation answer different questions.

Claim 4.39 (Manifestational reality does not require persistent stability)**.** *A manifestation can be real as manifestation without satisfying the persistence and stability conditions required for relational reality. Stability is therefore a variable property of manifestation rather than a universal threshold for entry into the manifestational register.*

This claim prevents the three registers from collapsing into one criterion. If every real manifestation had to persist and exercise causal efficacy, manifestational reality would become only a special case of relational reality. GR instead permits an event to be manifestationally real while remaining fleeting, weakly consequential, or difficult to reproduce. The analytic task is then to ask what kind of stability, if any, the manifestation acquires.

Several forms of manifestational stability can be distinguished. A manifestation

may be *temporally stable* when it remains available over an interval; *recurrently stable* when similar manifestations reappear under comparable conditions; *inscriptionally stable* when a record preserves the manifestation; *cross-contextually stable* when related forms appear across different manifestational configurations; or *procedurally stable* when a standardized practice repeatedly produces a comparable output. These forms should not be treated as equivalent. A persistent database entry, a recurring bodily sensation, and a reproducible measurement can all display stability while relying on different mechanisms.

Stability matters because stabilized manifestations can acquire new analytical and causal capacities. A fleeting observation can be remembered, recorded, replicated, standardized, circulated, or incorporated into a classification. Repeated manifestations can make a pattern easier to recognize. Institutionalized manifestations can become reference points for action. A statistical indicator that is repeatedly produced can influence contracts, policy, expectations, and investment. Under such conditions, the manifestation itself may begin to satisfy the criteria of relational reality: it can emerge as a relational object, persist, stabilize, and exert causal efficacy within the system. This transition is possible rather than automatic.

Remark 4.40 (Stabilized manifestation and relational reality). A stabilized manifestation becomes relationally real only when the full relational criterion is warranted. Repetition, inscription, or durability can contribute to that criterion, but none alone establishes causal efficacy or relational emergence.

This distinction is particularly important in economics, where measurements and classifications can become embedded in the domains they describe. A rating, index, price category, credit score, or accounting classification may begin as a manifestational device. Once actors coordinate around it, institutions incorporate it, and future opportunities are conditioned by it, the manifestation can participate in producing a new relational reality. The framework therefore leaves open a historically important pathway from manifestation to stabilization to causal participation without treating that pathway as inevitable.

4.6.3 Context-Dependent Manifestation

Manifestation is context-dependent because what becomes available, and in what form, depends partly on the configuration through which availability is produced. Context here does not mean merely a subjective frame imposed by an observer. It includes the material, technical, institutional, bodily, linguistic, historical, and relational conditions that organize manifestation.

Definition 4.41 (Manifestational configuration)**.** A *manifestational configuration* is the organized set of conditions through which differences can become available in a particular mode of manifestation. It may include subjects, bodies, instruments, media, institutions, categories, languages, technical procedures, spatial and temporal scales, and historically formed expectations.

Changing the configuration can change the manifestation without requiring that the underlying relational or ontological conditions have changed in the same way. A market process can look different at transaction-level, daily, and annual temporal resolutions. The same institutional relation can appear differently in a legal document,

an ethnographic encounter, an administrative database, and a network representation. A bodily condition can manifest through pain for one subject, an imaging signal for a clinician, and a coded category for an insurer. These differences are not necessarily errors. They reflect distinct manifestational configurations that select, amplify, suppress, aggregate, or transform different aspects of what becomes available.

Context-dependence therefore places a burden on analysis. A manifestation should be reported together with the conditions under which it arose when those conditions materially affect interpretation. A number without a measurement procedure, an image without information about the instrument or scale, a classification without its institutional rule, or a statement without the relational situation of utterance can obscure how the manifestation was generated. This requirement becomes especially important when manifestations are used epistemically, because the analyst may otherwise mistake properties of the manifestational configuration for properties of the relational reality under study.

Claim 4.42 (Context-dependence and constraint)**.** *The context-dependence of manifestation does not imply that manifestations are freely constructed by the manifestational configuration. Manifestations can be jointly constrained by the object, the generative-relational history, and the conditions of manifestation even when their form varies across contexts.*

Claim 4.42 protects the framework from a simple opposition between naive realism and unrestricted constructivism. GR allows that a manifestation can be mediated and context-sensitive while still being constrained by realities not reducible to the mediating context. The exact distribution of constraint is an empirical and theoretical question. In some cases instrumentation dominates the form of output; in others the object strongly constrains what can appear; in still others institutional categories shape which differences become visible at all. The framework does not decide these cases in advance.

Historical context adds another dimension. Manifestational configurations themselves evolve. Categories that once lacked institutional existence can later become standardized. New instruments can make previously inaccessible differences measurable. Changes in language can alter what can be articulated. Political and administrative reforms can transform what gets counted, recorded, or ignored. Digital infrastructures can increase the granularity and frequency with which economic conduct becomes manifest. Manifestational reality is therefore historical not only because the objects manifested can change, but also because the conditions of manifestation acquire histories of their own.

4.6.4 Multiple Forms of Manifestation

The manifestational register is plural. A single relational reality can become available through multiple forms, and these forms need not preserve the same dimensions of the underlying relations. GR therefore resists treating any one manifestational mode as universally privileged.

For analytical purposes, several broad forms can be distinguished. *Perceptual manifestations* include sensory appearances and experienced salience. *Affective manifestations* include felt intensities, moods, attractions, aversions, and embodied orien-

tations. *Behavioral manifestations* concern patterns expressed through action or response. *Material manifestations* include traces, spatial arrangements, artifacts, and physical inscriptions. *Institutional manifestations* include statuses, decisions, records, procedures, and classifications. *Symbolic manifestations* include linguistic expressions, images, signs, narratives, diagrams, and formal notations. *Statistical manifestations* make patterns available through aggregation, estimation, or comparison. *Computational manifestations* include model outputs, classifications, embeddings, simulations, scores, and other forms whose availability depends on computational procedures. These categories can overlap, and no exhaustive taxonomy is intended.

The plurality matters because different manifestations can support different kinds of action. A person may experience economic insecurity affectively before it becomes visible in an income statistic. A statistical indicator can reveal an aggregate pattern that is unavailable to individual perception. A legal category can make a relation institutionally actionable even when the lived experience of participants differs from the category's description. A model output can make a latent structure analytically tractable while remaining opaque to ordinary experience. GR treats these as different manifestational achievements rather than as successive approximations to a single canonical appearance.

Claim 4.43 (Manifestational plurality)**.** *The availability of multiple manifestations of an object does not establish that one manifestation is universally primary, nor does variation among manifestations by itself establish contradiction. Their relations depend on the conditions, scales, and dimensions through which each manifestation is generated.*

Manifestational plurality also means that absence in one mode does not establish absence in all modes. A relation that is not consciously perceived may nevertheless be institutionally recorded. A pattern that is statistically weak at one scale may become visible at another. A social expectation that is rarely articulated explicitly may manifest through repeated conduct. Conversely, strong manifestation in one mode does not guarantee corresponding manifestation elsewhere. A publicly salient narrative can be weakly reflected in measured behavior, while a powerful statistical regularity can remain culturally unnoticed.

This plurality prepares a later problem. If relationally different structures can sometimes give rise to similar manifestations, and if similar structures can sometimes generate different manifestations under different conditions, reverse inference from manifestation to relation becomes non-trivial. The present section does not yet formalize that inverse problem; Sections 96–98 will develop the generative relation and its possible non-invertibility. The point required here is simply that manifestation is many-formed and mediated.

4.6.5 Manifestation without Ontological Disclosure

A manifestation can be genuine without disclosing ultimate ontology. This is a direct consequence of the distinction among the three registers. The fact that something appears, is measured, is recorded, or becomes symbolically articulated establishes a manifestational fact. It does not automatically settle what ultimately exists, what type of entity is responsible for the manifestation, or which ontological account is uniquely correct.

Claim 4.44 (Manifestation does not entail ontological disclosure)**.** *A warranted claim that something has manifested does not by itself warrant a unique claim about the ontological identity, fundamental constitution, or complete generative structure of what manifests.*

The point is stronger than the familiar possibility of perceptual error. Even highly reliable manifestations can underdetermine ontology. A reproducible measurement may be compatible with several theoretical interpretations. A stable institutional record may establish how an organization recognizes a status without resolving the broader ontology of that status. A subject's persistent experience of self can be manifestationally robust while competing accounts of selfhood remain open. A religious manifestation can be experientially and socially consequential while theological ontology remains under suspension. The reality of manifestation and the ontology of its source are therefore distinct questions.

The flower example clarifies the distinction. A flower appearing under hallucinatory conditions and a flower encountered under ordinary physical conditions can both possess manifestational reality as appearances. Their manifestational status does not establish that their relational structures are the same, that their ontological statuses are the same, or that they can be compared through a common metric. The manifested forms may even be phenomenologically similar while being generated through substantially different relational configurations. Manifestational reality preserves the reality of what appears without using similarity of appearance as a shortcut to ontological identity.

Ontological suspension is therefore especially useful in the manifestational register. An inquiry can investigate the conditions, stability, variation, and consequences of manifestations while suspending stronger claims that are unnecessary for the problem at hand. This suspension should remain disciplined. If an ontological difference becomes causally operative for the manifestation or for the question being studied, the inquiry can no longer treat that difference as irrelevant. Section 4.3's distinction between operative and non-operative ontological disagreement thus applies directly here.

The same restraint is needed in formal analysis. A manifestational space may be modeled statistically, geometrically, categorically, or computationally without implying that the modeled coordinates constitute the ontology of what manifests. Formal proximity among manifestations does not establish ontological proximity among their sources. A classifier can group observations efficiently while leaving open whether the grouped cases share a common generative structure. Manifestational tractability is analytically useful, but it should not silently become metaphysical identification.

4.6.6 Manifestational Reality and Relational Reality

Relational reality and manifestational reality are distinct registers whose relations can run in more than one direction. The first distinction is temporal and constitutive: an object can become relationally real before it manifests within a particular configuration. The second is generative: once a manifestation occurs, it can enter the relations through which later realities are stabilized, transformed, or dissolved.

These two claims are compatible because the three-register architecture is a graph rather than a chain.

Claim 4.45 (Pre-manifestational relational reality)**.** *Relational reality does not require prior manifestation to a subject, institution, symbolic system, or measuring apparatus. A relationally real object can already persist, remain stable, and exercise causal efficacy before it becomes manifest within a particular manifestational configuration.*

This claim is especially important for GR's account of contingency and aesthetic judgment. The generative-relational and historical conditions that make a contingent configuration possible can already be operative before the contingency is recognized. When the configuration later becomes manifest as surprising, beautiful, meaningful, or worthy of attention, the judgment belongs to the manifestational history of the object rather than to the origin of all its relational reality. The same structure applies to latent institutional tensions, unrecognized dependencies, or ecological relations whose effects are already causal before they become publicly salient.

Claim 4.46 (Manifestational mediation)**.** *Once a manifestation enters a generative-relational system, it can participate in the generation, stabilization, transformation, or dissolution of relational realities by altering expectations, classifications, practices, capacities, constraints, or subsequent relations.*

A declaration of trust can modify the trust relation it manifests. A public price can alter transactions and expectations. A diagnosis can reorganize a person's institutional and interpersonal relations. A legal judgment can transform the relations whose status it articulates. An aesthetic judgment can redirect attention, preservation, teaching, funding, imitation, and collective memory. In these cases manifestation is not merely an epistemic window onto a completed relational object. It becomes one of the relations through which later reality is generated.

Manifestational mediation does not imply that every manifestation becomes relationally real. A fleeting image can disappear without reorganizing later relations. A measurement can remain unused. A symbol can fail to stabilize a practice. Conversely, a manifestation can acquire relational reality when it becomes sufficiently persistent, stable, and causally efficacious within the relevant system. The distinction is therefore maintained at the level of criteria rather than by assigning each object permanently to one register.

This point also clarifies why the registers should not be pictured as layers through which an object passes once. The same object can occupy different positions relative to different systems and times. A relation may be causally operative before it is manifest; later it may become visible through measurement; the measurement can then alter the relation; a new manifestation can follow from the altered relation; and some manifestations can become stabilized relational objects in their own right. Historical recursion replaces a universal sequence.

Remark 4.47 (Graph architecture of manifestation and relation)*.* The distinction between relational and manifestational reality specifies different criteria of reality, not a fixed ordering of stages. Their connections are historically variable and can include disclosure, mediation, feedback, stabilization, transformation, and loss.

Section 4.6 therefore gives manifestational reality a precise but non-reductive role within GR. Manifestation concerns the modes through which differences become

available in determinate configurations. It can be perceptual without being only perceptual, symbolic without being only symbolic, stable without requiring stability, and causally consequential without being defined by causal efficacy. Its reality can be affirmed while its ontology remains suspended. Most importantly, manifestation neither creates all relational reality nor merely reflects it. The next section develops this relation more closely by asking how manifestation itself can emerge through generative-relational processes and how historically formed conditions govern what becomes available to manifestation.

4.7 Manifestation through Generative Relational Emergence

Section 4.6 defined manifestational reality in terms of the conditions under which differences become available in determinate forms. The present section asks a prior generative question: how do those conditions themselves arise, and through what relations does one rather than another manifestation become possible? The objective is to treat manifestation as an emergent event within historically formed generative-relational systems rather than as a transparent encounter between a finished object and an abstract observer. The section develops the manifestation relation, clarifies how manifestations can be relationally generated, examines the historical formation of manifestation rules, and studies institutional and cultural mediation. It concludes by specifying how manifestation mechanisms can themselves become embedded within relational reality. This formulation preserves the distinction between the registers while explaining why their relations are recursive rather than sequential.

A manifestation can often be described retrospectively as though an object simply possessed an appearance that waited to be observed. GR treats this description as analytically incomplete. What becomes available, in what form, with what salience, at what resolution, and to which subject, instrument, institution, or practice depends on a configuration of relations. Some of these relations may be bodily or material; others may be linguistic, technical, institutional, historical, cultural, economic, or political. Their participation does not imply that they freely invent what manifests. It means that manifestation has generative conditions. These conditions can select, amplify, suppress, translate, discretize, classify, stabilize, or otherwise organize differences into forms that become available within a manifestational configuration. (Giddens 1984; Archer 1995; Bourdieu 1977)

Claim 4.48 (Generative condition of manifestation)**.** *A manifestation is generated through a determinate configuration of relations among what can manifest, the conditions through which it becomes available, and the historical structures that organize that availability. Manifestation therefore cannot in general be reduced either to an intrinsic property of an isolated object or to a free construction by an observing subject.*

Claim 4.48 gives the term *generative* a specific role. It directs inquiry toward the conditions under which a manifestation becomes possible and toward the processes that shape its form. The claim is compatible with ontological realism, constructivism in limited domains, process ontology, phenomenological inquiry, and other positions whose stronger metaphysical differences may remain suspended. Its commitment

is methodological and explanatory: manifested form has a history and a relational organization that can, at least in part, be investigated.

4.7.1 The Manifestation Relation

The most economical way to begin is to distinguish a manifestation from the *manifestation relation*. A manifestation is the available event, state, or form specified in Definition 4.35. The manifestation relation concerns the structured relation through which that availability is produced. It includes whatever configuration is relevant to explaining why a difference becomes manifest in one way rather than another.

Definition 4.49 (Manifestation relation)**.** A *manifestation relation* is a contextually specified relation among a potential source of difference, a manifestational configuration, and an available manifested form, such that the relations among these components participate in generating how the difference becomes manifest within the relevant system.

The term *potential source of difference* is deliberately cautious. GR does not assume that every manifestation can be traced to a single antecedent object whose independent ontology is already established. The source can be a relational configuration, an event, a process, a field of variation, an interaction, or another analytically warranted object. In some inquiries, the source may remain partly unknown while its manifestations are well characterized. In others, the source may itself be relationally real but not ontologically identified. Definition 4.49 therefore avoids building a stronger ontology into the concept than the inquiry has earned.

The manifestational configuration likewise need not be centered on a conscious subject. A telescope, laboratory protocol, legal procedure, market platform, archival system, machine-learning classifier, bodily sensory apparatus, ritual practice, or collective discourse can participate in the relation. Human awareness may enter later, or it may be only one component among several. The relation is consequently broader than perception and broader than representation.

A manifestation relation also need not be deterministic. The same relational configuration can permit several manifestations, and similar manifestations can arise under substantially different configurations. Noise, contingency, path dependence, measurement error, strategic behavior, institutional discretion, and historical variation can all contribute to this multiplicity. Section 98 will later examine the consequences for invertibility. At the present stage, the important point is that the manifestation relation can be probabilistic, underdetermined, multivalued, or only partially reconstructable.

Remark 4.50 (Manifestation relation and causal relation)*.* A manifestation relation can contain causal relations without being reducible to a single causal edge. It may include enabling conditions, constraints, classifications, selection procedures, interpretive conventions, technical transformations, histories of training, and other relations whose combined organization produces an available form.

This distinction matters for GRE because many economic manifestations are composites. A market price is not merely caused by a single underlying value. It becomes manifest through bids and offers, market rules, time windows, transaction infrastruc-

tures, currencies, accounting conventions, data publication, and expectations. An unemployment rate manifests through administrative and statistical categories that distinguish employment, unemployment, labor-force participation, and reference periods. A credit score manifests through variables, models, institutional objectives, data histories, and technical procedures. In each case, what becomes visible to later actors is generated through a manifestation relation whose components can themselves become objects of economic analysis.

The relation can also alter the salience of what becomes manifest. Two systems may contain similar differences while making different differences available for action. An institution that records only monetary transactions can make financial exchange highly manifest while leaving unpaid care weakly represented. A platform interface can make some prices, ratings, or rankings immediately visible while rendering other dimensions costly to discover. A legal procedure can transform a diffuse conflict into a set of admissible categories. Manifestation is therefore partly a problem of organized availability.

4.7.2 Relational Generation of Manifestation

The manifestation relation becomes generative when relations among its components do more than transmit a preformed appearance. They participate in producing the differentiated form through which something becomes available. This does not require the strong claim that manifestation creates the underlying object. It requires only that the manifested form cannot be adequately explained without the relations through which it is generated.

Definition 4.51 (Relational generation of manifestation)**.** *Relational generation of manifestation* occurs when the organization and interaction of elements within a manifestational configuration participate in producing the form, salience, resolution, classification, or availability through which a difference becomes manifest.

Several kinds of generation can occur. A relation may *select* among differences by making some detectable and others practically invisible. It may *transform* a difference by translating it into another medium, as when a physical signal becomes a numerical reading. It may *aggregate* multiple events into a statistical indicator. It may *classify* heterogeneous cases under a legal or administrative category. It may *amplify* weak variation into a salient signal, or *suppress* variation through thresholds and normalization. It may *sequence* events into a narrative or temporal ordering. It may *stabilize* an otherwise fleeting manifestation by inscription, repetition, storage, or institutional recognition. These are different mechanisms and should not be collapsed into a universal operation.

The relational generation of manifestation is especially clear when the same underlying configuration becomes available differently under changed conditions. A bodily process may manifest as pain, as an imaging signal, as a diagnostic code, as a disability category, or as an insurance claim. None of these manifestations is simply identical to the others. Each is generated through different relations, infrastructures, conventions, and purposes. The multiplicity does not make every manifestation arbitrary. It shows that the same object or process can enter several manifestation relations whose outputs differ because their generative conditions differ.

A similar structure appears in economic life. Productive activity can manifest as wage income, firm revenue, national accounts, household time use, ecological burden, or reputational value depending on the relational apparatus through which it is registered. A transaction can manifest simultaneously as a price, a legal transfer, a tax event, a behavioral data point, and a change in inventory. The manifestations overlap but need not coincide. Each selects and organizes a different dimension of the event.

Claim 4.52 (Relational generation without ontological reduction)**.** *The relational generation of a manifestation does not establish that the manifested object is exhausted by the relations that generate its manifestation. A warranted account of manifestation can therefore remain compatible with ontological suspension concerning the ultimate constitution of what manifests.*

This claim prevents two opposite reductions. One reduction treats manifested form as if it transparently revealed an independently fixed object. The other treats the object as if it were nothing more than the manifestation apparatus that renders it available. GR can reject both shortcuts. A scientific measurement can be instrument-dependent without implying that the measured phenomenon is only an instrument effect. A legal identity can be institutionally generated without implying that every relevant aspect of the person is reducible to legal classification. A market category can be constructed through conventions while still producing effects that constrain actors independently of their individual intentions.

The same reasoning is important for contingency. A contingent encounter may become aesthetically or existentially salient only within a historically formed relational field of expectations, memories, concepts, bodily dispositions, and prior experiences. The field participates in generating how contingency manifests. Yet the relevant relational structure need not begin at the moment of conscious judgment. It can already be operative before the subject recognizes the encounter as contingent. Aesthetic judgment can then become a later manifestation within that structure and, once expressed or acted upon, can feed back into subsequent relations. The example illustrates why manifestation is relationally generated without making perception the origin of relational reality.

4.7.3 Historical Formation of Manifestation Rules

Manifestations are not generated only by immediate relations. The relations governing manifestation can themselves have histories. Languages, measurement conventions, administrative categories, scientific instruments, market protocols, aesthetic canons, educational practices, and institutional procedures develop over time. These histories shape what can become manifest, what distinctions are available, and how manifestations are stabilized or interpreted.

Definition 4.53 (Manifestation rule)**.** A *manifestation rule* is a historically situated regularity, convention, procedure, threshold, classification, transformation, or selection principle that contributes to determining how differences become available within a manifestational configuration.

The term *rule* should not be read as requiring explicit codification. Some manifestation rules are written: accounting standards, legal definitions, laboratory protocols,

survey instructions, platform ranking procedures, or diagnostic criteria. Others are tacit: habits of attention, cultural expectations, aesthetic conventions, professional judgment, or learned bodily sensitivities. Still others are embedded materially in instruments and infrastructures. Their common feature is that they shape manifestation with sufficient regularity to be analytically relevant.

Manifestation rules can emerge through deliberate design, cumulative convention, conflict, adaptation, technological change, institutional inheritance, or combinations of these processes. Their histories therefore matter. A category that appears natural at one moment may be the product of earlier administrative choices. A statistical threshold can reflect technical constraints that later become institutionalized. A visual convention can persist long after the original reason for its design has disappeared. Historical formation can thus become sedimented into present manifestation without remaining visible to current users.

Claim 4.54 (Historicity of manifestation rules)**.** *Manifestation rules can be historically generated, reproduced, contested, and transformed. Their present operation therefore does not imply timeless necessity, and changes in these rules can alter what becomes manifest without requiring the underlying generative system to change in the same way or at the same rate.*

This claim is important for historical comparison. An economic object recorded under one classificatory regime may not be directly comparable with an apparently similar object recorded under another. A change in measured unemployment can reflect economic change, classificatory change, or both. The visibility of unpaid labor can change when survey design changes even if household practices remain partly continuous. A new diagnostic category can produce a sharp increase in recorded cases by reorganizing manifestation conditions. Historical analysis must therefore distinguish changes in what is generated from changes in how generation becomes manifest.

The same issue appears in intellectual history and aesthetics. What counts as a salient problem, elegant proof, beautiful form, or meaningful contingency is mediated by historically formed repertoires of attention and judgment. These repertoires do not mechanically determine judgment. They condition what is available for recognition and provide distinctions through which some encounters become expressible. An aesthetic judgment can therefore be both genuinely emergent and historically mediated. GR treats those properties as compatible.

Manifestation rules can also become self-reinforcing. Once an institution measures a phenomenon through a particular category, actors may adapt to the category; resources may be allocated through it; records may accumulate around it; and later inquiry may inherit the same distinction because data already exist in that form. The rule then participates in generating the relational reality it was initially used to manifest. Classification and object formation can become recursively coupled without becoming identical.

4.7.4 Institutional and Cultural Mediation

Institutions and cultures are especially important mediators because they stabilize manifestation relations across persons and time. They supply categories, roles, stan-

dards, symbols, practices, technologies, authorities, and expectations through which manifestations become publicly recognizable and actionable. Their mediation can increase coordination while also making some dimensions more visible than others.

Institutional mediation is evident in legal, administrative, financial, educational, scientific, and organizational settings. A legal institution can transform a history of conduct into a status, claim, liability, or judgment. A central bank can make monetary conditions manifest through rates, statements, balance sheets, and operational procedures. A university can convert heterogeneous intellectual activity into grades, degrees, publications, rankings, and appointments. A firm can make performance manifest through accounting categories and internal metrics. These manifestations often acquire consequences precisely because institutions authorize and reproduce them.

Cultural mediation operates through partially shared repertoires of interpretation, value, symbolism, attention, narrative, and expectation. Cultural mediation can affect which manifestations are immediately legible, which require explanation, which are trusted, and which are ignored. It can also affect the emotional and aesthetic force of manifestation. The same material configuration can be encountered as sacred, ordinary, threatening, beautiful, wasteful, prestigious, or economically valuable under different cultural relations. GR does not infer from this variability that cultural meaning is unconstrained. Material conditions, histories, institutions, and other relations can sharply delimit the range of viable manifestations.

Claim 4.55 (Mediation without passivity)**.** *Institutional and cultural mediation can participate in generating manifestational form while the manifested object, the mediating structures, and the subjects involved remain capable of constraining and transforming one another. Mediation is therefore a generative relation rather than a one-way transmission channel.*

This reciprocal structure becomes visible when manifestations modify the institutions and cultures through which they were generated. A published economic indicator can alter policy debate and market expectations. A court judgment can reshape the categories used in later adjudication. A public aesthetic judgment can redirect preservation, funding, teaching, and imitation. A religious manifestation can reorganize ritual practice or institutional authority. A newly visible form of vulnerability can generate advocacy, legal reform, or changes in professional classification. What manifests through a mediating system can return as a difference within that system.

The possibility of recursive mediation also clarifies why power matters without making power the sole explanation of manifestation. Institutions can privilege some forms of visibility, define admissible evidence, allocate attention, or authorize classifications. Cultural hierarchies can make some voices more legible than others. Yet manifestation can also escape intended control, generate unintended consequences, or reveal differences that established institutions cannot easily assimilate. The manifestational field is structured, but structure does not imply perfect determination.

For GRE, this point is central to the analysis of value. Market price is a powerful manifestation because institutions, currencies, infrastructures, legal rights, expectations, and accounting practices make it actionable across many relations. Its institutional strength does not entail that price exhausts value. Other values may manifest

through care, ecological resilience, symbolic significance, social recognition, lived capability, or forms that remain weakly commensurable with price. Treating one manifestation as exhaustive can therefore become an epistemic and political act with generative consequences of its own.

4.7.5 Manifestation Mechanisms within Relational Reality

The final step is to locate manifestation mechanisms within the relational reality developed in Section 4.5. A manifestation mechanism is not merely an abstract rule for converting one description into another. It is an organized process through which relevant relations participate in producing a manifestation. Instruments, institutions, habits, classifications, algorithms, rituals, sensory systems, and discursive practices can all function as components of such mechanisms.

Definition 4.56 (Manifestation mechanism)**.** A *manifestation mechanism* is an identifiable organization of relations and processes through which differences are selected, transformed, amplified, suppressed, aggregated, classified, recorded, expressed, or otherwise made available in a manifestational form.

Manifestation mechanisms can themselves become relationally real when they satisfy the criteria of relational emergence, persistence, stability, and causal efficacy. A statistical bureau's classificatory practice can persist across administrations and alter resource allocation. A pricing mechanism can become stable enough to organize expectations and transactions. A diagnostic infrastructure can shape treatment pathways and self-understanding. A platform ranking system can influence attention and behavior while being continually reproduced through technical and organizational relations. In such cases, the mechanism is not only a means through which other objects manifest; it becomes an efficacious object within the generative-relational system.

Claim 4.57 (Relational reality of manifestation mechanisms)**.** *When a manifestation mechanism emerges within a generative-relational system, persists with sufficient stability, and exercises causal efficacy within that system, the mechanism can itself possess relational reality independently of whether the objects it manifests share the same ontological or relational status.*

The qualification at the end of Claim 4.57 is important. A measurement institution can be relationally real even when what it attempts to measure remains ontologically contested. A religious interpretive practice can be relationally real without resolving the ontology of the divine object it concerns. A hallucination-generating process can be relationally real even when the manifested flower lacks the same physical ontology as an ordinarily encountered flower. The reality-status of the mechanism and the reality-status of what manifests through it therefore require separate analysis.

This separation also prevents a common inferential shortcut. The persistence and efficacy of a manifestation mechanism do not guarantee the truth of every manifestation it produces. Stable institutions can classify incorrectly. Reliable instruments can be applied outside their calibrated domain. Cultural conventions can stabilize misleading interpretations. Algorithms can reproduce systematic error. Relational reality concerns the mechanism's efficacy within the system; epistemic warrant concerns the adequacy of the manifestation as evidence for another claim. Chapter 5 will

develop this distinction more fully.

At the same time, recurrent manifestation can alter the mechanism itself. Users adapt to metrics, institutions revise categories after disputes, instruments are recalibrated, algorithms are retrained, and cultural expectations change after repeated encounters. The mechanism therefore participates in a recursive history: it generates manifestations, those manifestations enter subsequent relations, and those relations can reconfigure the mechanism. This recursion is one reason the three registers are better represented as a graph of historically evolving relations than as a fixed chain.

Section 4.7 has therefore shifted the analysis from manifestation as an available form to manifestation as a generative-relational achievement. A manifestation relation connects potential sources of difference with historically situated configurations of availability. Relations can generate manifestational form through selection, transformation, classification, amplification, aggregation, and stabilization. The rules governing these operations can themselves be historical products, while institutions and cultures can mediate manifestation without fully determining it. Finally, manifestation mechanisms can become relationally real when they acquire persistence, stability, and causal efficacy. The next section develops the stronger possibility that the mapping through which relational reality becomes manifest can itself be treated as a relationally real object, provided that its own conditions of stability, persistence, and causal efficacy are established.

4.8 Relational Reality of Manifestation Mapping

Section 4.7 treated manifestation as a generative-relational achievement and introduced manifestation mechanisms whose histories can become part of the conditions of later appearance, classification, measurement, and symbolization. The present section takes one further step. It asks whether the relation through which manifestation is generated can itself become an object of relational reality. The answer is affirmative under conditions that are already familiar from Section 4.5: a manifestation mapping can become relationally real when it emerges within a generative-relational system, persists with sufficient stability over a relevant region or interval of spacetime, and exercises causal efficacy within that system. This claim does not require the mapping to be ontologically fundamental, mathematically exact, consciously represented, or epistemically correct. It requires the mapping to become sufficiently organized and effective to participate in the subsequent generation of relations and manifestations.

The term *mapping* is used cautiously. It does not presuppose a mathematical function with a fixed domain, codomain, and unique output. Many manifestation mappings are partial, probabilistic, multivalued, path-dependent, historically revised, or only locally stable. A perceptual apparatus, an administrative classification, an accounting convention, a legal procedure, a scientific instrument, an algorithmic classifier, a market protocol, or a linguistic convention can all establish structured correspondences through which differences become manifest. In some cases a formal function is an appropriate representation. In others, a rule, relation, stochastic kernel, institutional procedure, embodied disposition, or family of transformations is

more adequate. The ontological point made here is prior to the choice among those representations. (Giere 2004)

Definition 4.58 (Manifestation mapping)**.** A *manifestation mapping* is a relatively organized relation, rule, process, or mechanism through which differences available within a generative-relational system are transformed, selected, classified, amplified, aggregated, translated, or otherwise rendered into one or more manifestational forms under specified conditions.

Definition 4.58 makes the mapping itself analytically visible. Instead of treating a manifestation as if it simply followed from an antecedent object, inquiry can ask what mediates the transition from a field of differences to the form in which those differences become available. This shift is important because the mediator can acquire a history, a domain of validity, a characteristic stability, and causal consequences of its own. Once this occurs, the mapping is no longer merely a convenient description imposed by an analyst. It can become part of the reality through which the system continues to generate later manifestations.

4.8.1 The Manifestation-Mapping Lemma

The relation between manifestation mapping and relational reality can be stated as a direct consequence of the criterion developed in Section 4.5. The statement is called a lemma because it does not introduce a new criterion of reality; it applies the existing criterion to a higher-order object whose role might otherwise remain implicit.

Lemma 4.59 (Manifestation-mapping lemma)**.** *Let a manifestation mapping be generated within a specified generative-relational system. If, over a relevant region or interval of spacetime, the mapping persists with sufficient stability and exercises causal efficacy in the production, organization, interpretation, or subsequent use of manifestations, then the manifestation mapping qualifies as relationally real relative to that system.*

The lemma is intentionally conditional. A proposed mapping does not become relationally real merely because an analyst can write it down. A transient coincidence, an unused classification scheme, a hypothetical function, or a rule that has not entered the operation of the relevant system may remain an analytical representation rather than a relationally real object. The mapping acquires relational reality when the system itself sustains it sufficiently for it to make a causal difference to what subsequently occurs.

This distinction can be illustrated by comparison between an analyst's model and an institutional classification. An economist may construct a mapping that groups heterogeneous transactions into a set of categories for one exploratory analysis. Unless that mapping enters broader practice, its reality may remain primarily representational. By contrast, when a tax authority, statistical office, payment platform, or accounting regime repeatedly classifies transactions according to a rule that affects reporting obligations, eligibility, prices, audits, or later decisions, the mapping can become relationally real. The classification rule participates in producing subsequent relations. Its effects can persist even when individual actors do not understand the rule in detail.

The same logic applies outside explicit institutions. A learned perceptual discrimination can become stable enough to alter attention and action. A linguistic distinction can guide recognition and social response across repeated situations. A ritualized interpretive practice can channel what members of a community notice and how they respond. An algorithmic ranking rule can shape visibility, participation, and incentives. In each case, the mapping is not merely between two descriptions. It is an operative relation embedded in a system.

Remark 4.60 (Higher-order relational objects). The manifestation-mapping lemma illustrates a broader feature of GR: a relation among objects, or a relation among relations, can itself become an analytically relevant object when it acquires persistence, stability, and causal efficacy. Relational reality therefore does not restrict objecthood to substance-like entities.

This remark is especially important for the graph architecture of the three registers. If mappings among relational and manifestational configurations can themselves become relationally real, then the edges of the graph are not always analytically external to the graph. Some edges can stabilize into objects that later participate in additional edges. A classification relation can become an institution; an interpretive convention can become a norm; a measurement protocol can become an infrastructure; an interface rule can become part of a market's operating environment. The system can therefore generate not only new nodes but also relatively stable relations that subsequently function as nodes at another analytical scale.

4.8.2 Stability of the Mapping

Stability is one of the conditions through which a manifestation mapping can become relationally real, but stability should not be confused with exact invariance. A mapping can remain sufficiently stable while its parameters, categories, thresholds, implementation, or local outputs change. The relevant question is whether enough of its organization persists for the mapping to remain identifiable and causally operative within the inquiry's scale.

Definition 4.61 (Mapping stability)**.** A manifestation mapping exhibits *mapping stability* when variations in its conditions, implementation, or inputs remain compatible with sufficient continuity of its organizing relation for the mapping to retain an identifiable role in generating manifestations over the relevant analytical interval.

This definition allows several forms of stability. A legal mapping from circumstances to status can be stable because courts and agencies reproduce a rule even while interpretations evolve. A market protocol can remain stable while prices and participants change continuously. A perceptual mapping can remain stable across ordinary variation in illumination or bodily state. A machine-learning classifier can preserve a recognizable decision regime across a period of use even if its inputs vary widely. Stability concerns the organization of the mapping, not identity of outputs.

The degree of stability required is domain-relative. A high-frequency trading rule may be relationally significant over milliseconds or hours. A monetary classification can persist for decades. A ritual or linguistic mapping may persist across generations while changing gradually. GR therefore does not impose a universal temporal threshold. The relevant interval is set by the system and the explanatory question. What

matters is that the mapping endure long enough, and coherently enough, to influence subsequent relational development.

Stability also has spatial and institutional dimensions. A classification may be stable within one jurisdiction and absent in another. A cultural mapping may operate within a community without extending beyond it. A measurement protocol may be valid only within a calibrated range. A platform's ranking mechanism can be stable inside one technical environment while changing rapidly after a redesign. Treating stability as local prevents a relationally real mapping from being mistaken for a universal law.

Claim 4.62 (Stability without universality)**.** *A manifestation mapping can be sufficiently stable to possess relational reality within a specified system without being invariant across all times, places, scales, institutions, or domains.*

Claim 4.62 is consequential for economic analysis. Economic categories often appear natural after long institutional stabilization. Wage, price, ownership, debt, unemployment, creditworthiness, productivity, and risk can become highly stable manifestations within particular infrastructures. Their stability can make them causally powerful without establishing that the mappings producing them are timeless or ontologically universal. A category may be deeply real in a relational sense precisely because institutions reproduce it, not because the category exists independently of those institutions.

Mapping stability can also be endogenous to repeated use. When actors anticipate how a system maps differences into manifestations, they can adapt their conduct accordingly. Firms alter reports to fit accounting categories; applicants modify behavior in response to scoring systems; researchers adapt experiments to measurement protocols; users optimize content for ranking systems. Repeated adaptation can stabilize the mapping by making surrounding behavior increasingly compatible with it. It can also destabilize the mapping by exploiting its weaknesses. Stability is therefore an historical outcome rather than a purely formal property.

4.8.3 Persistence of the Mapping

Persistence differs from stability. Stability concerns continuity of organization under variation; persistence concerns continued existence or recurrence of the mapping across the relevant spacetime interval. A mapping can persist while becoming less stable, as when a contested classification remains institutionally present but its interpretation fragments. Conversely, a mapping can be locally stable during each use yet fail to persist because the mechanism is abandoned after a short episode. Relational reality requires attention to both dimensions.

Definition 4.63 (Mapping persistence)**.** A manifestation mapping exhibits *persistence* when the relations, practices, mechanisms, or infrastructures that sustain the mapping continue or recur across a relevant spacetime interval such that the mapping remains available to participate in subsequent manifestation.

Persistence can be maintained through material infrastructure, institutional memory, embodied habit, repeated practice, archived rules, software, education, law, ritual, language, or combinations of these. Different supports can substitute for one

another. A monetary mapping between numerical denomination and purchasing capacity, for example, does not persist through one material carrier alone. It can be reproduced through bank ledgers, legal obligations, payment networks, accounting systems, public expectations, pricing practices, and state institutions. The relational object persists through distributed supports whose composition can change.

This distributed persistence matters because the disappearance of one carrier need not dissolve the mapping. Paper certificates can disappear while account-based records remain. A spoken norm can become codified. An institutional category can migrate from paper forms to databases. A scientific measurement practice can move from one instrument generation to another. Persistence therefore belongs to the generative organization rather than necessarily to a single substrate.

Historical transmission also permits mappings to outlive the conditions under which they first emerged. Categories may continue to organize manifestation after the original rationale has weakened. Administrative systems can preserve distinctions whose historical origin is forgotten. Economic indicators can continue to guide policy after production structures have changed. Such persistence is analytically important because the mapping can remain causally efficacious even when actors no longer possess a clear account of its genealogy.

Claim 4.64 (Persistence without conscious maintenance)**.** *A manifestation mapping can persist relationally without being continuously represented, understood, or intentionally maintained by any single subject, provided that the generative-relational system continues to reproduce the mapping through relevant practices, structures, or infrastructures.*

This claim parallels the pre-manifestational status of relational reality discussed earlier. Just as a relationally real object does not require prior perception, a relationally real mapping does not require a subject who explicitly knows the mapping. Some mappings are tacit, distributed, embodied, or infrastructural. Their reality becomes visible through regularities in what systems make available and through the effects that follow from those regularities.

Persistence also makes the history of mappings empirically investigable. One can trace when a distinction entered an institutional vocabulary, when a metric became standardized, when a legal category acquired force, when an algorithmic rule was deployed, or when a perceptual convention became culturally salient. Such histories can reveal that what later appears to be an immediate manifestation was mediated by a mapping that had itself undergone a process of stabilization and transmission.

4.8.4 Causal Efficacy of the Mapping

Persistence and stability alone do not complete the criterion. A mapping becomes relationally real in the stronger GR sense when it also exercises causal efficacy within the relevant system. Causal efficacy can arise at several points. The mapping can influence which differences become available, how they are organized, how actors respond to them, which resources are allocated, what categories are reproduced, and how later mappings are formed.

Definition 4.65 (Causal efficacy of a manifestation mapping)**.** A manifestation map-

ping has *causal efficacy* when its operation makes a difference to subsequent manifestations, actions, relations, constraints, capacities, allocations, classifications, or trajectories within the relevant generative-relational system.

A mapping's causal efficacy need not be deterministic. A credit score may change the probability of receiving credit without uniquely determining the decision. A diagnostic category may alter the range of available treatments without fixing an individual's course. A market price can reorient behavior while different actors respond differently. A cultural symbol can modify salience and expectation without compelling one interpretation. Probabilistic, enabling, constraining, and path-shaping effects can all be causal in the relevant sense when the mapping makes a counterfactually or dynamically significant difference within the system.

Causal efficacy also distinguishes the reality of a mapping from the accuracy of the manifestation it produces. A mistaken classification can still be causally powerful. A biased indicator can redirect resources. A misleading rumor can alter market behavior. A hallucinated object can affect bodily action and memory. An institution can stabilize an erroneous category whose consequences are nevertheless real. The mapping's relational reality therefore cannot be inferred from epistemic correctness, nor can epistemic correctness be inferred from relational reality.

Claim 4.66 (Reality of mapping and epistemic adequacy)**.** *The relational reality of a manifestation mapping and the epistemic adequacy of the manifestations it produces are distinct questions. A mapping can be persistent, stable, and causally efficacious while remaining inaccurate, biased, incomplete, or inappropriate for a particular inferential purpose.*

This distinction is particularly important in GRE. Economic systems are filled with manifestations that guide action because their mappings have become institutionally real: ratings, prices, scores, indicators, legal statuses, performance measures, rankings, and classifications. Their causal power can induce actors to reorganize behavior around them. Once this occurs, a measurement can partially participate in producing the reality it later appears merely to describe. A performance metric can reorganize work; a risk category can change financing conditions; a ranking can redirect attention; a price index can enter contracts; an eligibility threshold can reshape household decisions. The mapping becomes part of the generative field.

Causal efficacy can also operate through reflexivity. Actors can learn the mapping and strategically act upon it. Once a threshold is known, behavior can cluster around the threshold. Once a ranking formula is inferred, participants can optimize for it. Once a legal classification becomes consequential, actors can reorganize transactions to fall inside or outside its categories. Reflexive response does not make the mapping less real. It often provides evidence of its causal incorporation into the system.

At the same time, causal efficacy can contribute to transformation of the mapping itself. Strategic adaptation can expose failures, institutions can revise rules, and accumulated outcomes can alter normative or technical expectations. A manifestation mapping can therefore be both cause and object of later change. This recursive position reinforces the graph architecture: the mapping mediates manifestation, manifested outcomes alter relations, and those relations can return to modify the mapping.

4.8.5 Manifestation Mapping within Relational Reality

The preceding analysis allows manifestation mapping to be located more precisely within the three-register architecture. A mapping is not a fourth register. It is a relation whose analytical status depends on what it does. Some mappings remain hypothetical or representational devices introduced by inquiry. Others become embedded in generative-relational systems and thereby acquire relational reality. Once embedded, they can mediate what becomes manifest while also being transformed by the manifestations and relations they help generate.

Proposition 4.67 (Relational reality of manifestation mapping)**.** *A manifestation mapping belongs to relational reality when its generative-relational emergence, persistence, stability, and causal efficacy are sufficiently established relative to the system and scale under investigation. Its relational reality does not require that the mapping be consciously represented, mathematically exact, epistemically adequate, ontologically fundamental, or universally valid.*

Proposition 4.67 consolidates the section's argument. It also prevents several conflations. First, the mapping's reality is distinct from the ontological reality of what enters or exits the mapping. A perceptual mechanism can be relationally real whether the manifested object is physical, imagined, hallucinatory, remembered, or ontologically unresolved. Second, the mapping's reality is distinct from the reality-status of a particular manifestation. A durable classification system can produce fleeting manifestations, while a transient mapping can occasionally produce a stable recorded output. Third, the mapping's relational reality is distinct from its normative desirability. Persistent and causally efficacious mappings can reproduce exclusion, distortion, domination, or injustice. Reality does not imply legitimacy.

The distinction is also useful for the earlier example of the hallucinatory flower and the ordinarily encountered physical flower. Both can enter manifestational reality, and both can participate in relationally real consequences. Their manifestation mappings can nevertheless differ substantially. One may involve bodily or neurological conditions that generate a flower-like manifestation without a corresponding ordinary external flower; another may involve interactions among an external physical object, sensory apparatus, environmental conditions, memory, and perceptual organization. GR need not place these mappings in one metric space or claim that their structures are directly comparable. It can instead ask whether each mapping is identifiable, persistent, stable, and causally efficacious within its relevant system. Shared relational reality does not require shared generative architecture.

The same caution applies to comparisons among economic mappings. A price mechanism, a religious valuation practice, a legal recognition procedure, an aesthetic judgment, and an algorithmic score can all become relationally real mappings while lacking a justified common metric. Comparison requires an independently warranted relation of comparison. One can sometimes compare causal effects, stability, information loss, accessibility, or institutional reach, but each comparison constructs a domain and selects dimensions. The common label *relationally real* establishes a criterion of reality rather than a universal coordinate system.

This point becomes important for formalization. If an inquiry represents a mani-

festation mapping as

$$\mathcal{M}_C : X \rightsquigarrow Y, \tag{4.1}$$

where C denotes relevant conditions, Equation 4.1 should be interpreted cautiously: the symbol $\rightsquigarrow$ should be read as a deliberately general mapping relation rather than automatically as a single-valued mathematical function. Depending on the domain, $\mathcal{M}_C$ may be deterministic, stochastic, partial, multivalued, path-dependent, or historically variable. The formal representation becomes useful only after the analyst specifies what X, Y, C, and the mapping relation mean in the problem under study. The notation is therefore a compact placeholder for a family of possible structures rather than an ontological claim that manifestation universally follows one mathematical form.

Remark 4.68 (Mapping and graph architecture)*.* When a manifestation mapping becomes relationally real, the graph connecting relational and manifestational registers contains historically generated mediating structures with their own trajectories. The graph is therefore not merely a diagram of static correspondences; its mediating relations can emerge, stabilize, exercise causal efficacy, and transform.

This dynamic graph helps explain why manifestation cannot be treated as the terminal stage of a chain. A relationally real mapping participates in producing a manifestation; the manifestation can enter subsequent action and representation; those consequences can alter the system that sustains the mapping; and the altered mapping can generate different manifestations later. The history of the mapping becomes part of the history of what can appear.

Section 4.8 has therefore elevated manifestation mapping from an implicit bridge to an explicit object of relational analysis. The manifestation-mapping lemma applies the criteria of relational reality to mappings themselves. Stability concerns continuity of organizing relation under variation; persistence concerns continued or recurrent reproduction across a relevant spacetime interval; causal efficacy concerns the difference the mapping makes to later manifestations and relations. When these conditions are satisfied, the mapping is relationally real even while stronger ontological and epistemic questions remain open. The next section turns to a different problem. Once a mapping has been identified, the availability of a manifestation does not guarantee that the mapping can be reversed. Non-invertibility, multiplicity, and loss of relational information therefore become central to any inference from manifestational reality back toward the structures from which manifestation emerged.

4.9 Non-Invertibility of Manifestation

Section 4.8 established that a manifestation mapping can itself become relationally real when it is sufficiently persistent, stable, and causally efficacious within a generative-relational system. The present section examines a different property of such mappings: whether a manifestation can be used to recover, uniquely and adequately, the relational configuration from which it emerged. The central result is a disciplined account of *non-invertibility*. Manifestation may compress, select, transform, aggregate, or contextually reorganize relational differences. Consequently, a manifestational form can be compatible with several relational configurations,

while a given relational configuration can admit several manifestations. These possibilities limit reverse inference from what appears, is recorded, is measured, or is symbolized to the relational reality that participated in generating it. The argument proceeds through many-to-one manifestation, one-to-many manifestation, manifestational equivalence, relational difference beneath manifestational similarity, and the resulting limits of reverse inference.

The term *non-invertibility* is used here in an analytical rather than universally algebraic sense. Some manifestation mappings can be represented by ordinary functions and studied with familiar notions of inverse functions. Others are stochastic, partial, multivalued, historically variable, institutionally mediated, or dependent on conditions that cannot be held fixed across observations. Section 4.8 therefore represented a general manifestation mapping by Equation 4.1, using $\rightsquigarrow$ to indicate a mapping relation whose exact mathematical form remains to be specified locally. Non-invertibility concerns the information and structure that cannot be uniquely recovered when inquiry moves from a manifestational result back toward the relational configurations compatible with it. (Giere 2004)

A convenient formal device is the *compatibility set*. Let $\mathcal{M}_C$ denote a manifestation mapping under relevant conditions C, let X denote a selected space of relational configurations, and let Y denote a selected space of manifestations. For a manifestation $y \in Y$, define the set of relational configurations compatible with y under C by Equation 4.2.

$$\mathcal{P}_C(y) = \{x \in X \mid x \; \mathcal{M}_C \; y\}\,. \tag{4.2}$$

The notation in Equation 4.2 does not assume that X or Y is metric, that $\mathcal{M}_C$ is deterministic, or that every relevant relational configuration has already been exhaustively specified. It identifies a local inverse problem: given a manifestation and a specified manifestation regime, which relational configurations remain compatible with what has become manifest? When the compatibility set contains several materially different configurations, manifestation underdetermines relational reconstruction.

Definition 4.69 (Manifestational non-invertibility)**.** A manifestation mapping is *non-invertible for a specified inquiry* when the available manifestation, together with the mapping conditions and admissible evidence, does not support unique and warranted recovery of the relevant antecedent relational configuration at the scale required by that inquiry.

Definition 4.69 makes non-invertibility relative to an inquiry, scale, and evidential regime. A mapping can be invertible with respect to one coarse variable while remaining non-invertible with respect to a finer relational history. A measurement may uniquely determine a reported category while failing to determine the heterogeneous trajectories that produced that category. A legal status may uniquely identify the institutionally recognized state of a person while leaving the underlying social, economic, and historical relations radically underdetermined. Conversely, additional manifestations or interventions can sometimes narrow the compatibility set. Non-invertibility therefore concerns the relation between available manifestation and warranted reconstruction rather than an assertion that recovery is impossible under every conceivable extension of evidence.

4.9.1 Many-to-One Manifestation

Many-to-one manifestation occurs when materially different relational configurations generate the same, or sufficiently similar, manifestational form under the relevant conditions. This is the most direct source of non-unique reverse inference. If several relational configurations belong to $\mathcal{P}_C(y)$, observing y establishes compatibility with each of them until further evidence differentiates among the alternatives.

Definition 4.70 (Many-to-one manifestation)**.** A manifestation mapping exhibits *many-to-one manifestation* relative to conditions C when two or more relationally distinguishable configurations are compatible with a common manifestational form, or with forms treated as indistinguishable under the operative manifestational criterion.

The source of many-to-one manifestation can differ across domains. A mapping may aggregate several relational configurations into one category. An instrument may register only one dimension of a multidimensional process. An institutional procedure may intentionally suppress distinctions judged irrelevant to its purpose. A perceptual system may resolve several materially different stimuli into one recognizable form. A statistical summary may retain an average while discarding distributional structure. A market price may summarize heterogeneous beliefs, constraints, liquidity conditions, institutional rules, and strategic positions without uniquely revealing their composition. In each case, the manifestation can remain highly useful while carrying less relational information than the configuration from which it emerged.

Compression is therefore one important mechanism of many-to-one manifestation. Compression should be understood broadly. It includes numerical aggregation, categorical classification, perceptual simplification, institutional standardization, linguistic naming, algorithmic feature selection, and other processes through which a richer relational field is rendered into a lower-dimensional or less differentiated manifestational form. The compressed manifestation can be stable and causally powerful. Its stability does not restore the distinctions removed during manifestation.

Many-to-one manifestation can also arise without deliberate compression. Different histories can converge on similar configurations at the point of manifestation. Distinct causal paths can produce the same observed outcome. Heterogeneous social relations can produce similar behavioral regularities. Different institutional arrangements can yield the same reported indicator over a limited interval. Distinct bodily, perceptual, and environmental configurations can generate similar experiences. The manifestational similarity can therefore result from convergence rather than from a single mechanism that intentionally groups diverse inputs.

The distinction between *same manifestation* and *sufficiently similar manifestation* matters. Exact equality is often unavailable or analytically unnecessary. A measurement system can treat values within a tolerance interval as the same reading. A legal regime can place heterogeneous cases in the same category. A human observer can experience two appearances as indistinguishable despite physical differences. A model can treat two distributions as equivalent for a selected decision rule. The operative equivalence criterion belongs to the manifestation regime and should be stated rather than presumed.

Claim 4.71 (Manifestational underdetermination)**.** *When a manifestation is generated through a many-to-one mapping, the manifestation alone underdetermines the antecedent relational configuration. Reverse inference requires additional evidence, constraints, interventions, or assumptions capable of differentiating among the configurations that remain compatible with the manifestation.*

Claim 4.71 does not imply that reverse inference is futile. It specifies its evidential burden. If the compatibility set can be reduced through additional manifestations, historical records, controlled interventions, cross-context comparison, or independent knowledge of the mapping, reconstruction can become more informative. The point is that the manifestation does not carry a unique antecedent merely by virtue of appearing determinate.

This distinction has particular importance for GRE because economic manifestations often appear in standardized forms. A price, score, balance, wage, category, ranking, or aggregate may be numerically precise while remaining relationally underdetermined. Precision of manifestation and uniqueness of generative history are different properties. A highly precise number can summarize a heterogeneous field of relations, just as a coarse category can sometimes correspond to a relatively specific institutional mechanism. The degree of manifestational precision therefore provides limited information about the invertibility of the mapping.

4.9.2 One-to-Many Manifestation

Non-invertibility also arises in the opposite direction. A single relational configuration can generate several manifestational forms across contexts, observers, instruments, symbolic regimes, times, or scales. Section 4.6 already established that manifestational reality is condition-dependent and can take heterogeneous forms. The present subsection makes the consequence for inversion explicit: variation in manifestation need not imply variation in the relational object at the level under investigation.

For a relational configuration $x \in X$, define its admissible manifestation set under conditions C by Equation 4.3.

$$\mathcal{Y}_C(x) = \{y \in Y \mid x \, \mathcal{M}_C \, y\} \, . \tag{4.3}$$

Equation 4.3 allows the manifestation mapping to be multivalued. Even where a deterministic function is appropriate under fixed conditions, variation in C can generate a family of manifestations for the same selected relational configuration. The analyst must therefore distinguish changes in the relational configuration from changes in the conditions through which that configuration becomes manifest.

Definition 4.72 (One-to-many manifestation)**.** A manifestation mapping exhibits *one-to-many manifestation* relative to the selected analytical scale when one relational configuration can become manifest in more than one materially distinguishable form across admissible manifestation conditions.

The qualification *relative to the selected analytical scale* is essential. What appears to be one relational configuration at a coarse scale may contain fine-grained differences that explain manifestational variation. Conversely, an inquiry may have good

reason to treat those differences as irrelevant to its present object. One-to-many manifestation therefore does not establish that an identical microstate generates arbitrary outputs. It states that the relational identity preserved by the inquiry can coexist with plural manifestations.

A monetary relation illustrates the point. The same institutionalized monetary claim may become manifest as a banknote, an account balance, a payment message, an entry in a ledger, a spoken amount, or a displayed price. These manifestations differ materially and symbolically while participating in a relational structure that can remain continuous across them. Likewise, an institutional status can be manifested through a document, database record, uniform, title, access permission, spatial arrangement, or pattern of deference. A relation of trust can become manifest through speech, action, silence, delegation, disclosure, or patterned expectation. The plurality of manifestations does not by itself establish plurality of the relational object.

One-to-many manifestation also appears in scientific and empirical inquiry. A process can leave different traces under different instruments. A latent relation can generate several observable indicators. A historical event can become available through documents, material remains, memories, later institutional records, and statistical consequences. Each manifestation selects and transforms aspects of the underlying relational history. Their differences can be informative precisely because they arise through different manifestation mappings.

This plurality creates a second inverse problem. If one relational configuration can appear in several ways, then inferential procedures that expect a single canonical manifestation can miss relational continuity beneath manifestational difference. A change in representation can be mistaken for a change in the represented relation. A change in instrument can be mistaken for a change in the measured process. A change in symbolic vocabulary can be mistaken for the disappearance of the phenomenon. Conversely, stable terminology can conceal substantial relational transformation. The ontological and epistemic tasks therefore require attention to both directions of mismatch.

Remark 4.73 (Manifestational plurality and identity). Manifestational plurality does not by itself establish either relational identity or relational difference. Whether several manifestations concern one relationally continuous object depends on the persistence, stability, causal organization, and historical continuity that define the relational object at the relevant scale.

Remark 4.73 prevents an opposite overcorrection. The existence of one-to-many mapping does not license the analyst to declare diverse manifestations identical. The relation among them has to be established. The three-register architecture therefore places a burden on both identification and differentiation: similarity of appearance does not establish relational identity, and difference of appearance does not establish relational difference.

4.9.3 Manifestational Equivalence

Many-to-one manifestation requires a concept for cases in which distinct relational configurations cannot be distinguished within a specified manifestation regime. The appropriate concept is *manifestational equivalence*. The term is deliberately weaker

than ontological identity, relational identity, or structural isomorphism. It describes indistinguishability with respect to a specified manifestation mapping and criterion.

Definition 4.74 (Manifestational equivalence)**.** Two relational configurations are *manifestationally equivalent* relative to a specified manifestation regime when the distinctions between them are not expressed in the manifestational forms that the regime recognizes as relevantly distinguishable for the inquiry at hand.

Manifestational equivalence is therefore indexed by a regime. The regime includes the mapping, conditions, resolution, categories, instruments, symbolic resources, tolerances, and analytical purposes that determine what counts as a relevant manifestational difference. Two configurations can be equivalent under one regime and distinguishable under another. The equivalence can also disappear historically when new instruments, categories, practices, or sensitivities make previously unavailable differences manifest.

This relativity does not make manifestational equivalence arbitrary. A regime can have stable procedures and well-specified criteria. Under those criteria, the equivalence may be reproducible and operationally important. Two chemical states can be indistinguishable to one instrument and distinguishable to another; two institutional practices can receive the same administrative code while producing different lived consequences; two economic trajectories can yield the same quarterly aggregate while diverging in distribution, vulnerability, or future capacity. In each case, equivalence is real relative to a manifestation regime while remaining narrower than identity of the relational configurations.

Proposition 4.75 (Locality of manifestational equivalence)**.** *Manifestational equivalence warrants claims of indistinguishability only relative to the specified manifestation regime and criterion. It does not, by itself, warrant ontological identity, relational identity, equal causal structure, equal historical trajectory, or interchangeability across other manifestation regimes.*

Proposition 4.75 is especially important for comparative analysis. A common indicator can create an equivalence class that is useful for one purpose. Treating the same equivalence class as valid for another purpose requires additional justification. Equal income at one date does not imply equal wealth, security, capabilities, obligations, histories, or future opportunities. Equal test scores do not imply identical learning processes. Equal prices do not imply identical market structures. Equal institutional classifications do not imply identical relations of power. The manifestation criterion selects the dimension of equivalence; it does not silently generalize that equivalence to every other dimension.

Manifestational equivalence can itself become relationally consequential. Once an institution treats distinct cases as equivalent, resources, rights, obligations, attention, or sanctions may be allocated according to the shared manifestation. The equivalence relation then becomes part of the generative-relational system. An administrative category can make heterogeneous persons institutionally interchangeable for one procedure. A credit category can group heterogeneous borrowers and alter their future financing conditions. A ranking band can group organizations and affect later demand. A standardized diagnosis can coordinate treatment while also reorganizing self-understanding and institutional response. In these cases, manifestational equiv-

alence begins as a criterion of indistinguishability and can become part of the relational reality that shapes future trajectories.

This recursive possibility reinforces the graph architecture developed throughout the chapter. Manifestational equivalence can be generated by a relationally real mapping; the manifested equivalence can guide action; those actions can reshape subsequent relations; and the resulting relational changes can alter later manifestation mappings. Equivalence is therefore neither a passive label nor a guarantee of deep sameness. It can be an active component in the historical production of similarity and difference.

4.9.4 Relational Difference beneath Manifestational Similarity

The most important ontological consequence of non-invertibility is the possibility that substantial relational difference persists beneath manifestational similarity. A manifestation can be shared while the relations that generated it differ in organization, history, scale, causal mechanism, or normative significance. GR therefore treats the relational structure beneath a manifestation as an open object of inquiry rather than as something uniquely disclosed by appearance.

The example of the hallucinatory flower and the ordinarily encountered physical flower makes the distinction vivid. Both can enter manifestational reality as a flower-like appearance. Both can become causally consequential for attention, movement, memory, language, or subsequent action. Yet the relational configurations through which the manifestations arise can differ substantially. One may involve bodily or neurological conditions that generate a flower-like percept without the ordinary external object; another may involve an external physical flower, environmental conditions, sensory transduction, perceptual organization, memory, and learned categorization. The fact that both are manifestationally available as a flower does not establish a common generative structure, and GR has no need to presume that the two structures belong to a single metric space.

This example also shows why relational reality and manifestational reality should remain distinct. A hallucinatory flower can participate in relational reality if the generated object persists sufficiently and exerts causal efficacy within the relevant system. The relational reality of that object does not depend on identifying its generative structure with the structure of an ordinarily perceived physical flower. Shared manifestational form and shared relational reality-status therefore remain compatible with structural heterogeneity.

The same pattern appears in less unusual cases. Two organizations can report the same productivity indicator while relying on different labor relations, technologies, environmental externalities, or temporal strategies. Two households can report the same income while occupying different debt structures, care obligations, legal statuses, social networks, or exposure to risk. Two communities can exhibit similar rates of participation while differing in trust, coercion, institutional accessibility, or cultural expectations. Two artificial systems can produce similar outputs while relying on different architectures, data histories, or inference procedures. In each case, manifestational similarity narrows some differences while leaving others unresolved.

Claim 4.76 (Relational remainder beneath manifestation)**.** *For a specified manifestation regime, relational differences that do not alter the recognized manifestation constitute a* relational remainder *relative to that regime. Such differences can remain causally and historically significant even while they are absent from the manifestational distinction used by the inquiry.*

The term *remainder* does not imply that the omitted relations are secondary in reality. They are a remainder only relative to a particular manifestation regime. A variable excluded from an indicator can be central to later dynamics. A relation invisible to an administrative category can structure access to resources. A historical difference suppressed by aggregation can determine vulnerability under future disturbance. A symbolic system can render one distinction salient while leaving another difficult to articulate. The remainder is therefore an analytical warning against treating the dimensions made manifest as exhaustive of the relational configuration.

Relational remainder also clarifies why greater manifestational detail does not automatically eliminate non-invertibility. Adding variables can reduce the compatibility set, but every representation selects a domain, scale, resolution, and set of distinctions. A richer manifestation can reveal differences that a coarser regime concealed while still leaving other differences unexpressed. Complete inversion would require a specification of what counts as the full relational configuration and a mapping that preserves every distinction relevant to the inquiry. In many social, economic, historical, and perceptual settings, that requirement is stronger than the available evidence can support.

This point should be kept separate from skepticism. GR does not infer that knowledge is impossible because manifestation can be non-invertible. It infers that knowledge claims should be calibrated to the information preserved by the manifestation regime and to the additional evidence used in reconstruction. An inquiry can learn a great deal from a non-invertible mapping. It can identify equivalence classes, exclude incompatible explanations, estimate probabilities, compare mechanisms, reconstruct partial histories, and test interventions. The loss of unique inversion calls for epistemic discipline rather than epistemic paralysis.

4.9.5 Limits of Reverse Inference

Reverse inference begins from a manifestation and attempts to reconstruct relational structures, histories, mechanisms, or objects compatible with it. The analysis above yields a general constraint: the warranted strength of reverse inference depends on the structure of the manifestation mapping, the size and heterogeneity of the compatibility set, the stability of the conditions, and the availability of independent evidence. Manifestation can support inference without transparently revealing its antecedent relational reality.

Proposition 4.77 (Reverse-inference discipline)**.** *An inference from manifestational reality toward relational reality should state the manifestation regime, identify plausible multiplicity in the compatibility set, distinguish assumptions supplied by the analyst from information preserved by the manifestation, and limit the reconstructed claim to the level supported by the available evidence.*

The principle has several consequences. First, a manifestation should not be

treated as a self-interpreting trace. A number, category, statement, image, behavior, or institutional record becomes evidentially informative through knowledge of the relations and mappings that produced it. Second, reconstruction gains strength when independent manifestations arise through partially different mappings. If several traces with different failure modes converge on a compatible relational account, the compatibility set can become narrower. Third, interventions can sometimes distinguish among otherwise manifestationally equivalent configurations. Changing a condition and observing differential response can reveal structure that passive observation leaves hidden. Fourth, historical reconstruction requires attention to mapping change. A category recorded in one period can have a different generative and institutional meaning in another period even when the visible symbol remains constant.

Reverse inference can also be asymmetric across directions. A mapping may reliably predict a manifestation from a relational configuration while providing weak reconstruction from manifestation to configuration. If a broad range of configurations all produce the same output, forward prediction can be stable while inverse identification remains underdetermined. Conversely, a manifestation can sometimes be highly diagnostic of a narrow class of relational structures even when forward manifestation is probabilistic. The epistemic properties of the forward and reverse problems therefore need separate assessment.

This asymmetry is important for causal interpretation. A causal model can identify how a specified relation would affect manifestation under defined conditions without claiming that every observed manifestation uniquely identifies that cause. Similarly, an institution can reliably translate a legal status into a standardized record while the record alone remains insufficient to reconstruct the full path through which the status was obtained. Predictive adequacy in one direction does not guarantee explanatory uniqueness in the other.

Remark 4.78 (Manifestation and disclosure)*.* A manifestation can disclose genuine aspects of relational reality while remaining non-invertible with respect to the relational configuration as a whole. Partial disclosure and non-unique reconstruction are compatible.

Remark 4.78 protects the chapter from two opposed simplifications. Manifestation is more than arbitrary projection because it can be constrained by, and informative about, relational reality. Manifestation is also less than exhaustive disclosure because the mapping can transform or suppress relational differences. The three-register framework therefore allows a manifestation to be real, constrained, causally consequential, and epistemically useful without treating it as a transparent duplicate of what generated it.

The same discipline applies to symbolic and representational forms, which become central in Section 99. Symbolization can preserve some differences, create new distinctions, stabilize categories, and make relations transmissible across time and space. It can also compress, standardize, and reorganize what becomes manifest. A symbol can therefore increase epistemic reach while adding another mapping whose invertibility requires examination. The transition from manifestation to symbolization should consequently be treated as a further generative relation rather than as a neutral copying operation.

Section 4.9 has established non-invertibility as a structural possibility within the three-register architecture. Many-to-one manifestation generates underdetermination because several relational configurations can be compatible with one manifestational form. One-to-many manifestation generates plurality because a relational configuration can become manifest differently across conditions and regimes. Manifestational equivalence identifies local indistinguishability without converting it into ontological or relational identity. Relational remainder names differences that remain outside a specified manifestation criterion while potentially retaining causal and historical significance. Reverse inference is therefore possible under disciplined conditions, but its strength depends on the mapping, the evidence, and the scale of reconstruction. These results prepare the analysis of symbolization, where manifestations can become stabilized, transmitted, classified, and recursively incorporated into later relational reality.

4.10 Symbolization and Manifestation

Section 4.9 established that manifestation can preserve genuine information about relational reality without providing a uniquely invertible image of the relational configuration from which it emerges. The present section introduces a further mediation: symbolization. Its role is to distinguish manifestation from the processes through which manifestations, relations, subjects, values, and other objects are rendered in symbolic form. Symbolization is analytically important because symbols can preserve distinctions across time and space, make heterogeneous objects administratively or economically comparable, coordinate action among actors who do not share immediate experience, and enter institutions as operative records, categories, rules, and representations. These capacities give symbolic forms unusual generative reach. They also make it especially important to avoid treating symbolization as transparent copying. (Cassirer 1955; Bourdieu 1991; Wittgenstein 2009; Espeland and Stevens 1998)

The argument proceeds in six steps. It first separates manifestation from symbolization and defines a symbolic regime. It then examines symbolic representation as a selective relation rather than an identity between symbol and represented object. The following three subsections consider the symbolization of relations, subjects, and value. The final subsection asks when representations themselves become part of relational reality. Throughout, the method remains consistent with the three-register architecture: symbolization can mediate relational reality without being a prerequisite for relational reality, and symbolic efficacy does not establish that the represented object possesses the ontological status attributed to it.

4.10.1 Manifestation and Symbolization

Manifestation and symbolization overlap in many concrete cases but remain distinct analytical operations. A bodily sensation, a sudden interruption of expectation, a visible pattern, an affective response, a material trace, or a behavioral change can become manifest without first being encoded in a symbolic system. Conversely, a symbolic inscription can persist and circulate beyond the immediate manifestation

through which it was first produced. The distinction therefore protects two claims already established in the chapter: relational reality can precede symbolization, and manifestation is broader than symbolic representation.

Definition 4.79 (Symbolization)**.** *Symbolization* is a generative-relational process through which a difference, object, relation, manifestation, possibility, or constructed category is rendered in a symbolic form whose differentiation and use are organized by a symbolic regime.

The definition is deliberately broader than linguistic naming. Numbers, diagrams, legal categories, monetary denominations, account identifiers, rankings, scores, icons, mathematical expressions, database fields, ritual signs, and conventional gestures can all participate in symbolization when their differences are organized within a system of use. A symbol need not resemble what it represents. Its efficacy can arise from the relations through which a community, institution, technical system, or practice distinguishes the symbol, connects it to other symbols, and treats it as relevant to subsequent action.

Definition 4.80 (Symbolic regime)**.** A *symbolic regime* is a relatively organized set of relations, distinctions, conventions, procedures, media, and practices through which symbolic forms are produced, differentiated, interpreted, transmitted, or made operative within a specified generative-relational system.

A symbolic regime can be highly explicit, as in accounting standards, legal codes, programming languages, or administrative taxonomies. It can also be distributed across practice, as in ordinary language, professional conventions, ritual forms, or culturally stabilized categories. The regime may contain formal rules without being reducible to those rules. Institutional enforcement, habitual use, technological infrastructure, historical inheritance, and embodied competence can all contribute to the persistence of symbolic organization.

Symbolization therefore adds a further mapping to the architecture developed in Sections 4.7–4.9. A manifestation can be selected, segmented, named, quantified, classified, or otherwise encoded. Yet symbolization can also target something that has not been fully manifested to a particular subject. An automated system may classify a transaction, assign an identifier, or generate a score without any human observer first experiencing the underlying relation in an immediate perceptual form. Symbolic mediation is consequently not equivalent to conscious interpretation.

The limited Lacanian analogy introduced in Section 4.2 is useful at precisely this point. Lacanian accounts of the Symbolic do not treat symbolic order merely as labels added after an independently completed field of experience; symbolic relations can organize positions, differences, and possibilities within which later experience and subject formation occur (Johnston 2026). GR does not import Lacan's specific account of language, desire, or subjectivity. The relevant architectural insight is narrower: symbolic mediation can be constitutive of subsequent relations rather than only descriptive of antecedent ones. This is one reason the three registers are represented as a graph rather than a chain.

Claim 4.81 (Symbolization is neither necessary nor terminal)**.** *Relational reality does not require prior symbolization, and symbolization does not constitute a terminal stage of manifestation. Once symbolic forms enter subsequent relations, they can participate*

in further manifestation, stabilization, classification, coordination, and transformation.

Claim 4.81 prevents two opposed reductions. A pre-symbolic relation need not be unreal merely because no vocabulary yet captures it. At the same time, a symbolic representation need not remain external to the object it represents. A new legal name, scientific category, market quotation, diagnosis, public label, or institutional identifier can alter the relations through which the represented object subsequently develops. Symbolization belongs inside generative history when it becomes causally operative.

4.10.2 Symbolic Representation

Symbolic representation is one important use of symbolization, but representation should not be treated as identity. A representation selects differences, organizes them through a symbolic regime, and presents them in a form suited to some practice, audience, institution, medium, or inquiry. The represented object can therefore exceed the representation even when the representation is accurate for its stated purpose.

Definition 4.82 (Symbolic representation)**.** A *symbolic representation* is a symbolically organized object, expression, record, or configuration that stands in a specified representational relation to another object, relation, manifestation, possibility, or constructed target within a symbolic regime.

The term *specified* matters. The same inscription can represent different things under different regimes. A number may denote a price, quantity, rank, probability, account balance, legal threshold, or arbitrary identifier. A word can function as a name, category, command, promise, quotation, or fictional designation. An arrow in a diagram can indicate causation, implication, flow, sequence, correspondence, or merely graphical connection. Representation therefore depends on the relations that organize symbolic use rather than on the mark considered in isolation.

Symbolic representation inherits the non-invertibility examined in Section 4.9. Several relational configurations can be represented by the same symbolic category, while one relational configuration can receive different symbolic descriptions under different regimes. The symbolic form can compress history, suppress differences, aggregate relations, or introduce distinctions that were not previously operative. A category can be highly useful while remaining coarse relative to the relational domain. A detailed representation can preserve more distinctions while still leaving a relational remainder.

This selectivity is not necessarily a defect. Representation is often useful precisely because it reduces complexity. A balance sheet excludes many features of an organization so that specified claims and obligations become legible. A map suppresses most properties of a landscape so that spatial relations relevant to navigation become visible. A legal category narrows heterogeneous histories into a form that permits institutional decision. A statistical variable makes comparison possible by holding some distinctions constant. The relevant question is not whether representation reproduces everything, but what it preserves, what it transforms, what it omits, and what later action is organized through it.

Remark 4.83 (Representational adequacy is purpose-relative)*.* A symbolic represen-

tation can be adequate for one inquiry or practice while remaining inadequate for another. Adequacy therefore requires a stated purpose, scale, domain, and set of distinctions rather than an abstract demand for total correspondence.

Purpose-relative adequacy does not make representation arbitrary. A representation can fail because it omits a causally important distinction, misclassifies the object, applies a rule outside its domain, or produces consequences inconsistent with its stated purpose. The point is instead that symbolic adequacy is evaluated through a relation among representation, target, use, and conditions. No single representation is required to exhaust every relation in which an object participates.

Symbolic representation also introduces a distinction between the reality of the representation and the reality of its referent. A record can exist and be causally effective even if the proposition encoded in it is mistaken. A name can organize collective action even when the named object has uncertain ontological status. A false account balance, erroneous risk classification, or inaccurate administrative record can alter access, behavior, and expectations. The symbolic object and the truth of what it represents are therefore analytically separable.

4.10.3 Symbolized Relations

Relations frequently become actionable through symbolization. Contracts, titles, organizational charts, kinship terms, debt records, network links, legal statuses, platform connections, and institutional roles render some relation sufficiently explicit that it can be stored, communicated, enforced, compared, or incorporated into later decisions. Symbolization can thereby increase the persistence and reach of a relation without exhausting the relation itself.

A symbolized relation is not simply a picture of an antecedent connection. The act of recording, naming, or classifying a relation can change the relation's future trajectory. A debt entered into an enforceable ledger differs from an unrecorded expectation. An employment relation formalized by contract acquires rights, obligations, temporal boundaries, and institutional interfaces that can become causally significant. A platform's designation of two accounts as connected can affect information flow, recommendation, visibility, and later interaction. The symbolic form becomes one of the mediations through which the relation is reproduced.

Definition 4.84 (Symbolized relation)**.** A *symbolized relation* is a relation rendered through a symbolic regime in a form that selects, encodes, or organizes some of its differences and that may subsequently participate in the persistence, interpretation, coordination, or transformation of the relation itself.

Definition 4.84 leaves open whether the symbolic form is constitutive, evidential, descriptive, or merely auxiliary in a particular case. A legal marriage status can partly constitute institutional relations that would not exist in the same form without recognition. A diagram of an informal friendship network may instead be an analyst's representation that has little effect on the represented relations. A public label such as "ally," "competitor," or "debtor" can begin descriptively and later alter expectations enough to become generatively important. The role of symbolization is therefore an empirical and historical question.

Symbolization can also stabilize relations by making them portable across contexts. A credential allows a relation of qualification to travel beyond the place where competence was originally demonstrated. A title allows ownership claims to be recognized by actors who did not witness the original acquisition. A contract allows obligations to persist despite changing memories and personnel. A standardized code allows an institutional relation to be processed by distant offices or automated systems. Symbolization can thus extend relational efficacy across spatial, temporal, and organizational discontinuities.

This portability has limits. The symbolic relation can outlive the conditions that initially made it accurate. A category may persist after the underlying relation has transformed. A database can reproduce an outdated status. A contractual label can conceal asymmetries that the formal description does not register. A network edge can imply a homogeneous connection even when the relation changes in intensity, direction, or meaning. Symbolization increases persistence partly by reducing the number of differences that must be reproduced, and that reduction can later become a source of distortion.

4.10.4 Symbolized Subjects

Subjects are especially vulnerable to confusion between relational reality and symbolic representation because modern institutions operate through names, identifiers, roles, statuses, profiles, records, classifications, and credentials. These symbolic forms make subjects legible to systems that could not otherwise coordinate across large populations and long time horizons. They can also become part of the processes through which subject positions are stabilized.

A person can possess relationally effective subjecthood before or beyond any particular representation. Bodily continuity, memory, practical orientation, recognition by others, participation in institutions, and histories of interaction can sustain a subject across changes in name, account, role, or classification. Conversely, a symbolic subject can be generated institutionally even when the deeper ontological status of subjecthood remains unsettled. A corporation, state agency, software account, autonomous system, or legal estate can be treated as a subject for specified operations without GRE inferring that all such subjects share the same metaphysical or moral status.

Definition 4.85 (Symbolized subject)**.** A *symbolized subject* is a subject-position rendered within a symbolic regime through names, identifiers, categories, roles, records, credentials, profiles, or related representational forms that permit the subject to be recognized or acted upon within specified relations.

The definition refers to a subject-position rather than to the complete subject. This distinction is important. An institutional identifier can be necessary for taxation, payment, healthcare, education, migration, or platform participation while representing only a small subset of the relations through which the person exists. A legal person can be highly effective in contracting and ownership while remaining distinct from a human subject. A computational agent can occupy an operational role in a market or organization without the symbolic role settling questions of consciousness, responsibility, rights, or moral standing.

Symbolized subjecthood can nevertheless become causally powerful. A classification can determine access to benefits, credit, employment, insurance, mobility, or legal procedures. A professional title can organize expectations and authority. A public reputation can affect bargaining position. A profile assembled from behavioral traces can shape which opportunities become visible. Once these symbolic forms enter repeated institutional action, they can become part of the relational reality through which the subject's later possibilities are generated.

The possibility of misrepresentation is therefore normatively and economically significant. A mistaken or reductive representation of a subject can still have real effects if institutions act upon it. The subject may be forced to respond to a symbolic object that has acquired causal efficacy independently of its accuracy. This is another instance in which relational reality and epistemic adequacy must remain distinct: a representation can be relationally real in its consequences while being false, incomplete, outdated, or unjust.

4.10.5 Symbolized Value

Economic life depends heavily on symbolic forms of value. Prices, wages, account balances, exchange rates, ratings, scores, rankings, budgets, asset values, accounting categories, and monetary denominations make heterogeneous activities and objects available to calculation and coordination. Yet the presence of a common symbolic scale should not be confused with proof that the underlying values are intrinsically commensurable.

A price is a particularly important example. It can manifest conditions of exchange under a specified market arrangement and can represent a monetary valuation at a particular time. Once displayed, recorded, anticipated, or used as a reference, the price can also affect bargaining, expectations, investment, production, and later prices. The symbolic form therefore does more than report an antecedent value. It can participate in the generation of subsequent valuation relations.

The same is true of non-price representations. A credit score compresses a set of observations and modeling choices into a symbolic scale that can influence lending. A ranking compresses multiple criteria into an ordering that can alter applications, prestige, and resource flows. A performance indicator can reorganize work around what is measured. An accounting category can make one form of contribution legible while leaving another outside the reporting system. Symbolized value can therefore create pathways through which some differences acquire institutional force.

Definition 4.86 (Symbolic commensuration)**.** *Symbolic commensuration* is the construction or stabilization of a common symbolic scale, ordering, category system, or representational coordinate through which heterogeneous objects or relations can be compared for a specified practice, without thereby establishing that their underlying relational structures or values share an intrinsic common metric.

Definition 4.86 connects symbolization to the non-necessary comparability of relational realities established in Section 4.2. Symbolization can generate a practical comparison relation where none was previously available. Monetary units allow unlike goods to enter exchange calculations. Rankings place heterogeneous organizations in a common order. Composite indicators render different observations comparable by

applying weights and normalization rules. These operations can be useful and consequential. Their success as coordination devices does not establish that the compared objects were already elements of one natural metric space.

Claim 4.87 (Symbolic comparability does not establish relational equivalence)**.** *The successful placement of heterogeneous objects within a common symbolic scale or ordering establishes a practical relation of comparison under that regime; it does not by itself establish equivalence, identity, or intrinsic commensurability among the relational realities represented.*

This distinction matters for GRE because symbolic commensuration can redistribute attention and resources. Once a common scale becomes institutionally important, actors may adapt behavior toward improving the represented value. Objects may be redesigned to fit categories. Activities difficult to symbolize may receive less recognition. A symbolic metric can therefore help create the economic field it initially appears merely to measure. The normative evaluation of such a field requires more than checking whether the metric is consistently applied; it also requires asking which relations become visible, which remain outside the scale, and what generative consequences follow from acting through the representation.

4.10.6 Representation within Relational Reality

The preceding subsections converge on a central implication of the three-register architecture: a representation can itself become part of relational reality. The conditions are the same as for other relationally real objects. A symbolic form, symbolic regime, or representation must emerge within a generative-relational system, persist with sufficient stability over a relevant region or interval, and exercise causal efficacy within that system. Symbolicity alone is insufficient; relational efficacy is what makes the representation relationally real.

Proposition 4.88 (Relational reality of representation)**.** *A symbolic representation or symbolic regime qualifies as relationally real relative to a generative-relational system when it is sufficiently persistent and stable to exercise causal efficacy in the generation, coordination, constraint, interpretation, or transformation of subsequent relations within that system.*

Proposition 4.88 allows representation to be treated symmetrically with the manifestation mappings discussed in Section 4.8. An accounting standard can become relationally real because organizations reorganize reporting, investment, and compliance around it. A currency unit can become relationally real because obligations, prices, and expectations are denominated through it. A legal category can become relationally real because institutions repeatedly act upon it. A public narrative can become relationally real when it persists sufficiently to orient collective action. None of these conclusions requires the representation to be ontologically fundamental or epistemically flawless.

The distinction between causal efficacy and truth is particularly important. A representation can be inaccurate and still cause decisions. A rumor can move a market before being corrected. An erroneous database entry can block access. A mistaken classification can alter treatment by institutions. A misleading indicator can redirect resources. The relational reality of the representation concerns its generated persis-

tence and causal participation, not the truth of every proposition associated with it.

Remark 4.89 (Reality of a representation and truth of a representation). The reality of a representation as an operative object and the epistemic adequacy of what it represents are distinct questions. A representation can be relationally real in its effects while remaining incomplete, inaccurate, contested, or false with respect to its target.

This distinction also prevents a converse mistake. Accurate representation does not automatically imply strong relational efficacy. A carefully verified scientific description can remain causally marginal if it does not enter institutions, practices, decisions, or other subsequent relations. Relational reality depends on how the representation participates in the system, not solely on its correspondence to the represented object.

Symbolic forms therefore occupy a distinctive position in the graph among the three registers. They can arise from manifestations, represent relational realities, encode claims about ontological reality, and become relationally real through their own persistence and causal efficacy. They can also condition later manifestations by organizing what actors, institutions, and technical systems are prepared to recognize. The graph is recursive because a representation produced at one moment can alter the mappings, categories, expectations, and relations through which later reality becomes manifest.

The analysis of symbolization also clarifies why representation cannot be added to the three-register framework as a simple fourth layer above manifestation. Representation is a family of mediated relations that can operate across the graph. A symbolic representation may target a manifestation, a relational object, an ontological claim, another representation, or a possible future configuration. It can remain a transient analytical artifact or become a persistent causal object. Its location is therefore determined by the relations in which it participates rather than by a fixed position in a vertical hierarchy.

Section 4.10 has established six points. Manifestation is broader than symbolization. Symbolization occurs within symbolic regimes whose rules and practices can have histories of their own. Symbolic representation is selective and purpose-relative rather than identical with its target. Relations and subjects can be symbolized in forms that subsequently alter their relational development. Symbolized value can generate practical commensurability without proving intrinsic comparability or relational equivalence. Finally, representations themselves can become relationally real when they persist, stabilize, and causally participate in subsequent generation. These results prepare Section 100, where the book turns from individual mediations to the recursive relations among relational reality, manifestation, representation, and the later relations that they help produce.

4.11 Recursive Relations among Reality, Manifestation, and Representation

Sections 4.5–4.10 separated relational reality, manifestation, manifestation mappings, non-invertibility, and symbolic representation so that each could be analyzed without collapsing into the others. The present section recombines those distinctions into a re-

cursive architecture. Its role is to explain how relational realities can condition what becomes manifest, how manifestations can be stabilized or transformed through representation, and how representations can re-enter the generative-relational system to alter subsequent relations. The resulting structure is neither a linear sequence nor a closed cycle. It is a historically evolving graph in which different pathways can become active, inactive, reinforced, interrupted, or redirected under changing conditions. (Merton 1948; Giddens 1984; Arthur 1989)

The section proceeds in five steps. It first examines the movement from relational reality to manifestation while preserving the possibility that much relational reality remains unmanifested. It then considers the movement from manifestation to representation and the selective operations involved in symbolic articulation. The third subsection treats representation as an input into subsequent relations rather than as a terminal description. The final two subsections distinguish recursive stabilization from recursive transformation. This distinction is important because repeated mediation can reproduce an existing relational reality, but it can also change the conditions under which later reality emerges. Recursion therefore concerns the historical consequences of mediation rather than the mere repetition of a fixed circuit.

Definition 4.90 (Recursive generative mediation)**.** *Recursive generative mediation* is a historically situated process in which a manifestation or representation generated within a generative-relational system subsequently becomes an operative condition, input, constraint, capacity, or object within that system, thereby contributing to the generation of later relations, manifestations, or representations.

Definition 4.90 preserves the graph architecture established in Section 4.2. A manifestation need not arise only after a fully completed relational object, and a representation need not remain outside the relation it describes. Once a manifestation or representation acquires causal participation in subsequent processes, it becomes part of the history from which later configurations emerge. The recursion is generative because later states can differ from earlier states; it is historical because the effects of previous manifestations and representations can accumulate, dissipate, conflict, or become institutionalized over time.

For analytical purposes, one possible local description distinguishes a relational configuration $\mathcal{R}_t$, a manifestational configuration $\mathcal{M}_t$, a representational configuration $\mathcal{P}_t$, and a wider set of relevant conditions $\mathcal{C}_t$ at a time or interval indexed by t. A manifestation relation may be written schematically as

$$\mathcal{M}_t = \Phi_t(\mathcal{R}_t, \mathcal{C}_t), \tag{4.4}$$

while a representational process may be written as

$$\mathcal{P}_t = \Sigma_t(\mathcal{M}_t, \mathcal{R}_t, \mathcal{C}_t). \tag{4.5}$$

The subsequent relational configuration can then be represented schematically by

$$\mathcal{R}_{t+1} = \Gamma_t(\mathcal{R}_t, \mathcal{M}_t, \mathcal{P}_t, \mathcal{C}_t). \tag{4.6}$$

These expressions are not proposed as universal equations of social or economic reality. They provide a compact way to mark three analytical facts: manifestation de-

pends on conditions, representation can depend on more than manifestation alone, and later relational configurations can be affected by what has previously manifested or been represented. The mappings Φ_t, Σ_t, and Γ_t may themselves change historically and may, under the conditions established in Sections 4.5 and 4.8, become relationally real objects within the systems in which they operate.

4.11.1 Relational Reality to Manifestation

The first relation concerns how a relationally real object or configuration becomes manifest under specified conditions. Section 4.5 established that relational reality does not require prior manifestation. An institution, trust relation, debt relation, social expectation, symbolic convention, or historically stabilized sense of self can participate causally in a system even when parts of its operative structure remain outside present awareness, observation, or explicit articulation. Manifestation therefore selects from, responds to, or is generated through relational reality without exhausting it.

Equation 4.4 represents this relation only schematically. The manifestation $\mathcal{M}_t$ is generated through the conjunction of a relational configuration and the conditions under which manifestation becomes possible. Those conditions can include bodily capacities, technical instruments, institutional procedures, cultural categories, attention, spatial position, temporal position, data infrastructure, measurement rules, and prior symbolic expectations. A price becomes manifest through a market and quotation mechanism; an organizational hierarchy can become manifest through decisions, titles, reporting lines, or patterns of deference; trust can become manifest through disclosure, reliance, expectation, or vulnerability; a physical process can become manifest through an instrument whose design selects some differences while suppressing others.

The manifestation relation is therefore selective without being arbitrary. A relational reality can constrain the range of manifestations available under a given regime even when multiple manifestations remain possible. Conversely, a manifestational configuration can suppress, aggregate, or fail to disclose differences that remain causally important in the relational domain. The relational remainder introduced in Section 4.9 is especially relevant here: what remains unmanifested under one configuration may become important under another, and later consequences may reveal that an apparently negligible difference had continuing causal significance.

Claim 4.91 (Manifestational partiality)**.** *A manifestation can be genuinely generated by and informative about a relational reality while remaining partial with respect to the relational configuration, history, and unrealized possibilities through which it emerged.*

Claim 4.91 permits a middle position between transparent disclosure and radical disconnection. Manifestation can carry real information. It can support explanation, evidence, coordination, and intervention. Yet the information preserved by a manifestation depends on the mapping conditions through which it arises. Reverse inference therefore remains disciplined by the plurality of relational configurations compatible with the observed manifestation.

This partiality becomes important in cases of contingency and aesthetic judgment.

A contingent event can become salient to a subject at a particular moment, but the conditions through which that event becomes recognizable as surprising, beautiful, significant, or worthy of attention may have been generated historically before the moment of conscious judgment. Prior encounters, categories, practices, expectations, bodily capacities, institutional histories, and other relations can contribute to a manifestational configuration without first appearing to the subject as explicit objects of awareness. The subsequent judgment concerns a manifestation, but the relational-generative structure enabling that manifestation can precede the judgment. The reality of that structure is therefore not created merely by being noticed.

The same point also protects a distinction between manifestation and ontological access. A manifestation can be generated through a relational reality whose own ontological status remains suspended. The manifestation can then become evidence about relational organization without licensing a stronger claim about ultimate ontology. The graph from relational reality to manifestation consequently remains compatible with the local sufficiency of ontological commitment developed in Sections 4.1 and 4.3.

4.11.2 Manifestation to Representation

A manifestation can subsequently become represented, recorded, named, classified, quantified, narrated, diagrammed, encoded, or otherwise symbolized. Section 4.10 showed that this movement introduces another selective relation. Representation can preserve a manifestation across time, transmit it across space, place it in relation to other manifestations, and make it available to institutions or actors who were absent from the original event. These capacities enlarge the reach of manifestation. They also introduce new sources of transformation.

Equation 4.5 therefore allows $\mathcal{P}_t$ to depend on more than $\mathcal{M}_t$ alone. A representation can incorporate background theories, institutional categories, prior records, legal rules, measurement conventions, or relational knowledge that is not contained in the immediate manifestation. A medical image can be represented differently under different diagnostic categories; an observed transaction can be represented differently under accounting, legal, or statistical regimes; a verbal statement can be classified differently depending on institutional context. Representation is thus not a passive second copy of appearance. It is an organized operation within a symbolic regime.

This operation can make previously dispersed manifestations comparable. A price system places heterogeneous goods within a monetary scale. A ranking places organizations within an ordinal relation. A legal record places heterogeneous histories within a procedural category. A scientific variable can transform observations into comparable measurements. Such symbolic commensuration can enable coordination and analysis while also suppressing differences that do not enter the symbolic scheme. The practical success of representation therefore remains distinct from the claim that the represented realities share one intrinsic metric.

Remark 4.92 (Representation can preserve and transform)*.* Representation can simultaneously preserve selected information from a manifestation and transform the conditions under which that information is interpreted, compared, transmitted, and

acted upon. Preservation and transformation are therefore not mutually exclusive descriptions of the same representational process.

This duality is particularly visible when a representation creates a durable record. A transient manifestation can disappear while its symbolic trace persists. Once preserved, the representation can become available to actors, institutions, or technical systems in later contexts that differ substantially from those of the original manifestation. The later use can therefore generate relations that could not have arisen from the original manifestation alone. Historical records, legal precedents, archives, credit histories, scientific publications, accounting entries, and algorithmic profiles all illustrate ways in which representation can extend the temporal reach of a manifestation.

At the same time, what is represented can feed back into what later becomes manifest. Once actors learn the categories under which they are classified, they may adapt behavior, resist the category, seek inclusion, or reorganize self-understanding. Once organizations know the metrics by which they are evaluated, they may redesign processes to improve those metrics. Once a price becomes publicly quoted, expectations can change before the underlying production relation changes. Representation therefore begins to participate in the conditions of later manifestation even before it qualifies as a stable relational reality in its own right.

4.11.3 Representation to Subsequent Relation

The third relation is the point at which recursion becomes explicit. A representation can enter subsequent relations and thereby alter the generative-relational system from which later realities emerge. Section 4.10 established that a representation can itself become relationally real when it persists with sufficient stability and exercises causal efficacy. The present subsection focuses on what follows once such causal participation occurs.

Equation 4.6 represents the later relational configuration $\mathcal{R}_{t+1}$ as depending, where relevant, on prior relational structure, manifestation, representation, and wider conditions. This dependence need not be direct. Representations can act through institutions, expectations, technologies, incentives, memory, attention, authority, or collective coordination. The same representation can also generate different effects in different relational environments. A legal classification has little force without institutions able to recognize and enforce it; a market quotation acts differently under liquid and illiquid conditions; a self-description has different consequences depending on whether others recognize, contest, or ignore it.

The causal role of representation therefore depends on relational uptake. A symbol becomes generatively consequential when actors or systems are organized so that the symbol can affect later processes. This can occur through explicit interpretation, but conscious interpretation is not required. Automated scoring systems, database constraints, software permissions, payment infrastructures, and algorithmic classifications can produce consequences because technical and institutional relations are organized around symbolic states. A representation can therefore enter subsequent relations through human, institutional, material, or computational pathways.

Proposition 4.93 (Representational recursion)**.** *When a representation generated within a generative-relational system becomes causally operative in later relations, the*

representation becomes part of the historical conditions through which subsequent relational and manifestational realities are generated. Its later effects are therefore not external commentary on the system but part of the system's generative history.

Proposition 4.93 has important consequences for economic analysis. A credit score can affect access to credit, and the resulting access or exclusion can alter later financial behavior that contributes to future scores. A market price can affect production and demand, which then affect later prices. An accounting classification can alter organizational investment, which changes the activity later recorded under that classification. A public forecast can affect expectations and decisions that become part of the later economic configuration. In each case, representation and represented reality cannot be analyzed as permanently external to one another.

The same logic applies to subjectivity. A manifested experience can be narrated, named, or institutionally classified. That representation can affect memory, recognition, expectation, and future conduct, thereby participating in the relational conditions through which later subjectivity develops. The self-description is neither simply identical with the subject nor irrelevant to subject formation. It becomes one relation among others through which a relatively continuous subject can be sustained or transformed.

Aesthetic judgment provides another instructive case. A contingent encounter can become manifest as striking or beautiful; the judgment can then be symbolically articulated, recorded, taught, cited, or institutionalized. Such representations can redirect attention, confer prestige, organize preservation, influence research selection, and shape the conditions under which later observers encounter the object. The judgment therefore participates in a history that can alter the relational reality surrounding the object without implying that the object's earlier relational reality depended on having already been judged.

4.11.4 Recursive Stabilization

Recursive mediation can stabilize a relational reality when later manifestations and representations repeatedly reinforce the relations through which that reality persists. Stabilization is not mere repetition. Each iteration can occur under slightly different conditions, involve different actors, or produce different manifestations while nevertheless preserving enough structure for the relational object to remain recognizable and causally effective across time.

Definition 4.94 (Recursive stabilization)**.** *Recursive stabilization* is the process through which manifestations or representations generated by a relational reality subsequently reinforce, reproduce, coordinate, or restore relations that contribute to the persistence and stability of that relational reality over a relevant spacetime interval.

Money provides a familiar illustration. Monetary relations generate prices, account balances, banknotes, receipts, quotations, and other manifestations and representations. These forms then guide exchange, accounting, debt settlement, planning, and expectation. Repeated use contributes to the persistence of the monetary relation itself. The relational reality of money is therefore reproduced partly through manifestations and representations generated within monetary relations and later

re-entering those relations.

Trust can display a similar pattern without requiring explicit symbolic articulation at every stage. Repeated reliable interaction can generate manifestations of trust such as reliance, disclosure, delegation, or reduced monitoring. Some of these manifestations may be represented through promises, reputational records, narratives, or institutional certifications. Those representations can then support further reliance and coordination. The resulting recursive stabilization can make trust more persistent, although the process remains vulnerable to contradiction, changing conditions, and competing relations.

Institutional categories can also stabilize recursively. A category used to allocate rights, resources, or responsibilities can shape behavior around the category. The resulting behavior can then appear to confirm the category's practical importance, leading to further institutional use. The recursion may be administratively useful, but stabilization alone does not establish epistemic adequacy or normative legitimacy. A poorly founded category can become highly stable when institutional relations repeatedly reproduce it.

Claim 4.95 (Stability does not validate the stabilized representation)**.** *Recursive stabilization can increase the persistence and causal efficacy of a representation or relational object without establishing that the representation is epistemically adequate, normatively desirable, or ontologically fundamental.*

Claim 4.95 is especially important for GRE because economic systems frequently reward what they have already made legible. A metric used for allocation can cause actors to optimize for the metric; the resulting concentration of activity can make the metric appear increasingly representative of the field. A market category can attract capital, talent, and institutional attention; the resulting expansion can make the category appear more naturally given than it was at its emergence. Recursive stabilization can therefore generate historical depth and causal reality around initially contingent classifications.

This mechanism also helps explain why relational realities can exhibit self-reinforcing tendencies without becoming immutable attractors. Stabilization can be local, conditional, and reversible. Competing representations, institutional changes, shocks, new technologies, altered expectations, or previously suppressed relational differences can weaken the recursive support. The relevant analytical question is therefore which feedback pathways currently sustain the relational object, over what interval, and under what conditions those pathways may cease to reproduce it.

4.11.5 Recursive Transformation

Recursion can also transform rather than stabilize. A manifestation or representation can introduce a difference that changes the relations through which later manifestations and representations are produced. In such cases, the system does not simply reproduce an existing relational reality more strongly or weakly. The effective configuration of relations, constraints, capacities, categories, or manifestation rules changes.

Definition 4.96 (Recursive transformation)**.** *Recursive transformation* is the process

through which a manifestation or representation generated within a generative-relational system contributes to changing the relations, constraints, capacities, mappings, or symbolic regimes that condition subsequent relational and manifestational realities.

A new representation can transform the field by creating a distinction that later actors begin to organize around. A legal recognition can change who is able to contract, own, inherit, claim protection, or appear before an institution. A new accounting category can redirect investment and alter organizational boundaries. A scientific classification can reorganize research attention and intervention. A public articulation of an experience can provide a vocabulary through which previously dispersed manifestations become connected, compared, and institutionally recognized. In each case, representation contributes to changing the generative conditions rather than merely preserving an antecedent state.

Transformation can also occur through failure or contradiction. A representation may repeatedly fail to account for observed manifestations. Those mismatches can generate pressure to revise the symbolic regime, alter the manifestation mapping, or reconstruct the underlying relational model. The appearance of anomalies is itself conditioned by available representational resources, but once recognized, anomalies can become relationally consequential by reorganizing inquiry and intervention. Recursion therefore includes pathways in which the system revises the means through which it manifests and represents itself.

The distinction between stabilization and transformation should remain analytical rather than absolute. A recursive process can stabilize some relations while transforming others. The introduction of a standardized metric may stabilize a field of comparison while transforming organizational behavior. A legal reform may transform formal rights while stabilizing deeper resource asymmetries. A new identity category may stabilize recognition for some actors while transforming relations of affiliation and exclusion. GRE therefore requires the scale and object of stabilization or transformation to be specified rather than inferred from the existence of recursion alone.

Proposition 4.97 (Historical recursion of the three-register graph)**.** *In a generative-relational system, manifestations and representations can become historical conditions of later relational reality when they enter subsequent relations with sufficient causal efficacy. The three-register architecture is therefore recursively historical: later relations can depend partly on how earlier relational realities became manifest, represented, interpreted, preserved, and acted upon.*

Proposition 4.97 summarizes the principal result of the section. The graph among ontological, relational, and manifestational reality cannot be adequately understood as a static taxonomy. Relational reality can precede manifestation, yet manifestation can alter later relational reality. Representation can preserve or transform manifestation, yet representation can itself become relationally real. Symbolic regimes can mediate what later becomes manifest, and changing relations can alter the symbolic regimes through which earlier realities were understood. Historical time therefore enters not as an external parameter added after the ontology, but as part of the generative conditions through which the relations among registers evolve.

This recursive architecture also clarifies the limited use of the Lacanian analogy introduced earlier in the chapter. The relevant similarity lies less in matching ontological reality, relational reality, and manifestational reality one-to-one with the Real, Imaginary, and Symbolic than in refusing a simple hierarchy in which one register merely reflects another. Symbolic and manifestational forms can reorganize later relations; relations can condition later manifestation; and some dimensions of reality can remain resistant to the available symbolic or manifestational regime. GR preserves this graph-like intuition while assigning its own criteria of relational reality, causal efficacy, persistence, and historical emergence.

Section 4.11 therefore completes the first major movement of Chapter 4. Sections 4.1–4.11 have established an ontologically restrained three-register architecture in which relational realities can emerge before perception or symbolization, manifestations arise through historically formed mappings, representations can preserve and transform what manifests, and recursive mediation can stabilize or transform subsequent relations. The next movement turns from the architecture itself to particular classes of object that occupy it. Section 101 begins with subjects, asking how subjecthood can be distinguished across ontological, relational, manifestational, and institutionally represented forms without presuming that manifestational equivalence establishes subject identity.

4.12 Subjects across the Three Levels

The three-register architecture developed in Sections 4.2–4.11 becomes especially consequential when the analytical object is a subject. Economic, legal, institutional, interpersonal, and technical practices routinely treat subjects as if their identity were straightforward: a person signs a contract, an organization owns an asset, an account receives a payment, an employee performs a role, or an artificial system selects an action. Yet the apparently simple noun *subject* can refer to markedly different realities. It can refer to an ontological claim about what kind of being exists, a relationally stabilized locus of causal participation, a manifestation through which subjecthood becomes perceptible or experienceable, or an institutional representation through which a system identifies and acts upon a participant. The role of this section is to separate these senses while showing how they can recursively mediate one another. Its objective is to provide an ontologically restrained account of subjecthood adequate to GRE without reducing subjects to representations or presuming that every operationally similar subject shares the same underlying structure. The discussion proceeds from ontological subjecthood to relationally effective subjecthood, manifestational subjecthood, institutional representation, human and artificial subjects, and finally manifestational equivalence without subject identity. (Mead 1934; Ricoeur 1992; Goffman 1959; Honneth 1995)

The distinction extends rather than replaces the conception of the economic subject developed in Chapter 3, Section 75. Chapter 3 treated an economic subject as a relatively stabilized locus of economically consequential participation. The present section asks what kind of reality such a locus has and how that reality can diverge from the ways in which the subject appears, understands itself, or is represented by institutions. A worker, corporation, household, state agency, platform account,

or artificial system can therefore be approached through several registers at once. These approaches need not converge into one exhaustive description. Their analytical value lies partly in making divergence visible.

Definition 4.98 (Register-sensitive subjecthood)**.** *Register-sensitive subjecthood* is an analytical treatment of a subject that distinguishes among claims concerning its ontological status, its relationally stabilized and causally effective participation, its modes of manifestation, and its symbolic or institutional representation, while allowing these dimensions to mediate one another historically.

Definition 4.98 does not imply that every empirical inquiry requires four separate models of the same subject. It supplies a discipline of distinction. When the dimensions coincide sufficiently for the research question, a simpler representation can be appropriate. When they diverge, however, treating them as identical can conceal economically and normatively important mechanisms. A person can remain relationally consequential while disappearing from an administrative record; an institutional profile can persist after the relations that originally produced it have changed; a self-description can alter subsequent conduct; an artificial system can occupy a stable operational position without this position settling questions of consciousness or moral personhood. The registers therefore help specify which kind of subjecthood is being claimed in any particular analysis.

4.12.1 Ontological Subjecthood

Ontological subjecthood concerns the strongest question in the section: what, if anything, the subject is independently of a particular manifestation, classification, role, record, or analytical representation. The formulation is intentionally open. Different ontologies can locate subjecthood in an embodied organism, a persisting person, a conscious field, a process of self-organization, a bundle of capacities, a relationally constituted agent, a narrative continuity, or some combination of these and other structures. GR does not need to adjudicate this entire field before investigating economically consequential subjecthood. The principle of ontological suspension established in Section 4.3 therefore applies with particular force.

The analytical importance of the ontological question remains even when it is suspended. A legal person, a remembered self, a behavioral profile, a biological organism, and an institutional role may all be associated with what ordinary language calls the same subject, yet they select different persistence conditions. The organism can persist through loss of a role. A legal identity can persist through substantial biological and psychological change. A role can persist through replacement of its occupant. A digital profile can persist after the person it represents has ceased to participate in the relevant system. These differences indicate that subject persistence cannot be inferred from a single criterion before the relevant register has been specified.

The sense of “I” provides a particularly instructive case. A continuing self-experience can become relationally real when it emerges through bodily, mnemonic, interpersonal, linguistic, historical, and other relations, persists with sufficient stability, and causally organizes later conduct. The existence of such relational reality does not by itself settle whether there is an ontologically independent, indivisible, or permanently self-identical entity corresponding to that experience. Conversely,

ontological suspension concerning the ultimate status of the self does not weaken the causal reality of self-experience when it organizes memory, commitment, expectation, responsibility, attention, or action. The three-register architecture therefore allows inquiry into the reality of selfhood without forcing immediate passage from causal efficacy to metaphysical conclusion.

The same restraint applies to collective subjects. A corporation can own property, employ workers, enter contracts, borrow, sue, be sued, accumulate reputation, and survive replacement of many of its members. These properties make corporate subjecthood highly consequential in relational and institutional registers. Whether the corporation should also be treated as an ontologically irreducible collective subject is a stronger question. GRE can investigate the generative consequences of corporate action while leaving this stronger issue open unless the research problem makes it operative.

Remark 4.99 (Ontological subjecthood and analytical reference)*.* Suspending a final ontology of the subject does not make the term *subject* empty. It requires the analysis to specify the properties, persistence conditions, capacities, and relations relevant to the inquiry rather than treating ordinary-language identity as a complete ontological account.

Remark 4.99 is especially important for interdisciplinary work. Economics, law, psychology, computer science, biology, and political theory can refer to apparently similar subjects while selecting different properties as causally or normatively relevant. GRE can connect these descriptions where warranted, while preserving the possibility that their objects are only partially overlapping.

4.12.2 Relationally Effective Subjecthood

Relationally effective subjecthood concerns a different question: whether a subject has emerged as a sufficiently persistent and stable locus of participation to exercise causal efficacy within a generative-relational system. This formulation applies the relational-reality criterion from Section 4.5 directly to subjecthood. A subject is relationally effective when actions, expectations, obligations, memories, permissions, capacities, risks, or other consequences can accumulate around a recognizable locus and when that locus subsequently affects the development of the system.

Definition 4.100 (Relationally effective subject)**.** A *relationally effective subject* is a subject-position or subject-configuration that emerges within a generative-relational system, persists with sufficient stability over a relevant spacetime region or interval, and exercises causal efficacy within that system through the organization of action, expectation, attribution, capacity, constraint, responsibility, or subsequent relation formation.

The definition permits considerable heterogeneity in how subjecthood is stabilized. Biological continuity can matter for a human subject. Legal registration can matter for a corporation. Memory and recognition can matter for interpersonal identity. Repeated interaction can stabilize a household or community role. An account, mandate, technical identity, and authorization structure can stabilize the operational position of an artificial system. The common analytical feature is not a common substance but the emergence of a causally consequential locus around which relations

become organized.

This criterion also clarifies why relational subjecthood can precede explicit self-awareness or symbolic recognition. An infant can participate in relations of care, expectation, attachment, dependency, and resource allocation before possessing the symbolic capacities required for a mature self-description. A worker can occupy a structurally consequential position before recognizing its wider institutional significance. A population can be differentially affected by an institutional arrangement before a political or scholarly vocabulary exists through which that position is named. Subjecthood in the relational register therefore does not wait for complete manifestation to the subject itself.

Relational subjecthood can nevertheless be transformed through manifestation. A person who becomes aware of being trusted may act differently because that trust has become manifest. A worker who learns how an institution classifies a role can reinterpret obligations or opportunities. A community that acquires a shared description of its position can coordinate around that description. The manifestation does not create the entire relational history ex nihilo; it enters that history and can reorganize its subsequent development. Subjecthood therefore exemplifies the recursive mediation described in Section 4.11.

Persistence in this register remains relative to the relevant process. A market transaction may require only short-lived identification. Credit, employment, reputation, liability, insurance, inheritance, or long-term cooperation require longer continuity. Some systems construct subject persistence through identifiers, records, biographies, organizational membership, addresses, credentials, or legal continuity. Others rely more strongly on embodied recognition, memory, or recurring interaction. The duration and mechanism of persistence are therefore empirical properties of the relational system rather than fixed attributes of subjecthood in general.

The relational criterion also permits subjecthood to be distributed. A decision attributed to one organization can depend on committees, software, routines, legal mandates, data infrastructures, professional norms, and external constraints. A subject can remain a useful locus of attribution even when the causal organization supporting that locus is internally heterogeneous. The analytical task is then to distinguish the stabilized subject-position from the wider relational architecture that enables it. Relative individuation and relational dependence can coexist.

Claim 4.101 (Relational subjecthood without exhaustive individuation)**.** *A subject can become sufficiently individuated for causal, institutional, or economic analysis while remaining dependent on a wider relational configuration for the persistence, capacities, and boundaries through which that individuation is sustained.*

Claim 4.101 protects GRE from two opposite simplifications. Subjecthood need not be treated as fully pre-given before relation, and relational dependence need not dissolve every subject into an undifferentiated field. The degree and mechanism of individuation are themselves objects of inquiry.

4.12.3 Manifestational Subjecthood

Manifestational subjecthood concerns the ways in which a subject becomes available within a manifestational configuration. The subject may become manifest to itself, to another subject, to an institution, to an instrument, to a public, or to a computational system. These modes can include bodily appearance, speech, action, affect, memory, narrative, performance, biometric signal, statistical pattern, recorded behavior, visual image, or other forms through which some aspect of subjecthood becomes accessible.

Definition 4.102 (Manifestational subjecthood)**.** *Manifestational subjecthood* denotes the reality of a subject insofar as some aspect of that subject becomes available, distinguishable, experienceable, recordable, measurable, interpretable, or otherwise present within a specified manifestational configuration.

Manifestational subjecthood can be fleeting. A facial expression may reveal a momentary affective state without becoming a persistent identity. A statement may disclose an intention that changes shortly afterward. A measurement may reveal one bodily or behavioral feature while leaving many others inaccessible. The entry condition for manifestational reality therefore differs from the persistence condition required for relational reality. A manifestation can be real as manifestation even when it does not stabilize into a durable subject-position.

The first-person case deserves particular care. Self-awareness is a manifestation of subjecthood, yet the relational conditions from which it emerges can precede the moment of explicit awareness. Memory, bodily continuity, habits, language, recognition by others, prior commitments, and institutional histories can participate in stabilizing a subject before those conditions become thematized by the subject. A reflective judgment such as “this is who I am” can then become a new manifestation that feeds back into the relational system. It can alter conduct, expectation, affiliation, memory selection, and the interpretations supplied by others. The manifestational and relational registers thus become recursively coupled without becoming identical.

Manifestation to others can diverge from manifestation to oneself. A person can experience continuity while being institutionally treated as discontinuous because of lost records or changed identifiers. Conversely, an institution can preserve a stable identity while the subject experiences profound discontinuity in self-understanding. A public performance can stabilize one recognizable persona while private experience remains substantially different. The three-register framework allows these differences to be described without requiring one manifestation to stand automatically as the complete truth of the subject.

Manifestations can also conflict. Spoken self-description, observed behavior, physiological measurement, administrative classification, and third-party testimony may disclose different aspects of a subject and can be produced through different manifestation mappings. Their disagreement does not necessarily imply that one simple hidden subject could be reconstructed by choosing the single correct manifestation. Section 4.9 already established that manifestation is generally non-invertible. The subject case makes the implication concrete: multiple manifestations can remain jointly informative while preserving a relational remainder that no one manifestation exhausts.

Remark 4.103 (Plural manifestation of a subject). Different manifestations of a subject can carry different forms of evidential, practical, or institutional relevance. Their plurality does not by itself establish either contradiction or equivalence because each manifestation can depend on a different mapping, audience, purpose, timescale, and relation to the subject's history.

This plurality becomes especially important in economic life. Creditworthiness, productivity, reliability, vulnerability, preference, risk, need, and identity may each be manifested through different procedures. Economic institutions frequently act on these manifestations as though they captured the subject itself. GRE instead asks which aspect became manifest, through which conditions, and with what consequences for later relations.

4.12.4 Institutionally Represented Subjecthood

Institutionally represented subjecthood is a more specific case in which manifestations are selected, symbolized, recorded, and made operational within an institutional system. A legal name, taxpayer identifier, employee number, account, credit file, eligibility category, citizenship status, corporate registration, professional credential, platform profile, or risk score can become a representation through which institutions recognize and act upon a subject. Such representations are often economically decisive because they determine access, liability, authority, visibility, payment, exclusion, or the accumulation of records across time.

Definition 4.104 (Institutionally represented subject)**.** An *institutionally represented subject* is a symbolically or technically stabilized representation through which an institution identifies, classifies, tracks, authorizes, constrains, rewards, sanctions, or otherwise acts upon a purported subject within a specified domain of operation.

The word *purported* is analytically important. The institution's representation can refer adequately to a relationally effective subject, can refer only partially, can lag behind changes in the subject, can combine several subjects, can split one subject across multiple records, or can persist after the relevant relation has ended. The representation and the represented subject are therefore distinguishable objects even when institutional practice treats them as interchangeable.

Represented subjecthood can itself acquire relational reality. An account profile can influence whether a payment is accepted. A credit record can alter borrowing possibilities. A legal status can determine which contracts become available. A credential can organize access to occupations. A platform category can change visibility and expected conduct. Once these representations become persistent, stable, and causally efficacious within the relevant system, they satisfy the relational-reality criterion in their own right. Their causal reality remains distinct from the accuracy or justice of the representation.

This distinction is especially important where institutional systems act faster than subjects can contest their representations. A classification can shape subsequent opportunities and thereby help generate the behavior that later appears to confirm the classification. A profile can influence which information, prices, tasks, or social contacts become available, changing the relational environment from which later manifestations emerge. The representation can therefore participate in producing the

future subject-position that it was initially intended only to describe.

The recursive structure also permits resistance and revision. Subjects can correct records, challenge classifications, strategically present themselves, acquire new credentials, create alternative institutions, or refuse particular categories. Institutions can redesign identifiers, revise eligibility rules, or abandon representations that produce systematic error. Institutionally represented subjecthood is therefore historically alterable even when its practical effects are substantial.

Claim 4.105 (Representational efficacy and subject accuracy)**.** *The causal efficacy of an institutional representation of a subject can vary independently from the representation's descriptive adequacy to the subject it purports to represent.*

Claim 4.105 extends the distinction developed in Section 4.10. A highly influential profile can be incomplete or mistaken; a highly accurate description can remain institutionally irrelevant. Economic analysis therefore needs separate accounts of representational accuracy, institutional uptake, and causal consequence.

4.12.5 Human and Artificial Subjects

The distinction among registers becomes particularly useful when human and artificial subjects occupy adjacent operational positions. Chapter 3 introduced a working distinction between *human subjecthood* and *artificial operational subjecthood*. The present chapter can now state why that distinction matters ontologically. Two systems can become manifest through similar outputs, occupy similar institutional roles, or even be treated as interchangeable for a bounded task while differing substantially in embodiment, historical formation, dependence relations, vulnerability, ownership, persistence conditions, and the wider structures through which their capacities are generated.

A human subject is relationally situated through bodily existence, care, development, language, memory, social recognition, material dependence, institutional position, and historical participation. Many economically relevant properties of human subjecthood are inseparable from vulnerability and finite embodiment: needs must be met through time, bodily capacities can change, care relations can become necessary, and economic loss can affect lived possibilities. These observations do not provide a complete ontology of the human person. They identify dimensions that are causally and normatively relevant to economic analysis and that should not disappear merely because another system can reproduce a selected manifestation of human performance.

Artificial operational subjecthood can arise when an artificial system becomes a sufficiently stable and causally consequential locus of delegated or institutionally recognized action. A system can select transactions, generate offers, route resources, negotiate within constraints, produce classifications, communicate with counterparties, or maintain a persistent operational identity. Where these functions persist and affect subsequent relations, the artificial system can be relationally real as an operational subject-position. This claim does not require GRE to settle whether the system is conscious, possesses first-person experience, qualifies as a legal person, or has independent moral standing.

The relevant relations surrounding artificial operational subjecthood can include model architecture, training data, deployment infrastructure, ownership, authorization, interface design, objective specification, maintenance, oversight, and liability. These relations can differ radically from those that sustain human subjecthood. Even where a human and an artificial system generate the same answer to a query, execute the same trade, or satisfy the same institutional test, equality of manifestation under that test provides limited information about equality of relational structure.

The same caution applies in the opposite direction. Difference in underlying structure does not imply that artificial systems are economically negligible. A system can occupy a causally central position precisely because institutions, firms, markets, or individuals organize their activity around its outputs. The analytical task is therefore to identify the kind of subject-position that has emerged, the relations that sustain it, the manifestations through which it becomes legible, and the institutions through which its actions are attributed.

Claim 4.106 (Operational subjecthood and ontological restraint)**.** *Attribution of operational subjecthood to an artificial system records a stabilized and causally consequential position within a generative-relational system. It does not, without additional argument, establish experiential, ontological, juridical, or moral equivalence with human subjecthood.*

Claim 4.106 permits GRE to analyze technologically mediated economies without choosing between two unhelpful extremes: treating artificial systems as mere inert tools regardless of their operational role, or treating functional substitution as sufficient evidence of full subject identity. The three-register architecture keeps the empirical consequences of artificial action visible while preserving stronger questions for the domains in which they can be responsibly examined.

4.12.6 Manifestational Equivalence without Subject Identity

The preceding distinctions culminate in the problem of manifestational equivalence. Two subjects can become indistinguishable with respect to a specified manifestation while remaining different in relational organization and with their ontological relation unresolved. The equivalence is therefore local to the manifestation criterion, the conditions under which it is produced, and the purpose for which the comparison is made.

Definition 4.107 (Local manifestational equivalence of subjects)**.** Two subjects are *locally manifestationally equivalent* when, under a specified manifestational configuration and comparison criterion, the manifestations relevant to the inquiry are indistinguishable or sufficiently equivalent for that purpose. Such equivalence does not by itself establish relational identity, ontological identity, equal historical formation, equal capacities outside the comparison domain, or equal normative standing.

The definition applies to human–human, human–artificial, artificial–artificial, organizational, and other comparisons. Two people can produce identical answers while arriving at them through different memories or reasons. Two firms can display the same price while relying on different cost structures and financing relations. Two artificial systems can produce the same output while differing in architecture, training history, ownership, or failure modes. A human and an artificial system can

generate behavior that is indistinguishable through a particular interface while belonging to substantially different relational structures. The manifestation therefore supports an equivalence claim only at the level for which the comparison criterion has been specified.

This point is stronger than the familiar observation that appearances can deceive. A manifestation can be completely accurate with respect to the property it manifests and still remain insufficient for subject identity. If two systems genuinely have the same measured response time, the equality need not be illusory. It simply establishes equality of that measured property. The inference from local equality to global identity requires additional mappings and additional evidence. Non-invertibility therefore arises even when the manifestation itself is reliable.

The relation between an illusory flower and an ordinarily perceived physical flower provides a useful limiting example from the wider architecture of this chapter. Both can become manifest, can enter attention and memory, and can produce subsequent action. Under suitable conditions, the experienced flower can also acquire relational reality through its causal participation in the subject's system. Yet shared manifestational properties such as apparent color, shape, or salience do not establish shared generative structure. The same discipline applies to subjects: similarity in one manifestational domain does not supply a universal metric through which their full relational structures become commensurable.

Manifestational equivalence can nevertheless have powerful institutional consequences. If an institution recognizes subjects only through a narrow interface, subjects that are equivalent under that interface may receive the same permissions, prices, rankings, opportunities, or liabilities. The institution can thereby convert local equivalence into a consequential social fact. Conversely, a representation that distinguishes subjects through an institutionally salient criterion can generate different treatment even when the subjects remain equivalent along many other dimensions. The design of manifestational criteria is therefore itself part of the generative-relational economy.

Claim 4.108 (Subject identity exceeds local manifestational equivalence)**.** *Local manifestational equivalence licenses an equivalence claim only within the specified manifestational domain and comparison criterion. Extension from that equivalence to relational or ontological subject identity requires independent justification.*

Claim 4.108 provides a compact rule for later GRE analysis. It prevents operational tests, institutional classifications, market signals, or behavioral outputs from silently becoming complete ontologies of the subjects they classify. It also preserves the legitimate analytical use of equivalence where a bounded comparison is sufficient. A payment system may need only authorization equivalence; a contractual process may need legal-capacity equivalence; a production model may need task-performance equivalence. The mistake lies in allowing the local criterion to expand beyond the scope it was designed to establish.

Subjects across the three registers can now be understood as historically coupled without becoming reducible to one another. Ontological subjecthood names the strongest and often partly suspended question of what the subject is. Relationally effective subjecthood identifies sufficiently persistent, stable, and causally efficacious

loci of participation. Manifestational subjecthood concerns the modes through which aspects of those subjects become available. Institutional representation stabilizes selected manifestations into symbolic or technical forms through which systems act. Human and artificial subjects can occupy overlapping operational domains while retaining potentially substantial relational and ontological differences. Manifestational equivalence can support bounded coordination and comparison while leaving subject identity open.

This register-sensitive account also prepares the next section. Value and meaning are frequently attributed to, generated by, experienced through, represented for, and circulated among subjects. The same discipline that prevents subject representation from replacing the subject will therefore be required when GRE turns to value and meaning across the three levels.

4.13 Value and Meaning across the Three Levels

Value and meaning are central to economic life because subjects, institutions, and communities act through distinctions concerning what matters, what counts, what is worth preserving or exchanging, and what objects, events, relations, or representations signify. The three-register architecture developed in this chapter permits these phenomena to be examined without collapsing them into either objective properties or subjective reports. The role of this section is to specify how value and meaning can be approached across ontological, relational, and manifestational registers. Its objective is to distinguish the relational reality of value and meaning from stronger claims concerning their ultimate ontological status, normative validity, or semantic truth, while preserving the causal and historical importance of valuation and interpretation. The discussion proceeds from relationally emergent value and meaning to their manifestation, symbolic mediation, partial commensuration, and historical transformation. The method is analytical and reconstructive: the section applies the ontology developed in Sections 4.2–4.11 to evaluative and meaningful phenomena while keeping heterogeneous forms of value and meaning open to later domain-specific analysis. (E. Anderson 1993; Appadurai 1986; Bourdieu 1984; Reber et al. 2004)

Chapter 2, Section 43 reconstructed several existing traditions concerning value, valuation, plural forms of value, and commensurability. The present section has a different task. It asks what kind of reality value and meaning can possess within GR. The answer cannot be supplied by declaring that value is simply subjective, objective, social, or symbolic. A value can be historically generated yet highly stable; it can organize action before being explicitly articulated; it can acquire symbolic representation in prices, rankings, rituals, or categories; and its representation can subsequently alter the relations through which value is generated. Meaning exhibits a parallel complexity. An interpretation can emerge through language, practice, memory, expectation, embodiment, and institutional history; it can become causally consequential before it is formulated propositionally; and its later articulation can transform the field of relations in which it continues to operate.

The resulting framework therefore separates three questions. The ontological question concerns whether value or meaning has a status independent of the par-

ticular relational and manifestational configurations through which it becomes available. The relational question concerns whether evaluative or meaningful structures have emerged with sufficient persistence, stability, and causal efficacy to become relationally real within a generative-relational system. The manifestational question concerns the forms through which value or meaning becomes perceptible, articulable, measurable, symbolizable, or otherwise available under particular conditions. These questions can interact without yielding identical answers.

Definition 4.109 (Register-sensitive value and meaning)**.** *Register-sensitive analysis of value and meaning* distinguishes among their possible ontological status, their relational emergence and causal efficacy, and the particular forms through which they become manifest or represented, while allowing these dimensions to mediate one another historically.

Definition 4.109 preserves two forms of restraint. First, the existence of relationally real value does not by itself establish that whatever is valued is normatively good. Second, the existence of relationally real meaning does not by itself establish that the interpretation is semantically true, referentially successful, or epistemically justified. A society can stabilize harmful forms of valuation. A community can organize action around a false interpretation. These formations can nevertheless be causally real because they structure conduct, institutions, expectations, and subsequent relations. GRE therefore requires a vocabulary capable of studying the reality of value and meaning without treating causal stabilization as moral or epistemic vindication.

4.13.1 Value as Relationally Emergent

Value becomes relationally relevant when something acquires evaluative significance through a generative-relational system and that significance participates in the organization of subsequent action. The relevant relations can include desire, need, use, care, recognition, exchange, scarcity, obligation, attachment, institutional classification, historical memory, ecological dependence, collective identity, or aesthetic orientation. Different forms of value can therefore arise through markedly different structures. The relational account does not require these structures to be reducible to a common mechanism or a single scalar quantity.

Definition 4.110 (Relationally emergent value)**.** *Relationally emergent value* is evaluative significance that emerges within a generative-relational system, persists with sufficient stability over a relevant spacetime region or interval, and exercises causal efficacy by orienting selection, preservation, exchange, allocation, attention, commitment, refusal, or subsequent relation formation.

The definition applies the general relational-reality criterion from Section 4.5. It does not imply that every transient preference is already a relationally real value. A fleeting attraction can become manifest without acquiring sufficient persistence or causal force to organize later relations. By contrast, a durable commitment to a person, a sacred object, a professional norm, a currency, a landscape, an institutional mission, or a form of knowledge can become relationally real when the evaluative orientation survives across situations and affects future conduct.

Relationally emergent value can precede explicit valuation. A child can be embedded in relations of care before possessing a developed vocabulary of value. A com-

munity can sustain practices that preserve a landscape before articulating a formal environmental ethic. A researcher can repeatedly orient attention toward a problem experienced as promising or beautiful before producing an explicit account of why it matters. In these cases, the evaluative structure is already participating in the organization of action even though its later symbolic formulation remains incomplete.

This pre-manifestational possibility is especially important for aesthetic judgment. An object does not need to become explicitly judged as beautiful before the relational-generative-historical conditions that make such a judgment possible begin to exist. The history of training, perceptual formation, disciplinary practice, memory, cultural repertoire, bodily disposition, and previous encounters can already structure susceptibility to a later manifestation of beauty, elegance, significance, or importance. The eventual judgment therefore emerges within a field whose evaluative organization partly precedes conscious recognition.

Relational emergence also permits value to be plural without assuming that every plurality can be converted into one metric. Money, friendship, legal equality, ecological continuity, scientific insight, bodily integrity, cultural memory, and aesthetic experience can all acquire relational reality as forms of value while belonging to different evaluative domains. Some domains support stable conversion procedures; others permit only partial comparison; still others may lack a warranted common ordering for the relevant inquiry. The existence of multiple relationally real values therefore does not itself establish commensurability.

Claim 4.111 (Relational reality and normative validity)**.** *The relational reality of a value establishes that the evaluative formation is sufficiently persistent, stable, and causally efficacious within a relevant generative-relational system. It does not by itself establish the normative validity, justice, desirability, or universal authority of that value.*

Claim 4.111 is indispensable for GRE. Market value, status value, ideological value, discriminatory valuation, and exploitative institutional priorities can become highly stable and causally consequential. Their relational reality is an object of explanation, not a certificate of legitimacy. Normative assessment requires additional arguments concerning justice, capability, freedom, care, ecological consequence, rights, or other relevant standards. The three-register architecture therefore keeps descriptive ontology and normative evaluation connected without allowing one to substitute for the other.

The ontological status of value can remain more open. A moral realist, constructivist, pragmatist, relational theorist, or other philosophical position may offer different accounts of whether some values obtain independently of their historical realization. GR does not need to resolve those disagreements in order to study how value becomes causally effective in economic systems. Ontological suspension is especially useful here because it permits strong claims about the historical reality of valuation while leaving stronger metaethical questions available for separate treatment.

4.13.2 Meaning as Relationally Emergent

Meaning concerns the significance through which an object, event, relation, sign, practice, or possibility becomes situated within a field of interpretation and action.

It can involve semantic reference, practical significance, narrative orientation, institutional interpretation, affective salience, symbolic association, or a subject's understanding of what an encounter means for subsequent conduct. These modes should not be reduced to a single linguistic model. A gesture can carry meaning without being a sentence; a price can signal scarcity or prestige; a ritual can organize belonging; a legal category can determine institutional consequence; and an unexpected event can acquire significance before its interpretation becomes verbally explicit.

Definition 4.112 (Relationally emergent meaning)**.** *Relationally emergent meaning* is significance generated through a relational configuration that persists with sufficient stability and exercises causal efficacy by organizing interpretation, expectation, attention, memory, orientation, communication, or subsequent action within a generative-relational system.

Meaning in this sense can be relationally real before it is fully symbolized. A familiar place can carry significance through repeated embodied and interpersonal relations without that significance being translated into a proposition. A social role can orient expectation before participants articulate its rules. A contingent encounter can become structured as potentially significant through a subject's history before the subject becomes reflectively aware of what the encounter means. Symbolic language may later stabilize and communicate such meanings, but symbolization is one mediating pathway rather than a universal prerequisite.

The distinction between relational meaning and semantic truth is parallel to the distinction between relational value and normative validity. A rumor can acquire meaning and alter behavior even when its propositional content is false. A mistaken diagnosis can reorganize a person's expectations, institutional treatment, and future decisions. A fictional character can possess enduring cultural meaning without being an ontologically existing historical person. A religious symbol can become highly consequential within a community while its associated metaphysical claims remain subject to independent inquiry. The causal reality of meaning therefore concerns what the interpretation does within a system, while truth concerns a different relation whose criteria depend on the relevant epistemic domain.

Claim 4.113 (Meaning and truth)**.** *The relational reality of a meaning records the persistence, stability, and causal efficacy of an interpretive formation. It does not by itself establish the truth, referential adequacy, or epistemic justification of the interpretation through which that meaning is organized.*

Claim 4.113 protects the framework from a form of relational relativism. GR can recognize that meanings are historically and relationally generated while also allowing evidence, logical consistency, causal inquiry, testimony, measurement, and other epistemic practices to constrain claims about truth. Relational generation explains how an interpretation becomes operative; it does not make every operative interpretation equally warranted.

Value and meaning also interact without becoming identical. Something can be meaningful without being positively valued. A traumatic site can carry intense meaning while being associated with aversion. A market price can be valuable as information for one actor while symbolizing exclusion for another. A mathematical conjecture can possess meaning within a disciplinary history before a community attributes

high research value to it. Conversely, something can be valued instrumentally while carrying little broader meaning for the subject who uses it. GRE therefore benefits from treating evaluative orientation and interpretive significance as partially coupled dimensions rather than interchangeable terms.

4.13.3 Manifestation of Value

Relationally emergent value becomes manifest through heterogeneous forms. A price, ranking, vote, award, credential, investment decision, act of preservation, ritual gesture, refusal to sell, allocation of time, emotional response, legal protection, or pattern of care can each manifest evaluative significance under particular conditions. None of these manifestations is automatically exhaustive. A market price can manifest one institutionally stabilized form of valuation while leaving other forms of value unexpressed. A conservation designation can manifest institutional recognition while only partially representing the attachments, ecological dependencies, or historical meanings through which the protected object matters.

Definition 4.114 (Manifestation of value)**.** A *manifestation of value* is a perceptual, behavioral, affective, institutional, symbolic, quantitative, or other form through which an evaluative significance becomes available within a specified manifestational configuration.

The definition preserves the distinction from Section 4.6: manifestation does not require the persistence or stability required for relational reality. A momentary expression of delight can manifest value even if the evaluation does not persist. Conversely, a relationally stable value may remain only partially manifested at any particular moment. The mapping from evaluative structure to manifestation is therefore neither complete nor necessarily invertible.

Economic analysis often relies on manifestations of value because many evaluative processes become observable through choices, bids, prices, quantities, scores, surveys, ratings, or institutional decisions. Such manifestations can be informative, but Section 4.9 implies a discipline of inference. Similar prices can arise from different evaluative structures; similar preferences expressed in a survey can be sustained by different histories; and the same underlying commitment can generate different behavior under changing constraints. An observed manifestation should therefore be treated as evidence about value under specified assumptions rather than as an automatic identity between the measure and the value itself.

Symbolization can further transform the evaluative field. Once a value is assigned a numerical score, price, label, ranking, or category, the symbolic representation can become part of the system through which later valuation occurs. Rankings can redirect attention. Prices can reorganize expectations. Certification can create prestige. Accounting categories can determine which contributions become visible. Repeated symbolic representation can therefore stabilize one evaluative dimension while weakening, obscuring, or transforming others.

This process can create practical commensurability among heterogeneous objects. A price system, index, scoring rubric, or ranking scheme can place previously heterogeneous objects within a shared representational space. Section 4.10 characterized this process as symbolic commensuration. The common metric can become

highly consequential without establishing that the underlying values were intrinsically commensurable before the mapping was imposed or negotiated. GRE should therefore distinguish the existence of a functioning conversion interface from the stronger claim that the converted values share a common evaluative structure.

Remark 4.115 (Manifested value and commensuration)*.* A successful symbolic conversion can make heterogeneous values operationally comparable for a specified purpose. The existence of that comparison does not establish complete equivalence among the relational structures from which those values emerge.

This distinction becomes central for later GRE analysis of allocation, return, exploitation, compensation, and justice. An institution can compensate one loss through money because monetary conversion is legally or practically available while the affected subject continues to experience an irreducible remainder. The existence of exchange does not establish that nothing was lost in translation.

4.13.4 Manifestation of Meaning

Meaning likewise becomes manifest through multiple channels. Speech, writing, gesture, image, bodily orientation, narrative, ritual, classification, architecture, interface design, statistical representation, silence, and patterned action can all make significance available. Manifestational plurality is especially important because the same relational meaning can become differently available across subjects and contexts, while similar symbolic forms can sustain different meanings in different histories.

Definition 4.116 (Manifestation of meaning)**.** A *manifestation of meaning* is a form through which relationally generated significance becomes perceptible, interpretable, communicable, recordable, or otherwise available within a particular manifestational configuration.

The definition makes room for both symbolic and non-symbolic manifestations. A facial expression can make distress manifest before it is named. The spatial organization of a courtroom can manifest authority without requiring a verbal proposition. A recurring economic practice can manifest expectations that participants have never written down. A scientific diagram can render a relation visible in a form unavailable to ordinary perception. Symbolization becomes especially powerful because it allows meanings to be stabilized, transmitted, recombined, compared, archived, and recursively reintroduced into later relations.

The mapping from meaning to manifestation remains context-sensitive and non-invertible. The same sentence can carry different meanings in different histories. Different languages can manifest overlapping meanings without exact structural equivalence. Silence can signify consent in one institutional context and resistance in another. A numerical indicator can be interpreted as evidence of performance, risk, failure, or injustice depending on the relational field in which it appears. Reverse inference from manifestation to meaning therefore requires knowledge of the historical and relational conditions through which the manifestation becomes interpretable.

Meaning can also mediate value. A commodity's price can change when its meaning changes from ordinary good to collectible object. A place can acquire economic value after becoming symbolically associated with heritage. A technology can be-

come desirable because it signifies modernity, status, autonomy, or belonging. Conversely, valuation can reshape meaning by directing preservation, repetition, institutional recognition, and educational transmission toward some interpretations rather than others. The relation between value and meaning is therefore recursive and historically generative.

Aesthetic judgment again offers a useful limiting case. The manifestation of beauty is not reducible to the verbal statement that something is beautiful. Aesthetic salience can appear affectively or perceptually before reflective judgment, while the relational conditions enabling that appearance may have been generated over a much longer history. Once articulated, the judgment can further alter attention, prestige, memory, canon formation, research investment, and transmission. The manifestation therefore both discloses and participates in the future generation of evaluative and meaningful reality.

4.13.5 Historical Transformation of Value and Meaning

Value and meaning are historically transformable because the relations, manifestation mechanisms, representations, subjects, and institutions through which they are generated can change. A value can persist while its manifestation changes. A symbolic representation can persist while the relational value beneath it weakens or shifts. A meaning can survive through translation into new media, or a stable sign can acquire substantially different meanings across periods. Historical analysis must therefore distinguish continuity of representation from continuity of relational structure.

The recursive architecture from Section 4.11 supplies a useful model. At one time, a relationally emergent value or meaning contributes to a manifestation. That manifestation can be represented, recorded, institutionalized, taught, priced, ranked, or contested. The representation then becomes part of the later relational environment in which subjects form new valuations and interpretations. Historical transformation therefore need not occur through replacement of one complete value system by another. It can proceed through gradual changes in the relations among practices, symbols, institutions, subjects, and memories.

Money illustrates the point clearly. Monetary value depends on historically stabilized relations among institutions, legal arrangements, accounting practices, expectations, exchange, and recognition. Monetary symbols then participate in reproducing those relations. A unit of account can persist while its purchasing power, political significance, technological embodiment, and relation to trust change. The representation remains recognizable, yet the relational field through which it is valuable evolves.

The same structure applies to prestige, professional credentials, cultural objects, legal rights, religious symbols, scientific problems, and forms of identity. A credential can remain formally identical while the labor market changes the opportunities it generates. A cultural symbol can retain its visual form while becoming associated with different collective histories. A research problem can acquire greater value after new techniques make it tractable or after a disciplinary community interprets it as theoretically central. Historical change therefore concerns both the objects valued

and the relations through which valuation itself becomes possible.

Claim 4.117 (Historical plasticity of value and meaning)**.** *The persistence of a value or meaning across time can coexist with substantial transformation in the relations, manifestation mechanisms, representations, and subjects through which it is generated and reproduced. Apparent continuity at one register therefore does not establish structural continuity across the others.*

Claim 4.117 also clarifies why GRE should preserve records of category change. If an institution measures "merit," "risk," "productivity," "quality," or "need" across decades, continuity of vocabulary can conceal changing evaluative structures and meanings. A time series may remain numerically continuous even while the social object represented by the variable changes. Conversely, terminology can change while a deeper relational structure remains comparatively stable. Historical comparability therefore requires reconstruction of the manifestation mappings and valuation practices that connect periods.

The three-register view consequently prevents both reification and dissolution. Value and meaning need not be treated as timeless substances in order to be real. Their historical and relational emergence does not make them causally negligible, arbitrarily subjective, or reducible to discourse. When they acquire sufficient persistence, stability, and causal efficacy, they can become relationally real. When they appear through prices, judgments, classifications, emotions, symbols, practices, or institutions, they acquire manifestational forms whose structure can be studied independently. Questions of ultimate value, normative validity, semantic truth, and ontological fundamentality remain distinguishable and can be addressed where the inquiry requires them.

This register-sensitive account prepares the transition to social facts and institutional reality. Values and meanings frequently become durable precisely because institutions stabilize classifications, expectations, obligations, roles, and authorized interpretations across persons and time. Section 103 therefore turns from evaluative and meaningful reality to the institutional structures through which relational realities can become collectively reproducible and causally persistent.

4.14 Social Facts and Institutional Reality

Social facts and institutions provide some of the clearest cases in which the three-register architecture can be applied to economic reality. Money, property, legal status, organizational office, debt, professional qualification, citizenship, contractual obligation, and corporate personality can organize action with considerable durability even though their efficacy cannot be identified with the material objects through which they are manifested. Chapter 2, Section 40 reconstructed several existing accounts of social facts, institutional stabilization, legal constitution, symbolic authority, and historical revisability. The role of the present section is different. Its objective is to specify how such phenomena can possess relational reality within GR, how institutional stabilization alters the persistence and causal reach of social facts, and how legal, monetary, and organizational realities traverse ontological, relational, and manifestational registers. The method is register-sensitive: the section distinguishes

the material and other ontological conditions on which institutions may depend, the relational configurations through which institutional objects persist and act, and the texts, records, symbols, performances, classifications, and interfaces through which institutional realities become manifest.

The central claim is modest but consequential. Social construction does not imply diminished reality. When a socially generated object persists with sufficient stability and exerts causal efficacy within the generative-relational system that sustains it, it can satisfy the criterion of relational reality developed in Section 4.5. Its relational reality does not settle whether it possesses an independent ontological existence, whether its representation is epistemically adequate, or whether the institution is normatively legitimate. A legal status can be relationally real while unjust. A monetary unit can be relationally real without being an ontologically fundamental object. An organizational classification can be causally effective even when it misdescribes the people to whom it is applied. The ontology of institutional life therefore requires several distinctions that become obscured when "socially constructed" is treated either as a synonym for unreality or as a complete theory of what social objects are. (Berger and Luckmann 1966; Searle 1995; North 1990; Ostrom 2005)

Definition 4.118 (Institutional reality)**.** *Institutional reality* denotes the relational reality acquired by socially generated objects, statuses, rules, roles, classifications, procedures, or organized capacities when they are stabilized through sufficiently persistent configurations of recognition, practice, authorization, record, material support, expectation, enforcement, or resource allocation and thereby become causally efficacious within the relevant generative-relational system.

Definition 4.118 intentionally includes several possible stabilizing mechanisms rather than reducing institutions to one source. Some institutional realities depend strongly on formal authorization. Others are sustained primarily through convention, habit, organizational routine, infrastructural dependence, or mutually adjusted expectations. Many combine several of these mechanisms. The definition also leaves open whether the relevant institutional object possesses an ontological status beyond its relational realization. The analytical burden is first to identify how it is generated, how it persists, what stabilizes it, and how it affects subsequent relations.

4.14.1 Social Facts

A social fact, in the present framework, is not defined merely by the existence of a shared belief. Shared representations can contribute to its formation, but the relational reality of a social fact requires more than mental agreement. The fact must become sufficiently stabilized within a social field to organize conduct, expectations, opportunities, obligations, identities, access, or resource flows. The relevant relations may include mutual recognition, legal authorization, customary practice, material infrastructure, records, sanctions, market coordination, professional routines, or repeated interaction. What is socially factual is therefore tied to a configuration capable of making a difference within the system.

Definition 4.119 (Relationally real social fact)**.** A *relationally real social fact* is a socially generated object, status, rule, distinction, or expectation that persists with sufficient stability across a relevant spacetime interval and exercises causal efficacy

within the social system through which it is sustained.

This definition preserves the general GR criterion while making the social mode of generation explicit. A marriage, debt, academic credential, property title, rank, office, or currency denomination may be relationally real because actors, organizations, databases, legal procedures, infrastructures, and expectations collectively sustain a configuration through which subsequent action is differentiated. The relevant efficacy may occur even when a particular subject is unaware of the fact. A person can acquire a tax liability without having noticed it, be subject to a legal restriction without understanding its doctrinal basis, or hold a claim recorded in an institutional system before becoming aware that the record exists. Subjective apprehension is therefore neither a necessary nor a sufficient condition of relational reality.

The same point helps distinguish social facts from manifestational facts. A passport, contract, certificate, database entry, court order, price display, uniform, title, or public ceremony can manifest an institutional status. Yet the manifested object is not automatically identical with the relational structure through which the status persists. A printed certificate can be destroyed while the qualification remains institutionally recognized through other records and practices. Conversely, a visually convincing certificate can exist without the institutional relations required to make its represented status effective. Manifestation can disclose, transmit, stabilize, or transform a social fact, but it does not exhaust the social fact's relational reality.

Social facts can also precede explicit symbolization in a local context. Repeated patterns of deference, exclusion, obligation, entitlement, or informal authority may become sufficiently stable to shape conduct before participants develop a settled vocabulary for them. Once named, codified, measured, or represented, these patterns can enter the recursive dynamics described in Section 4.11. The new manifestation may render an existing relation more legible, but it can also reorganize that relation by enabling contestation, coordination, enforcement, comparison, or institutional redesign.

Claim 4.120 (Social fact without universal awareness)**.** *The relational reality of a social fact does not require universal recognition or simultaneous awareness among the subjects affected by it. It requires a sufficiently stable generative-relational configuration capable of sustaining the fact and mediating causal consequences within the relevant system.*

Claim 4.120 matters for large institutional systems. Modern societies routinely coordinate relations among participants who possess highly unequal knowledge of the rules, databases, classifications, procedures, and infrastructures that shape their actions. Institutional reality can therefore be distributed across persons, documents, software, offices, routines, and material arrangements rather than residing in a single collective representation. The resulting social fact may be real for the system even though no individual actor possesses a complete representation of the relations that sustain it.

Social facts need not be mutually commensurable merely because they share the same relational-reality criterion. A religious office, a financial claim, a kinship relation, a legal title, and an academic credential may all be relationally real while being generated through different mechanisms and embedded in different comparison

structures. Even objects bearing similar labels across jurisdictions or historical periods may not be structurally equivalent. Cross-institutional comparison therefore requires an explicitly justified mapping rather than an assumption that shared terminology identifies a common metric space.

4.14.2 Institutional Stabilization

Institutionalization concerns the transition from recurrent social relations toward more durable configurations in which expectations, roles, procedures, classifications, sanctions, and resources become mutually reinforcing. The transition is rarely a single event. It can involve repetition, record keeping, formalization, professionalization, infrastructural investment, legal recognition, routinized enforcement, education, socialization, technological embedding, or the accumulation of precedent. Different combinations can produce different degrees and forms of institutional stability.

Definition 4.121 (Institutional stabilization)**.** *Institutional stabilization* is the historical process through which a socially generated configuration acquires sufficient persistence, reproducibility, and causal reliability that its roles, rules, statuses, procedures, or organized capacities can structure subsequent relations beyond the immediate interactions in which they first emerged.

Institutional stabilization can extend a relational reality across time and space. A bilateral promise can depend heavily on the memory and continued willingness of the two participants. A standardized contract recorded within a legal and administrative system can remain efficacious through changes in personnel, location, ownership, or organizational membership. Stabilization therefore changes not only duration but also the architecture through which persistence is achieved. Memory can be externalized into records; authorization can be attached to offices rather than persons; sanctions can be routinized; procedures can be standardized; and material infrastructures can preserve practical continuity across generations of participants.

This extension of persistence should not be confused with immutability. An institution can be highly stable while remaining historically revisable. Indeed, some institutions stabilize procedures through which their own rules can be amended, offices replaced, assets transferred, or statuses terminated. A constitution, corporate charter, professional code, or monetary regime can therefore include relations of authorized transformation within the institutional reality itself. Stability and revisability are compatible when the procedures governing change are themselves sufficiently stabilized.

Institutional reality can also become recursively self-supporting. A rule shapes behavior; repeated behavior creates expectations; expectations increase the cost of deviation; organizations invest in infrastructure built around the rule; records accumulate; professional roles emerge to interpret and administer it; and these developments make the rule more consequential for later participants. Such recursion can deepen relational reality without converting historical contingency into necessity. What has become difficult to change may still have been generated through a path that could have developed differently.

The three-register architecture helps separate several components of stabilization.

A building, server, ledger, biometric device, courtroom, banknote, or communications network may provide material conditions. A role, entitlement, debt, office, legal relation, or monetary claim may be relationally real within the institution. A statute, record, symbol, dashboard, credential, verdict, price, or ceremony may manifest and represent the relevant relation. Institutional persistence often depends on the coupling among these registers rather than on any one of them in isolation.

Remark 4.122 (Institutional object and institutional manifestation)*.* The persistence of an institutional object can survive the loss or replacement of particular manifestations, while changes in manifestation can nevertheless transform the institutional object when the manifestation itself enters the relations that reproduce it.

This remark captures an important asymmetry. A corporation can survive replacement of its logo, offices, employees, directors, databases, or paper records because its relational continuity is distributed across multiple mechanisms. Yet a change in registration, governance rules, legal classification, or ownership records can alter the corporation precisely because these manifestations are institutionally operative. Manifestation is therefore neither merely superficial nor automatically constitutive; its role depends on the generative relations in which it participates.

4.14.3 Legal Reality

Law offers a particularly clear illustration of relational reality mediated through manifestation. Legal systems depend heavily on texts, judgments, filings, signatures, classifications, procedures, and public acts. These are manifestational forms. Their legal efficacy, however, depends on historically stabilized relations among institutions, officials, subjects, records, recognized procedures, interpretive practices, enforcement capacities, and expectations. The written form of a rule is therefore important without being sufficient to explain the reality of law.

Definition 4.123 (Legal relational reality)**.** *Legal relational reality* is the relational reality acquired by legal statuses, rights, duties, powers, disabilities, procedures, and institutional acts when they are sustained through a sufficiently stable legal-institutional configuration and become causally capable of structuring action, authorization, access, sanction, liability, or resource distribution.

A property right illustrates the distinction. The physical object that becomes property does not contain the right as one of its material attributes. The right is sustained through relations among recognized holders, registries, courts, contractual practices, administrative procedures, social expectations, and enforcement capacities. It may be manifested through a title, deed, digital register, possession, boundary marker, or judicial decision. These manifestations can be indispensable to particular legal systems, but the right's relational reality consists in the stabilized configuration through which claims and actions acquire differential consequences.

Legal acts can also generate new relational realities through authorized manifestation. A judgment, registration, marriage declaration, incorporation filing, appointment, or transfer can change what relations exist because the relevant system assigns generative force to the act. The manifestation is then performative in a specific institutional sense: its efficacy arises from its position within an authorized relational configuration rather than from the words or marks alone. The same utterance or

document outside the relevant institutional relations may lack the corresponding effect.

This generative feature helps explain why legal reality cannot be reduced either to symbolic representation or to physical enforcement. A court order can remain legally real during an interval in which enforcement has not yet occurred. Conversely, coercive conduct can occur without possessing the legal status claimed for it. Legal reality therefore involves relations of validity, authorization, interpretation, institutional competence, and expected consequence that can be analytically distinguished from both textual manifestation and material force.

The framework also permits a distinction between legal reality and legal justice. A discriminatory status, exclusionary rule, or procedurally valid decision can become relationally real when institutions sustain and enforce it. Its causal reality does not establish moral legitimacy. Conversely, a normatively compelling claim may lack institutional realization and therefore possess little or no legal relational reality within a particular jurisdiction at a particular time. GRE can study the economic consequences of this gap without treating the existing legal order as normatively self-validating.

Claim 4.124 (Legal efficacy without ontological identity)**.** *A legal object can possess substantial relational and causal reality without requiring the analyst to posit a distinct ontological substance corresponding to the legal category. Its reality can be traced through the relations that generate, stabilize, manifest, interpret, and enforce it.*

This claim illustrates ontological suspension in practice. Competing philosophies of law may disagree about the ultimate nature of legal normativity, institutional facts, or legal obligation. The relational analysis can remain productive across part of that disagreement by identifying how legal objects become effective in historically specific systems. Where deeper ontological commitments alter the explanation, the disagreement becomes operative and should be addressed explicitly rather than prematurely resolved.

4.14.4 Monetary Reality

Money provides an especially useful case because its manifestations are easy to confuse with the relational object itself. Coins, banknotes, account balances, ledger entries, payment messages, and displayed prices are manifestations through which monetary relations become available and actionable. Their material or digital existence is important, but the monetary reality of a unit, balance, or claim depends on a wider relational configuration involving issuers, banks, payment systems, legal rules, accounting practices, expectations, exchange relations, taxation, contracts, and institutional trust.

Definition 4.125 (Monetary relational reality)**.** *Monetary relational reality* is the relational reality acquired by monetary units, balances, claims, prices, and payment capacities when they are stabilized within a generative-relational system sufficiently to coordinate valuation, settlement, obligation, exchange, accounting, or resource allocation and to exert causal effects on subsequent economic relations.

This definition does not require every monetary form to share the same institu-

tional architecture. Commodity money, state-issued currency, bank deposits, community currencies, digital payment balances, and other monetary arrangements can differ in their stabilization mechanisms. The relevant inquiry concerns the relations through which a particular monetary object is recognized, transferred, accounted for, redeemed, taxed, enforced, trusted, or otherwise made consequential. Similar manifestations can conceal different relational structures, just as similar relational functions can be realized through different manifestations.

A banknote therefore offers only a partial view of monetary reality. The note can be materially destroyed without eliminating the currency. A counterfeit note can closely reproduce the manifestation while lacking the institutional relations that normally sustain the represented monetary claim. A digital balance can persist without any particular physical token corresponding to each unit. These examples reinforce the non-invertibility developed in Section 4.9: observation of a manifestation does not by itself reveal the relational structure that gives it monetary efficacy.

Monetary reality also demonstrates manifestational mediation. Prices, balances, ratings, exchange rates, accounting categories, and policy announcements do more than make an antecedent monetary system visible. Once circulated, they can alter expectations, spending, lending, investment, collateral relations, contractual decisions, and institutional responses. A manifested monetary quantity can therefore enter the generative field that helps produce later monetary and economic relations. The symbolic and relational registers remain distinct while becoming recursively coupled.

The familiar question of whether money is "real" is therefore decomposed into more precise questions. The physical substrate of a note or computer system raises one ontological issue. The stabilized monetary relation raises another. The displayed balance or printed denomination concerns manifestation and representation. The causal effects of monetary recognition concern relational reality. Normative questions concerning distribution, exclusion, monetary governance, or justice require further evaluation. The three-register architecture avoids forcing these questions into one binary judgment.

4.14.5 Organizational Reality

Organizations extend institutional reality through coordinated capacities that exceed the continuity of particular members. A university, corporation, ministry, association, or cooperative can retain identity across changes in personnel, offices, technologies, assets, and internal procedures. This continuity is neither purely symbolic nor reducible to a fixed material substrate. It depends on relations that reproduce membership, authority, decision procedures, ownership, records, routines, responsibilities, resources, and external recognition across time.

Definition 4.126 (Organizational relational reality)**.** *Organizational relational reality* is the relational reality of an organized collective configuration that persists through stabilized relations of membership, authority, procedure, resource control, role differentiation, record, and external recognition, thereby acquiring capacities and causal effects that cannot be identified with any single current participant or manifestation.

The definition does not imply that organizations act independently of people, tech-

nologies, infrastructures, or environments. It identifies a level at which organized relations become sufficiently stable that actions can be attributed to an institutional configuration across turnover in the specific relata realizing it. A company can enter a contract before one manager leaves and remain bound after another arrives. A university can award a degree through procedures distributed across departments, registries, committees, information systems, and legal recognition. The organization persists because relevant relations are reproduced, not because an unchanging substance passes through time.

Organizational personality provides a particularly clear example of the distinction among registers. A legal person can be manifested through a registered name, identifier, seal, website, letterhead, bank account, or contractual signature. The legal representation enables coordinated action, but the organization's relational reality includes governance relations, employees, assets, liabilities, routines, authorizations, counterparties, and historical commitments that extend beyond any one symbol. The organization may therefore possess relational continuity even when particular representations change.

At the same time, organizational representations can reshape the organization. A new accounting category can redirect managerial attention. A performance metric can reorganize incentives. A revised organizational chart can redistribute authority if it is institutionally implemented. A mission statement can remain largely ceremonial or become relationally consequential depending on how it enters hiring, budgeting, evaluation, and decision procedures. The causal significance of representation is thus an empirical property of the generative-relational system rather than an automatic consequence of textual existence.

Organizational reality also clarifies why agency attribution requires care. An organization can possess operational capacities that justify treating it as an analytical subject for particular inquiries, while responsibility, experience, intention, and moral standing may remain distributed or contested. Section 4.12 therefore remains relevant: manifestational or operational unity does not establish identity across every dimension of subjecthood. The three-register architecture permits the analyst to study organizational action without assuming that organizational and human subjectivity are equivalent.

4.14.6 Causal Reality of Social Constructions

The examples above converge on a broader ontological point. A social construction can be causally real because construction refers to a mode of generation rather than to an absence of reality. Once a category, status, institution, or representation becomes embedded in stable relations, it can constrain and enable action, redirect resources, allocate rights, organize expectations, change bodies and environments, reproduce inequality, create capabilities, or alter the conditions under which later relations emerge. The historical contingency of its origin does not cancel these effects.

Claim 4.127 (Causal reality of social construction)**.** *A socially constructed object can possess relational reality when the generative-relational system that sustains it gives the object sufficient persistence, stability, and causal efficacy. Social construction therefore describes a possible history and mechanism of emergence rather than a criterion*

of unreality.

This claim does not imply that every social construction becomes relationally real. A proposed category that fails to circulate, an unenforced rule that leaves practice unchanged, an ephemeral rumor, or an institutional reform that remains purely nominal may lack sufficient persistence or causal efficacy. Nor does it imply that the same constructed object has equal reality across systems. A credential can open access in one institutional field and be ignored in another. A currency can be effective within one payment network and practically unusable outside it. Relational reality remains domain-sensitive and historically situated.

The causal effects of social constructions can also outlive the representations through which they were initially generated. A historical classification may disappear from official vocabulary while its accumulated effects remain embedded in property distributions, organizational routines, infrastructures, reputations, or spatial arrangements. Conversely, a representation can survive after the relations that once made it effective have weakened. This temporal divergence between manifestation and relational efficacy is another reason to resist identifying institutional reality with visible symbols alone.

Institutional reality can further alter its own conditions of reproduction. Once a legal category, currency, organization, or administrative classification becomes established, later actors encounter a relational field already structured by it. They invest, learn, comply, resist, innovate, migrate, or organize around the inherited configuration. Their responses can stabilize the institution, transform it, produce new representations, or generate alternative relations. Institutional reality is therefore historical not only because it has an origin, but because each period of reproduction changes the conditions inherited by the next.

This recursive temporality is especially important for GRE. Economic analysis frequently treats institutions as background constraints or parameters. The generative-relational view instead permits institutions themselves to be investigated as historically produced realities that subsequently participate in producing economic subjects, opportunities, values, incentives, resource distributions, and future institutional forms. A property regime, monetary system, labor classification, welfare category, organizational structure, or accounting convention does not merely constrain choices made within an otherwise unchanged field. It can help generate the field within which later choices, relations, and forms of value become possible.

Remark 4.128 (Reality, legitimacy, and truth). The relational reality of an institution establishes neither its normative legitimacy nor the truth of the representations through which it operates. Causal efficacy, epistemic adequacy, legal validity, social recognition, and normative justification remain distinct dimensions that may interact without collapsing into one another.

The remark preserves a central discipline of the three-register architecture. A discriminatory classification may be institutionally real and normatively objectionable. A mistaken risk score may be epistemically poor and causally powerful. An informal norm may be socially effective without legal validity. A legal entitlement may be valid yet weakly realized in practice. A public representation may accurately describe an institution yet have little causal influence. Analytical precision requires these possi-

bilities to remain separately visible.

The ontological significance of social facts and institutions can therefore be stated without metaphysical inflation. Their reality is not diminished by the fact that they emerge historically through relations, and their relational reality does not compel a claim that they exist independently of those relations. They occupy a domain in which stabilized relations acquire causal efficacy, manifestations become operative components of reproduction, and historically generated objects can confront later actors with substantial practical force. This account prepares the next section's turn from relatively stabilized institutional objects toward process, event, and becoming, where persistence itself must be situated within continuing transformation.

4.15 Process, Event, and Becoming

The preceding sections have developed relational reality largely through objects, subjects, values, institutions, manifestations, and representations that achieve sufficient persistence and stability to become causally efficacious. The role of the present section is to clarify the temporal form of such reality. Its objective is to show how GR can analyze processes, events, and becoming without treating persistence as immobility, without reducing events to instantaneous points, and without turning process language into a final metaphysics. The discussion proceeds through five steps. It first specifies processual reality, then develops an account of events, examines stability within becoming, defines relational transformation, and finally considers how historically generated changes can require new ontological categories within an inquiry. The method remains consistent with the chapter's ontological suspension: temporal and processual descriptions are treated as analytically serious claims about organization and causal efficacy while stronger claims about the ultimate temporal constitution of reality remain open unless the inquiry independently warrants them.

The central difficulty is that relational reality requires persistence and stability, while generative-relational systems are continually changing. These conditions are compatible once stability is understood dynamically. A monetary system persists while transactions, balances, technologies, regulations, and participants change. An organization persists while personnel, routines, assets, and strategies are revised. A sense of self can persist while memory, embodiment, social recognition, and self-description develop. The reality of such configurations lies partly in their capacity to reproduce an organized pattern through change. Processual analysis therefore does not displace the criterion of relational reality developed in Section 4.5; it clarifies one way in which that criterion can be satisfied across time. (Whitehead 1929; Mead 1932; Davidson 2001; Sewell 1996)

Definition 4.129 (Processual reality)**.** *Processual reality* denotes the relational reality of an organized pattern of change whose temporally extended configuration persists with sufficient stability and causal efficacy to participate in the subsequent development of the generative-relational system in which it occurs.

Definition 4.129 makes the process itself, rather than any single temporal slice, the relevant analytical object. A process can include changing components, variable relations, discontinuities, and internal differentiation while remaining identifiable at the

scale of inquiry. Its persistence therefore concerns continuity of organization, trajectory, or generative function rather than exact repetition of state. The definition also remains scale-sensitive. What appears as a relatively stable object at one temporal resolution can appear as an active process at another. A firm can be represented as an institutional entity in one model and as a changing configuration of contracts, routines, capacities, expectations, and material flows in another. Both descriptions can be analytically useful when their scale and purpose are explicit.

4.15.1 Processual Reality

Processual reality becomes important whenever the causal significance of an object depends on the organized continuation of change. A market, learning trajectory, supply chain, technological regime, administrative procedure, or relation of trust may be poorly described by a sequence of independent states because later states depend on how earlier configurations were generated. Historical order, memory, accumulated commitments, adaptation, and feedback can therefore be constitutive of the object under study. The process is relationally real when this temporally extended organization persists sufficiently to shape what can occur next.

The distinction between state and process is analytical rather than absolute. A state description compresses a configuration at a selected temporal resolution. A process description retains some of the transformations through which configurations succeed one another. The appropriate representation depends on the research question. A bank balance at a particular time may be adequately represented as a state for one inquiry, while the sequence of transfers, authorizations, interest accruals, obligations, and institutional validations through which that balance was produced may be indispensable for another. GR therefore treats temporal compression as a methodological choice whose omitted relations should remain visible when they matter to explanation.

Processual reality also clarifies why persistence need not mean substrate identity. Some processes persist through turnover in the entities that realize them. A payment network can continue while servers, software versions, account holders, and organizational personnel change. A legal procedure can retain recognizable continuity while statutes, interpretive conventions, and administrative technologies are revised. A language practice can persist through generations of speakers. In such cases, continuity is carried by a sufficiently stable organization of relations and transformations rather than by an unchanging set of relata.

Claim 4.130 (Dynamic persistence)**.** *A relational reality can persist through substantial change in its constituent states, relata, and manifestations when the organization of transformation remains sufficiently stable to preserve causal continuity at the scale relevant to the inquiry.*

Claim 4.130 is intentionally scale-relative. The same history can support continuity at one scale and rupture at another. A corporation may remain legally continuous through a major restructuring even though employees experience the restructuring as the end of an earlier organizational form. A monetary regime may preserve a currency name while changing the institutions, convertibility rules, settlement technologies, or policy mechanisms that sustain it. The analytical task is therefore to specify

which organization persists, for whom or for what system, across which interval, and with what causal consequences.

Processual reality also accommodates rhythms, cycles, and recurrent dynamics without assuming exact periodicity. Many economic processes are reproduced through recurring but variable practices: payroll, taxation, budgeting, maintenance, certification, price revision, inventory replenishment, and contractual renewal. Their relational reality can depend on repeated coordination whose timing and content change within bounded ranges. Stability here is statistical, institutional, or organizational rather than identical repetition. The relevant process persists because enough of its generative structure is reproduced to maintain causal continuity.

Some processes possess several interacting timescales. Regulatory change can occur slowly relative to trading, infrastructural replacement slowly relative to software updates, and demographic change slowly relative to organizational decisions. GR can represent these differences without assuming that one timescale is ontologically fundamental. The important question is how processes operating at different rates constrain, amplify, or reorganize one another. A slowly changing legal framework can stabilize fast transactions; repeated fast transactions can accumulate pressures that eventually transform the legal framework. Temporal structure is therefore relational and potentially recursive.

The processual view has an additional consequence for manifestation. A process may be relationally real before it is manifested as a coherent process to any subject. Individual observations can appear disconnected until a historical pattern becomes recognizable through later comparison, measurement, narration, or modeling. The manifestation of the process can then feed back into it. Once inflation is represented through an index, organizational decline through a performance metric, or ecological change through a monitoring series, subjects may alter behavior in response to the manifestation. The process existed relationally before its explicit representation in such cases, while its later manifestation becomes one of the relations shaping its subsequent development.

4.15.2 Events

Processes unfold through temporally differentiated changes, some of which acquire a distinctive status as events. An event in GR need not be instantaneous, spectacular, or wholly discontinuous. It is better understood as a temporally bounded reconfiguration whose occurrence makes a consequential difference to the development of a relational system. The event can be brief or extended, visible or initially unrecognized, intentionally produced or emergent from distributed interactions. Its analytical importance lies in the reorganization it introduces into subsequent possibilities.

Definition 4.131 (Relational event)**.** A *relational event* is a temporally delimited reconfiguration within a generative-relational system that produces a causally consequential difference in the organization, constraints, capacities, or trajectories of subsequent relations.

Definition 4.131 distinguishes an event from arbitrary temporal segmentation. Any interval can be bounded by an analyst, but eventhood requires a difference that matters to the system under study. Signing a contract can become an event because obli-

gations, permissions, expectations, and future options are reorganized. A payment default can become an event because it changes credit relations, legal possibilities, reputational classifications, and later financing. A policy announcement can become an event when actors reorganize behavior around it. A software release can become an event if it changes operational capacities or participation conditions. The boundary of the event is therefore partly analytical and partly constrained by the causal structure of the system.

Eventhood can be retrospective. A change that initially appears minor can later be recognized as consequential because subsequent relations amplify it. A local technical modification may become a turning point after complementary technologies, regulations, practices, or expectations align around it. Conversely, an occurrence widely represented as momentous can have limited relational consequences if the surrounding system absorbs it without substantial reorganization. Manifestational salience and relational eventhood can therefore diverge.

This divergence matters for historical analysis. Public discourse often privileges events that are visible, narratively convenient, institutionally recorded, or symbolically dramatic. GR allows an analyst to distinguish the manifestational prominence of an occurrence from its relational significance. A highly publicized announcement may remain weakly causal, while a quiet administrative change, altered database schema, revised eligibility rule, or gradual infrastructural threshold may reorganize access and behavior across a large system. Event analysis therefore requires attention to causal consequences as well as to representation.

Events can also emerge without a single author. A financial panic, collective shift in expectations, congestion cascade, labor shortage, reputational collapse, or technological convention may become event-like through distributed interactions. The event is then generated by a relational configuration whose participants may possess only partial knowledge of the overall process. This distributed generation is compatible with the relational-reality criterion because causal efficacy can be system-level even when no actor intends or fully represents the resulting reconfiguration.

Remark 4.132 (Event and manifestation)*.* A relational event can precede its explicit recognition, while a manifested occurrence can acquire additional event-like consequences through the responses its manifestation generates. Eventhood and manifestation therefore interact recursively without being identical.

Remark 4.132 extends the graph architecture developed earlier in the chapter. A threshold crossing may reorganize a system before subjects recognize it. Later measurement, naming, announcement, or narration can then become a second source of causal change. The event's relational reality and its manifestational history should therefore be reconstructed separately when both matter.

4.15.3 Stability within Becoming

The concept of becoming names the continuing production of difference through time. GR uses the term cautiously. It does not require a metaphysical doctrine in which process is declared more fundamental than entity, nor does it imply that every configuration changes at the same rate or in the same manner. Becoming identifies the analytical fact that generative-relational systems can produce new states, relations,

capacities, constraints, meanings, manifestations, and objects through their histories. Stability must therefore be understood within this ongoing production of difference.

A stable relational reality is often maintained through active reproduction. Money remains effective because infrastructures settle payments, institutions enforce claims, subjects continue to price and transact, records are maintained, and expectations are reproduced. An organization remains continuous because roles are reassigned, records updated, resources replenished, decisions implemented, and membership boundaries reproduced. Trust can persist because interaction repeatedly confirms or repairs expectations. Stability is therefore frequently achieved through work, adjustment, feedback, repair, and renewal.

This point motivates a distinction between static and dynamic stability. Static stability would describe limited change around a configuration under specified conditions. Dynamic stability describes persistence of organization through continuing transformation. The distinction is analytical; many systems exhibit mixtures of both. A legal rule may remain textually unchanged while its interpretation evolves. A platform may continually update software while preserving a recognizable participation architecture. A household may maintain a pattern of care through changing tasks, needs, and members. The relevant form of stability depends on what must remain sufficiently organized for causal continuity to persist.

Claim 4.133 (Stability within becoming)**.** *Stability in a generative-relational system can consist in the continued reproduction of an organized relational pattern through change. Persistence therefore remains compatible with becoming when the transformations themselves sustain sufficient continuity of structure, constraint, capacity, or causal orientation.*

Claim 4.133 prevents a false choice between stable reality and historical transformation. The same relational reality can be persistent and continually reproduced. At the same time, reproduction is never guaranteed. Small modifications can accumulate, external conditions can change, internal contradictions can intensify, new relations can enter the system, and earlier stabilizing mechanisms can lose efficacy. Dynamic stability can therefore weaken, recover, or pass into transformation.

The temporal extent of stability also matters. A configuration can be stable over a short interval and unstable over a longer one. A speculative price regime may persist long enough to organize investment decisions even if it later collapses. An emergency institution can be relationally real during a crisis despite its intended temporariness. A temporary identity category can shape access and conduct while it remains institutionally operative. Relational reality therefore does not require indefinite duration. It requires sufficient persistence relative to the causal processes under analysis.

Becoming also complicates identity. If a relational reality changes continuously, the question of whether it remains the same object cannot always be answered by a single invariant criterion. Legal continuity, organizational continuity, functional continuity, experiential continuity, material continuity, and historical continuity may diverge. GR therefore treats identity through change as an inquiry-relative reconstruction. The analyst should specify which continuities matter to the question and which transformations count as preserving or ending the object under study.

This approach is especially relevant to subjectivity. The continuing experience of

"I" can be relationally real even though embodiment, memory, social position, commitments, and self-description change. Its reality need not depend on an immutable ontological core. At the same time, ontological suspension prevents the relational account from proving that no such core exists. GR can therefore analyze continuity of self through changing relations while leaving stronger metaphysical conclusions open.

4.15.4 Relational Transformation

Relational transformation occurs when change modifies the organization through which a relational reality is generated, stabilized, or made causally effective. The concept therefore concerns more than variation in the values of fixed variables. A relation may change in strength, direction, meaning, institutional form, temporal ordering, or scale; relations among relations may be reorganized; new relata may enter; earlier ones may disappear; and the mechanisms through which manifestations feed back into the system may themselves change.

Definition 4.134 (Relational transformation)**.** *Relational transformation* denotes a historically situated change in the organization of a generative-relational system that modifies the conditions through which relational realities emerge, persist, interact, manifest, or exercise causal efficacy.

Definition 4.134 distinguishes transformation from ordinary state change. A price change within an otherwise stable market arrangement may alter a state without transforming the relational architecture. A change in settlement rules, ownership structure, access rights, information infrastructure, or category system can transform the relations through which prices are generated and acted upon. The distinction remains scale-dependent, but it directs attention toward changes in generative conditions rather than toward magnitude alone.

Relational transformation can be cumulative. Repeated small changes can modify expectations, routines, infrastructures, and classifications until a system operates under materially different generative conditions. The absence of a single dramatic event does not preclude transformation. Gradual digitization of payment systems, for example, can change the relations among money, identity, privacy, institutions, and access through accumulated infrastructural revisions. Similarly, gradual adoption of algorithmic evaluation can reorganize employment, credit, insurance, education, or welfare relations even when no single deployment constitutes the entire transformation.

Transformation can also be path-dependent. Earlier relations shape which later changes are feasible, costly, intelligible, or institutionally legitimate. Historical residues can remain operative after the representations associated with them disappear. Infrastructures, legal precedents, accumulated skills, property distributions, organizational routines, and categories can constrain later possibilities. The transformed system therefore carries aspects of its history into new configurations even when its manifestational vocabulary changes substantially.

The recursive architecture of Sections 4.10 and 4.11 becomes especially important here. Representations can become mechanisms of transformation when classifications, measurements, models, narratives, or interfaces alter behavior and institu-

tional response. A newly introduced performance score can reorganize organizational incentives; a legal category can create new rights and duties; a public risk classification can alter investment; an economic indicator can change policy behavior. Once such representations become causally embedded, transformation occurs partly through manifestational mediation.

Relational transformation can also dissolve relational realities. A currency can lose the relations that sustain its practical efficacy. A legal office can be abolished. A social norm can weaken until it ceases to organize conduct. A trust relation can collapse. Dissolution does not imply that the earlier reality was illusory. A relational reality can have been historically real, causally consequential, and later absent. The ontology developed here is therefore temporally indexed: reality within a generative-relational system can emerge, persist, transform, and cease.

Remark 4.135 (Historical reality and dissolution). The later disappearance of a relational reality does not retroactively remove its earlier causal reality. Historical existence and present persistence are distinct questions.

This remark matters for economic history and institutional analysis. Defunct currencies, dissolved corporations, abolished legal statuses, vanished markets, and obsolete technologies can remain causally significant through accumulated effects, inherited infrastructures, debts, memories, distributions, and institutional residues. Their present relational reality may have ended while consequences generated during their persistence continue to structure later systems.

4.15.5 Emergence of New Ontological Categories

Relational transformation can eventually strain the categories through which an inquiry describes what exists. Existing categories may continue to capture some features of a changing system while becoming inadequate for others. New kinds of institutional object, operational subject, property relation, value form, technical agency, or manifestation can arise through combinations of relations that earlier classifications did not anticipate. The emergence of such objects creates an ontological problem for analysis: the investigator must decide whether an existing category can be extended, whether several categories should be distinguished, or whether a new category is warranted.

The phrase *new ontological category* is used here with ontological restraint. It does not mean that the analyst has discovered a new fundamental constituent of reality. It means that the system presents a sufficiently stable and causally consequential form whose existing analytical classification is inadequate for the inquiry. Category formation is therefore a response to emergent reality under specified evidential and methodological conditions. The category can later be revised, divided, merged, or abandoned as the object and the inquiry develop.

Definition 4.136 (Emergent ontological category)**.** An *emergent ontological category* is an analytically warranted category introduced when a historically generated configuration displays sufficiently distinctive persistence, organization, causal capacities, or modes of manifestation that the categories previously available to the inquiry no longer provide an adequate account of the relevant reality.

Definition 4.136 links ontology to historical inquiry without reducing reality to naming. The category is analytically introduced, but the warrant for introducing it is constrained by the properties and effects of the configuration being studied. A new term alone does not create a new ontological category. Conversely, a novel relational reality may begin to operate before a vocabulary for it exists. This preserves the distinction between relational reality and symbolization established earlier in the chapter.

Contemporary artificial systems offer one illustration. The emergence of systems capable of sustained interaction, autonomous-seeming task execution, representation, coordination, and intervention can strain categories built around tools, agents, organizations, and human subjects. GRE need not settle this difficulty by declaring such systems persons or by reducing them to ordinary instruments. Section 4.12 introduced artificial operational subjecthood precisely as a differentiated analytical category whose scope is narrower than human subjecthood. The category becomes useful when it tracks stable capacities and causal roles that existing descriptions obscure, while ontological and normative questions beyond that scope remain suspended.

Economic institutions can generate similar categorical pressure. Digital assets, platform-mediated labor relations, algorithmically administered claims, hybrid public-private infrastructures, and machine-mediated forms of coordination can combine properties previously distributed across several categories. Whether they warrant genuinely new analytical categories depends on the structure of the inquiry. GRE therefore treats category formation as a disciplined response to emergent configurations rather than as conceptual novelty for its own sake.

The same discipline applies to historical categories. A category that once tracked a stable relational reality can lose adequacy as the system changes. Retaining the old name may conceal transformation if its referent has acquired substantially different generative conditions and causal capacities. Conversely, rapid renaming can exaggerate novelty where relational continuity remains strong. Category revision therefore requires comparison of historical organization, persistence, causal efficacy, manifestation, and transformation rather than lexical difference alone.

Claim 4.137 (Category emergence under ontological suspension)**.** *The emergence of a new analytical ontological category can be warranted by historically generated differences in organization and causal efficacy without requiring a claim that the category identifies a new fundamental kind of being.*

Claim 4.137 connects the present section back to ontological suspension. GR can revise what it counts as an object, process, event, subject, institution, or form of value when reality under inquiry changes or when earlier descriptions prove inadequate. This flexibility is compatible with ontological seriousness because revision responds to evidence about persistence, difference, causal efficacy, and generative structure. It is also compatible with metaphysical restraint because local analytical differentiation does not automatically become a universal ontology.

Process, event, becoming, transformation, and category emergence therefore provide a temporal extension of the chapter's three-register architecture. Relational realities can persist through organized change; events can redirect trajectories before or after they become manifest; manifestations and representations can become causal

components of transformation; and new configurations can eventually require revised categories of analysis. Stability and becoming are thus mutually informative rather than mutually exclusive. The result prepares the transition to Section 105, which introduces a category-theoretic view as one possible formal language for describing objects, morphisms, mappings, and equivalences across relational and manifestational domains while preserving the ontological restraint established throughout the chapter.

4.16 A Category-Theoretic View

The preceding sections have developed an ontology in which relational realities emerge, persist, manifest, become represented, and transform through historically structured systems. The role of the present section is to introduce category theory as one possible formal language for describing selected aspects of this architecture. Its objective is not to claim that relational reality is fundamentally categorical. Rather, category-theoretic language can help distinguish objects from mappings, preserve compositional structure, compare different descriptive domains, and make explicit when two paths of mediation are treated as equivalent or when they remain distinct. The section proceeds from objects and morphisms to categories of relational and manifestational reality, then considers functorial manifestation, loss and excess of information, equivalence, symbolic mediation, changing manifestation rules, multiple realization, and diagrammatic path dependence. Throughout, the formal vocabulary is treated as a methodological expedient whose appropriateness depends on whether the relations under study actually support the compositional assumptions imposed by the model.

Category theory is attractive for GR partly because it directs attention away from intrinsic properties alone and toward relations, mappings, transformations, and preservation across descriptions. Yet this attraction requires restraint. A category is a mathematically specified structure with objects, morphisms, identity morphisms, and associative composition. A generative-relational system need not present itself in this form without analytical construction. The investigator must decide what counts as an object, which transformations count as morphisms, when two morphisms are composable, and what form of equality or equivalence is appropriate. These decisions can illuminate structure, but they also select and compress reality. Category-theoretic analysis therefore belongs within the chapter's broader principle of open ontological commitment: it can support rigorous local claims without acquiring metaphysical authority beyond the structures it successfully represents. (Mac Lane 1998; Awodey 2010)

Definition 4.138 (Category-theoretic representation)**.** A *category-theoretic representation* of a generative-relational domain is an analytically constructed category whose objects and morphisms represent selected configurations and admissible relations or transformations in that domain, with identity and composition specified in a manner appropriate to the inquiry.

Definition 4.138 emphasizes representation rather than identity. The category is a model of selected structure. It can preserve relations that matter to the inquiry while

leaving other features unrepresented. This makes category theory especially useful for the three-register architecture, where the same object can be described within different domains and where manifestation, representation, and transformation often involve mappings between domains rather than a single common metric space.

4.16.1 Objects, Morphisms, and Relational Description

A category consists, minimally, of objects and morphisms between them. For objects A, B, and C, morphisms can be written

$$f : A \to B, \qquad g : B \to C, \tag{4.7}$$

Equation 4.7 introduces the basic source–target notation used in this section. A composite $g \circ f : A \to C$ is defined when the codomain of f matches the domain of g. Each object has an identity morphism, and composition is associative wherever it is defined. These requirements are simple, but their interpretation in a generative-relational analysis is not automatic.

An object can represent a stabilized relational configuration, an institutional state, a manifestation, a symbolic representation, a process considered at a selected scale, or another analytically bounded unit. A morphism can represent a transformation, translation, admissible relation, institutional operation, manifestation process, or structure-preserving map. The same empirical material can support more than one categorical representation because the choice of object and morphism depends on the analytical question.

For example, firms can be represented as objects and contractual transformations as morphisms in one model. In another model, contractual arrangements themselves can become objects, while legal or organizational transformations act as morphisms among them. A third representation can treat manifestations of those firms—financial reports, registrations, ratings, or platform profiles—as objects within a manifestational category. Category theory therefore does not decide in advance what the economically relevant object is. It disciplines relations among whatever objects the inquiry has justified selecting.

Remark 4.139 (Object selection). Categorical objecthood is an analytical role, not a declaration of fundamental ontological objecthood. The same relational reality can occupy different formal roles under different resolutions and research questions.

This point matters because objectification can conceal internal structure. Treating an organization as a single categorical object may be useful for studying interorganizational transformations while suppressing internal power relations, departments, subjects, and material infrastructures. Treating those internal elements as separate objects can recover some of that structure but may suppress other scales. The categorical model therefore inherits the boundary and scale problems already identified in GRE. Formal clarity does not remove the need to justify what has been made visible and what has been compressed.

4.16.2 Relations as Morphisms and Relations among Relations

The language of morphisms is naturally attractive to a relational framework, but GR should resist a simple identification between every relation and every morphism. In an ordinary category, morphisms possess specified domains and codomains and participate in associative composition. Many empirical relations are symmetric, partial, probabilistic, context-sensitive, historically contingent, or difficult to compose. Some can nevertheless be represented categorically by choosing an appropriate category; binary relations, for example, can themselves be treated as morphisms in a category whose composition is relational composition. In other cases, transformations rather than relations in the broad GR sense provide the more suitable morphisms.

The useful methodological question is therefore whether a selected relational domain supports a compositional representation. When it does, composition can expose how relations among relations generate higher-order consequences. If $f : A \to B$ and $g : B \to C$ represent two admissible transformations, then $g \circ f$ represents the result of applying them in sequence. The composite can be analytically important even when neither transformation alone determines the final configuration. Contract formation followed by registration, classification followed by allocation, or measurement followed by administrative decision can all be represented through composition when the domain and codomain assumptions are justified.

Relations among relations can also require higher-order structures. A change in the rule by which one morphism is interpreted, a comparison between two mappings, or an intervention on a manifestation rule is not simply another relation among the original objects. Category theory offers several ways to represent such higher-order structure, including functors and natural transformations. GR need not adopt the most elaborate formalism by default. The important insight is that the relation connecting two objects and the transformation of that relation belong to distinguishable analytical levels.

Claim 4.140 (Compositional warrant)**.** *A categorical representation of a relational domain is warranted only to the extent that the selected objects, morphisms, identities, and compositions preserve structures relevant to the inquiry. Formal composability should not be inferred merely from the presence of empirical relations.*

This claim protects the method against decorative formalization. A category-theoretic diagram becomes informative when its compositions correspond to meaningful sequences or transformations in the domain. Where composition is ambiguous, history-dependent, or only partially defined, the model should represent that limitation rather than assume away the problem.

4.16.3 Categories of Relational Reality

The strict criterion of relational reality developed in Section 4.5 can be combined with category-theoretic representation without identifying the two. Let a category $\mathcal{R}$ represent a selected domain of relational realities. Its objects can stand for relational configurations that satisfy the relevant persistence, stability, and causal-efficacy conditions at the scale of inquiry. Its morphisms can represent transformations, admissible relations, or structure-preserving changes among those configurations.

The resulting category does not contain relational reality in its entirety. It contains only those distinctions that the model has made categorical. A monetary relation, institution, trust relation, self-model, or organization can possess internal histories and causal structures that are absent from the chosen object. The category becomes analytically useful when the omitted features are not required for the question being asked or when they are represented at another level.

A category of relational reality can also be local. Different subsystems can support different object types and transformation rules. A category appropriate to legal relations need not be identical to one used for technological systems, subjective continuity, or financial networks. The possibility of relating these categories through functors can be more informative than forcing all of them into a common metric or a single universal object space.

Definition 4.141 (Relational category)**.** A *relational category* is a category constructed for an inquiry in which objects represent selected relationally real configurations and morphisms represent admissible relations or transformations whose composition preserves structures relevant to that inquiry.

The definition deliberately leaves open what counts as preservation. In one study, preservation can concern legal validity; in another, organizational continuity, causal accessibility, information flow, contractual structure, or some other relation. The category gains explanatory value from the explicitness of these choices rather than from conformity to a single ontology.

4.16.4 Categories of Manifestational Reality

Manifestational reality admits a parallel but distinct categorical treatment. Let $\mathcal{M}$ denote a category whose objects represent manifestations available under a specified manifestational regime and whose morphisms represent admissible transformations, translations, comparisons, or transitions among those manifestations. The objects of $\mathcal{M}$ can include observations, measurements, classifications, reports, symbolic forms, perceptual states, institutional records, or other manifestations selected by the inquiry.

A manifestational category is not merely a category of representations. Section 4.6 distinguished manifestation from symbolization, and Section 4.10 distinguished symbolic representation from manifestational reality more broadly. A bodily response, an observed pattern, a measurement trace, a legal inscription, and a linguistic description can therefore belong to different manifestational subdomains while all remaining manifestations in the broader GR sense.

The categorical distinction between $\mathcal{R}$ and $\mathcal{M}$ provides a disciplined way to express a point developed throughout the chapter: relational and manifestational realities need not share the same objects or the same structure. A relational configuration can support multiple manifestations, and several relational configurations can become manifest in indistinguishable ways under a limited regime. Instead of treating these mismatches as defects in a single space, category-theoretic analysis can represent them as properties of mappings between distinct categories.

Remark 4.142 (Heterogeneous domains)*.* The usefulness of separate relational and

manifestational categories lies partly in permitting heterogeneity. A mapping between domains can be studied without presuming that the domains share a common metric, coordinate system, or ontology.

This is especially important for the non-necessary comparability of relational realities. Two relationally real objects can belong to categories whose internal morphisms, equivalences, and invariants differ substantially. Comparison then requires an explicit functor, correspondence, or other mapping rather than an assumed common scale.

4.16.5 Manifestation through Functorial Mapping

A functor provides one formal model of manifestation across categorical domains. Suppose $\mathcal{R}$ is a relational category and $\mathcal{M}$ a manifestational category. A functor

$$F : \mathcal{R} \longrightarrow \mathcal{M} \tag{4.8}$$

Equation 4.8 names the functor that will serve as the local manifestation model. It assigns each modeled object A in $\mathcal{R}$ an object $F(A)$ in $\mathcal{M}$ and each modeled morphism $f : A \to B$ a morphism $F(f) : F(A) \to F(B)$ while preserving identity morphisms and composition.

The preservation of composition is the substantive assumption. If a relational transformation f followed by g is represented by $g \circ f$, functoriality requires the manifestation of that composition to agree with the corresponding composition of manifested morphisms:

$$F(g \circ f) = F(g) \circ F(f). \tag{4.9}$$

Equation 4.9 can be analytically powerful because it identifies a condition under which relational composition is preserved through manifestation. It can also fail. A manifestational regime may erase sequence, reorder operations, introduce threshold effects, or depend on contextual information absent from the source category. Functoriality should therefore be treated as a model property to be investigated rather than a universal fact about manifestation.

Definition 4.143 (Functorial manifestation)**.** *Functorial manifestation* is a model of manifestation in which selected relational objects and morphisms are mapped into a manifestational category while identities and relevant compositional structure are preserved.

This definition does not require manifestation in general to be functorial. It identifies a useful special case. Administrative systems often aspire to such preservation: a legally valid sequence of operations is expected to produce a corresponding sequence of records; an accounting transformation is expected to be reflected in a consistent ledger transformation; a data pipeline is expected to preserve specified relations among inputs and outputs. Failures of preservation can then become analytically visible as breaks between relational process and manifestation.

4.16.6 Non-Faithful Manifestation and Loss of Relational Information

A functor is faithful when it maps distinct morphisms between the same pair of source objects to distinct morphisms in the target. Non-faithfulness therefore provides one precise formal model of relational distinctions that become indistinguishable in manifestation. Suppose $f, g : A \to B$ are distinct morphisms in $\mathcal{R}$ but

$$F(f) = F(g). \tag{4.10}$$

Equation 4.10 states the relevant collapse: the manifestational category fails, under this model, to preserve the distinction between the two relational transformations.

This formal structure corresponds closely to the relational remainder developed in Section 4.9. Different causal histories, institutional pathways, or social relations can produce the same recorded outcome. Two workers can receive the same wage through substantially different relations of bargaining power and security. Two firms can receive the same credit classification despite different dependency structures. Two subjects can produce the same interface response while differing in histories, capacities, or internal organization. In each case, a manifestational system can preserve an outcome while collapsing distinctions among the morphisms that generated it.

Claim 4.144 (Non-faithfulness and relational loss)**.** *When a manifestation functor is non-faithful, distinct modeled relational transformations can become manifestationally indistinguishable. The resulting loss of distinction concerns the selected manifestation regime and does not imply that the source transformations were relationally identical.*

Faithfulness is only one form of information preservation. A functor can distinguish morphisms while still mapping distinct objects to the same object, depending on the category and model. Conversely, object-level differences can remain visible while important internal relations are lost. GR therefore uses faithfulness as a precise local concept rather than as a complete measure of manifestational adequacy.

The category-theoretic language also clarifies why improving measurement can require more than adding variables. If a regime systematically identifies distinct relational pathways, richer data may leave the collapse intact unless the mapping itself is redesigned. The epistemic problem can therefore reside in the structure of manifestation rather than only in the quantity of manifested information.

4.16.7 Non-Full Manifestation and Unmanifested Relational Possibilities

Fullness requires a different interpretation. A functor $F : \mathcal{R} \to \mathcal{M}$ is full when every morphism in $\mathcal{M}$ between $F(A)$ and $F(B)$ is the image of at least one morphism in $\mathcal{R}$ between A and B. A non-full functor therefore indicates that the target category contains morphisms between manifested objects that are not induced by morphisms represented in the source category.

This point should be distinguished carefully from an *unmanifested source possibility*. In a strict functor, every source morphism receives an image. Non-fullness therefore does not, by itself, mean that a relational morphism exists but fails to man-

ifest. Rather, it means that the manifestational domain admits transformations or relations that are not accounted for by the modeled source relations. These can arise from measurement procedures, symbolic recombination, institutional processing, artifacts, interpretive operations, or relations introduced by the manifestation system itself.

To represent relational possibilities that are not manifested at all, the model must be modified. One option is to define the manifestation functor only on a subcategory $\mathcal{R}_{\text{vis}} \subseteq \mathcal{R}$ of relational configurations and morphisms that are accessible under the relevant regime. Relational possibilities in $\mathcal{R}$ outside that subcategory remain unmanifested relative to the regime. Another option is to use a partial, lax, stochastic, or correspondence-based structure where strict functorial assignment is inappropriate.

Remark 4.145 (Fullness and invisibility)*.* Non-fullness and relational invisibility are different structural problems. Non-fullness concerns target morphisms lacking source antecedents in the model; unmanifested relational possibilities concern source structure excluded from, undefined under, or inaccessible to the manifestation mapping.

This distinction is methodologically useful because the two problems call for different interventions. If relevant source relations are invisible, the manifestational regime may require expanded access or a different mapping. If the target generates relations not grounded in the source model, the analyst must study the generative contribution of measurement, classification, symbolic processing, or institutional mediation itself. In GR terms, manifestation can add structure rather than merely transmit it.

4.16.8 Isomorphism, Equivalence, and Manifestational Indistinguishability

Category theory offers several notions of sameness, and GR benefits from keeping them distinct. Two objects A and B in a category are isomorphic when there are morphisms between them whose compositions yield the respective identity morphisms. Isomorphism therefore captures sameness of categorical structure relative to the category, not numerical identity. Two categories can be equivalent even when they are not isomorphic as categories, provided they preserve the relevant structure up to natural isomorphism.

Manifestational indistinguishability is weaker. Section 4.9 defined manifestational equivalence locally to a regime. In categorical terms, two relational objects can satisfy $F(A) = F(B)$ or otherwise become isomorphic or observationally equivalent in $\mathcal{M}$ without being isomorphic in $\mathcal{R}$. Likewise, two source categories can generate equivalent manifestations while differing in relational organization.

Claim 4.146 (Manifestational equivalence is not relational isomorphism)**.** *Equivalence or isomorphism in a manifestational category does not, without additional assumptions on the manifestation mapping, establish isomorphism, equivalence, or identity in the relational category.*

The additional assumptions can be strong. A fully faithful functor preserves and reflects important morphism structure between modeled objects, but even full faith-

fulness does not automatically settle every ontological question outside the representation. GR therefore treats categorical equivalence as always relative to a selected formal domain.

This discipline is particularly important for economic equivalence. Equal price, equal legal category, equal score, equal statistical profile, or equal platform status can create manifestational equivalence under a practical regime. Such equivalence can have real effects because actors and institutions respond to it. Yet the equality need not erase differences in histories, dependencies, capacities, vulnerabilities, or generative conditions. Category theory provides precise language for separating equivalence under a mapping from identity of what is mapped.

4.16.9 Functors between Symbolic and Relational Descriptions

Symbolic regimes can also be modeled categorically. Let $\mathcal{S}$ denote a category of selected symbolic objects and transformations: classifications, legal codes, identifiers, prices, scores, textual descriptions, or other symbolic forms. An encoding or representation functor can map selected relational configurations into $\mathcal{S}$, while an interpretation or institutional enactment mapping can connect symbolic objects back to relational consequences.

The two directions should not be assumed to be inverses. A symbolic representation can compress several relational realities into one category, and an interpreted symbol can generate relations that were not present before the symbolization. A credit score, legal status, diagnostic category, occupational code, or monetary denomination can therefore be both a representation of prior relations and a causal input into later relations. The categorical picture is consequently recursive rather than merely representational.

One can schematically distinguish a relational category $\mathcal{R}$, symbolic category $\mathcal{S}$, and later relational category $\mathcal{R}'$ with mappings

$$\mathcal{R} \xrightarrow{E} \mathcal{S} \xrightarrow{I} \mathcal{R}', \tag{4.11}$$

Equation 4.11 separates the two mappings explicitly: E represents a selected encoding or symbolization and I represents the institutional, interpretive, or practical mediation through which symbols enter later relations. The notation does not imply that $\mathcal{R}'$ is determined by symbols alone. Other histories, material conditions, subjects, and constraints can contribute to its generation.

The value of the categorical representation lies in its ability to make preservation questions explicit. Which distinctions survive E? Which symbolic morphisms become causally operative under I? Which compositions commute, and which depend on the order or path of mediation? These are empirical and theoretical questions, not consequences of the notation itself.

4.16.10 Natural Transformations and Changing Manifestation Rules

The chapter has repeatedly emphasized that manifestation mappings can change historically. Category theory offers a formal language for comparing two functors that

map the same source category into the same target category. If $F, G : \mathcal{R} \to \mathcal{M}$ represent two manifestation regimes, a natural transformation $\eta : F \Rightarrow G$ assigns to each source object A a morphism

$$\eta_A : F(A) \to G(A) \tag{4.12}$$

in a way compatible with the morphisms of $\mathcal{R}$. Equation 4.12 therefore represents the objectwise component of a change between two manifestation regimes rather than an isolated conversion.

In applications, F and G can represent different measurement systems, classification regimes, institutional reporting rules, interfaces, or symbolic conventions. The components η_A then represent transformations between the manifestations produced under the two regimes. Naturality is a strong structural condition: it requires these transformations to cohere with the modeled relations among source objects rather than being arbitrary object-by-object conversions.

Definition 4.147 (Coherent change of manifestation regime)**.** A *coherent change of manifestation regime* is a model in which two manifestation functors are connected by transformations that preserve the relational compatibility conditions represented by a natural transformation.

Not every historical change satisfies this condition. A new accounting standard, legal classification, algorithmic interface, or statistical methodology can reorganize categories so substantially that no natural transformation between old and new regimes provides an adequate model. The failure of naturality can itself be informative: it signals that translation between regimes depends on path, context, exception, or reinterpretation not captured by a uniform structural mapping.

This makes natural transformations useful for analyzing comparability over time. A time series constructed under changing measurement systems may appear continuous while the transformation between regimes fails to preserve the relevant relational structure. Conversely, a carefully calibrated change can preserve enough structure to support meaningful historical comparison. Category theory therefore turns the vague question of whether two regimes are "comparable" into a more explicit inquiry about what transformations preserve which relations.

4.16.11 Multiple Realization and Functorial Equivalence

Multiple realization describes situations in which different underlying relational configurations realize the same or sufficiently equivalent higher-level organization, function, or manifestation. The three-register framework already permits this possibility because manifestational equivalence does not imply relational identity. Category theory offers several ways to formalize the relation without collapsing the realizing systems into one object.

Distinct objects A and B in $\mathcal{R}$ can be mapped to the same manifestational object or to isomorphic objects in $\mathcal{M}$. More strongly, distinct subcategories of relational realization can be mapped into equivalent manifestational structures. This can model cases in which different technologies, organizational arrangements, biological substrates, cultural practices, or computational architectures support similar manifested capacities.

Multiple realization should be distinguished from arbitrary substitution. Two realizations count as equivalent only relative to specified functions, relations, or manifestations. A payment service implemented through different technical infrastructures can appear equivalent to users for a selected transaction set while differing in resilience, surveillance, governance, energy use, or legal dependency. An artificial system and a human subject can produce locally equivalent outputs while differing profoundly in relational histories and forms of subjecthood. The relevant equivalence therefore belongs to the specified category and mapping, not to the entities without qualification.

Claim 4.148 (Locality of functorial equivalence)**.** *Functorial equivalence among realizations is always relative to the categories, morphisms, and invariants selected by the inquiry. It does not entail equivalence with respect to omitted relational, causal, normative, experiential, or ontological structure.*

This claim preserves the book's resistance to premature equivalence. A formal equivalence can be powerful precisely because its scope is explicit. It identifies what is preserved while leaving open what differs.

4.16.12 Commutative and Non-Commutative Diagrams of Representation

One of category theory's most useful habits is to ask whether different compositional paths yield the same result. A commutative diagram represents paths whose composite morphisms are equal within the model. In a representation problem, commutativity can express consistency between direct and mediated descriptions. If a relational configuration can be manifested directly or first symbolized and then translated into a manifestation, commutativity states that the two modeled paths agree.

Such agreement should not be presumed. Economic and institutional systems are often path-dependent. Classification before valuation can yield a different result from valuation before classification. Legal recognition followed by market participation can generate different relations from market participation followed by later recognition. A symbolic description produced before an intervention can affect the intervention itself, while a description produced afterward has a different causal role. In these cases the relevant diagram is non-commutative: the order and path of mediation matter.

Definition 4.149 (Representational path dependence)**.** *Representational path dependence* occurs when two admissible compositional paths connecting corresponding source and target configurations produce distinguishable outcomes within the modeled domain.

Non-commutativity is particularly important for the recursive architecture of Section 4.11. Once a manifestation or representation becomes causally operative, changing the order of manifestation, classification, recognition, or intervention can change the later relational configuration. Diagrammatic non-commutativity therefore provides one formal language for historical mediation.

At the same time, commutativity can be a normative or engineering objective rather than an empirical fact. An administrative system can be designed so that

equivalent procedural paths yield equivalent outcomes; an accounting architecture can seek consistency across transformations; a legal procedure can attempt to preserve rights across different channels. The diagram then encodes a desired invariant whose empirical realization must be tested.

4.16.13 Limits of the Category-Theoretic View

Category theory provides a powerful language of structure, composition, equivalence, and translation, but its usefulness within GR has identifiable limits. First, categorical analysis depends on prior choices of objects and morphisms. These choices can clarify a domain while reifying boundaries that remain contested or historically variable. A category can therefore be internally rigorous and still poorly matched to the relational reality it is intended to represent.

Second, ordinary categories encode composition abstractly but do not automatically represent probability, intensity, duration, geometry, uncertainty, power, cost, or causal strength. Such information can be added through enriched, probabilistic, metric, higher-order, or other categorical structures, but the additional formalism must earn its relevance. GRE should not escalate mathematical complexity merely because a richer category can be defined.

Third, some generative relations admit composition only partially, depend on context, or are themselves transformed through composition. Historical sequence can change the meaning of later operations; institutional exceptions can defeat uniform mapping; stochastic processes can make a single deterministic morphism inappropriate. In these settings, strict categories and strict functors may be approximations. Partial categories, correspondences, profunctors, lax structures, higher categories, or non-categorical models may provide better representations, but no formal family receives automatic priority.

Fourth, categorical equivalence can preserve structure while leaving material, experiential, historical, and normative differences outside the model. A fully faithful representation of selected relations can still omit who bears risk, whose experience is recognized, what resources are consumed, or which histories made the structure possible. Formal invariance therefore does not substitute for substantive economic inquiry.

Remark 4.150 (Methodological status of category theory)*.* Within GR and GRE, category theory is best treated as a language for disciplined structural comparison and composition. Its successful application establishes properties of the represented domain under specified modeling assumptions; it does not by itself establish that reality is fundamentally categorical.

The category-theoretic view nevertheless contributes something distinctive to the chapter. It allows relational and manifestational domains to remain heterogeneous while still being connected through explicit mappings. It distinguishes loss of relational distinctions from excess structure introduced by manifestation. It separates isomorphism, equivalence, and manifestational indistinguishability. It provides a formal language for coherent changes of mapping rules, multiple realization, and path-dependent representation. Most importantly, it makes visible the conditions under which a comparison preserves structure and the points at which such preser-

vation fails.

These contributions prepare the move to Section 106. Category theory can relate heterogeneous domains without requiring a shared metric, but it does not eliminate differences of scale or the possibility that similar higher-level realities are realized through different lower-level configurations. Scale-relative reality and multiple realization therefore require separate treatment. The categorical language developed here will remain available as one analytical resource while the next section returns to the ontological problem itself: how reality can be stable and causally efficacious at one scale while being differently constituted at another.

4.17 Scale-Relative Reality and Multiple Realization

The preceding section introduced category theory as one formal language for relating heterogeneous domains without requiring a common metric or an identity of underlying structure. The role of the present section is to address a more general ontological problem that remains even when no categorical formalism is used: the same generative-relational system can present different relatively stable objects, relations, processes, and functions at different scales, and similar higher-level functions can be realized through heterogeneous lower-level configurations. The objective is to clarify how GR can speak of scale-relative reality without making reality arbitrary, and how it can recognize multiple realization without treating functional similarity as ontological identity. The section proceeds through scale-relative entityhood, scale-relative relationality, multiple realization of similar functions, heterogeneous realization, and cross-scale reality. Throughout, scale is treated as an analytically specified resolution constrained by the organization and causal structure of the system, rather than as a freely chosen perspective detached from what the system can sustain.

Scale enters GR in several forms. It can be spatial, temporal, organizational, institutional, functional, informational, or relational. A household can be treated as an economic subject at one organizational scale while being analyzed as a changing set of interpersonal, legal, affective, material, and monetary relations at another. A firm can appear as a single contracting entity in one model and as a distributed process of governance, routines, assets, labor, software, infrastructures, and expectations in another. A price can be treated as a scalar variable at one analytical resolution while another inquiry reconstructs the market-making, institutional, informational, and symbolic relations through which that price becomes possible. None of these descriptions is automatically more real because it is finer grained. The relevant question is which organization persists and exerts causal efficacy at the scale required by the inquiry. (P. W. Anderson 1972; Bar-Yam 2004; Simon 1962)

This position differs from a simple micro–macro hierarchy. A scale is not defined only by size, and a finer resolution does not necessarily reveal a privileged ontological base. A legal status can operate at an institutional scale that is not reducible to physical size; a norm can persist across many material realizations; a computational function can be implemented through architectures with different internal organizations; and a subject can occupy several overlapping relational scales simultaneously. Scale-relative analysis therefore concerns the resolution at which organization, per-

sistence, constraint, and causal efficacy become analytically distinguishable.

Definition 4.151 (Analytical scale)**.** An *analytical scale* is a specified resolution of a generative-relational system at which selected entities, relations, processes, boundaries, and causal differences are treated as distinguishable for the purposes of an inquiry.

Definition 4.151 makes scale an explicit component of representation. It does not imply that the analyst creates the relevant reality by choosing a scale. The chosen resolution must remain answerable to the system. If a purported object fails to persist, stabilize, or exercise causal efficacy at the selected resolution, treating it as a relationally real entity becomes difficult to justify. Conversely, a configuration can be relationally real even when a finer-grained description reveals continual replacement, turnover, or transformation among its constituents.

4.17.1 Scale-Relative Entityhood

Entityhood in GR is therefore often scale-relative. A configuration can function as an entity when enough of its organization is stabilized to support identification, interaction, and causal participation at a selected resolution. This entityhood does not require that the configuration be simple, internally homogeneous, or materially indivisible. It requires that treating it as a unit preserve causal and relational differences relevant to the inquiry.

Definition 4.152 (Scale-relative entityhood)**.** *Scale-relative entityhood* denotes the status of a configuration that exhibits sufficient persistence, stability, boundary coherence, and causal efficacy to be treated as a distinguishable relational object at a specified analytical scale, even when finer or alternative scales reveal it as internally heterogeneous, processual, or distributed.

A corporation illustrates the point. At one scale it can enter contracts, own assets, incur liabilities, employ workers, issue securities, and survive changes in membership. At another scale it is constituted through legal rules, governance procedures, organizational routines, technologies, buildings, documents, labor, interpersonal relations, and expectations. The higher-level entity does not disappear because its lower-level realization is heterogeneous. At the same time, the lower-level relations cannot be inferred exhaustively from the fact that the corporation persists as a legal and economic entity. Scale-relative entityhood therefore preserves both the causal reality of the higher-level object and the incompleteness of any single-scale description.

The same pattern appears in money. A unit of account can be analyzed as a stabilized relational object within a monetary system, while its realization depends on material tokens, ledgers, settlement infrastructures, legal rules, central-bank practices, commercial banking, expectations, software, and repeated acts of pricing and payment. A monetary unit is neither reducible to any one of these components nor independent of the system that sustains it. Its entityhood is scale-relative because it becomes causally tractable at the level at which monetary claims, prices, debts, and payments operate.

Scale-relative entityhood also applies to subjects. The continuing sense of “I” discussed in Section 4.12 can possess relational reality at a scale of autobiographical con-

tinuity and practical agency while being realized through changing bodily, neural, mnemonic, linguistic, social, and institutional processes. The fact that these lower-level realizations change does not by itself negate the relational reality of the self-model that persists sufficiently to guide action. Conversely, persistence of the practical self does not settle whether an ontologically independent and unchanging self exists. The three-register architecture and ontological suspension remain intact.

Scale-relativity therefore differs from nominalism about entities. GR does not treat entities as mere names imposed on an otherwise undifferentiated flow. Some boundaries are institutionally authorized, materially reinforced, operationally reproduced, or causally consequential. Others are weak, temporary, contested, or analytically convenient. The task is to identify the mechanisms through which entityhood is stabilized and the range over which treating the configuration as an entity preserves explanatory adequacy.

Claim 4.153 (Constraint on scale-relative entityhood)**.** *A scale-relative entity claim is warranted only insofar as the proposed entity exhibits sufficiently stable organization and causal efficacy at the selected scale; changing the scale can alter the adequacy of the entity description without making the underlying inquiry arbitrary.*

Claim 4.153 prevents two opposite errors. One is reductionism, in which a higher-level object is dismissed because it can be decomposed. The other is reification, in which a convenient aggregate is treated as independently real even when its internal heterogeneity materially changes explanation. A national unemployment rate, a firm's productivity, a household preference, or a platform's market share can be useful higher-level objects, but the explanatory adequacy of each depends on whether aggregation preserves the differences relevant to the problem.

Scale-relative entityhood also has a temporal dimension. An entity can be stable at one temporal resolution and transient at another. A coalition can organize a negotiation for several months without becoming a durable institution. A market panic can persist long enough to reorganize credit even if it dissipates rapidly in historical time. A technical standard can remain stable for decades while individual implementations change continuously. Persistence must therefore be evaluated relative to the causal timescales of the relations being studied.

4.17.2 Scale-Relative Relationality

Relations are also scale-relative. A relation observed at one scale can summarize a large number of lower-level interactions, while a lower-level relation can become invisible or irrelevant at a higher resolution. For example, an employer–employee relation can be represented as a contractual relation in one model, while another inquiry decomposes it into wage-setting procedures, supervisory practices, legal rights, informal expectations, technical dependencies, bargaining capacities, and histories of recognition or conflict. Neither representation is automatically superior. Each preserves different relations and suppresses others.

Scale-relative relationality matters because GR places relations at the center of explanation without assuming that all relations must be represented at the finest available resolution. An economic system would become analytically unusable if every molecular, neurological, linguistic, contractual, technological, and institutional inter-

action had to be represented simultaneously. Relational analysis therefore requires principled compression. The question is whether the compressed relation retains the causal and generative structure relevant to the inquiry.

Definition 4.154 (Scale-relative relation)**.** A *scale-relative relation* is an analytically specified relation whose relata, structure, and causal significance are defined at a selected resolution and whose adequacy depends on whether it preserves the relational differences relevant to the inquiry.

A relation at one scale can itself become a relatum at another. A long-term contractual relation between two firms can be treated as one edge in a supply network even though the relation is internally complex. A local credit network can become a component of a regional financial structure. A household can become a relatum in a tax system. An institution can become a node within an international regime. This nesting is not merely representational convenience when the higher-level configuration develops persistence and causal efficacy of its own.

Relations across scales can also constrain one another. A regulatory regime can shape permissible transactions among individual firms; repeated firm-level practices can gradually alter regulatory expectations; a platform's architecture can condition interactions among users; accumulated user practices can produce pressures that change the platform's rules. GR therefore avoids a one-directional picture in which causal explanation always moves from smaller to larger units. Cross-scale causal organization can involve amplification, constraint, feedback, path dependence, and institutional mediation.

The possibility of scale-relative relationality also clarifies why relational realities need not share a common metric. A relation between two persons, a relation between institutions, and a relation between a legal category and an administrative procedure can all be causally important without being distances in one numerical space. Moving across scale can require translation among heterogeneous forms of relation rather than rescaling a single measure. The category-theoretic view of Section 4.16 provides one possible formal language for such translations, but the ontological point is broader: relational connectedness does not imply metric homogeneity.

Remark 4.155 (Relational compression)*.* A higher-scale relation can be analytically legitimate even when it compresses many lower-scale relations, provided that the compression preserves the distinctions necessary for the explanatory or evaluative task and does not conceal lower-scale heterogeneity that materially changes the conclusion.

Remark 4.155 is especially important for GRE. Economic analysis routinely works with households, firms, sectors, markets, institutions, and states. GRE does not reject these units because they are relationally constituted. It asks when their internal constitution matters and when a stabilized higher-scale relation is an adequate object of inquiry. The answer can change across questions. A firm can be a useful unit in a trade model and an inadequate unit in an analysis of workplace power. A household can be useful in a consumption model and inadequate in an analysis of intra-household allocation. Scale selection therefore carries explanatory and normative consequences.

4.17.3 Multiple Realizations of Similar Functions

Scale-relativity becomes especially important when similar higher-level functions are realized through different lower-level configurations. A payment function can be supported by cash, bank deposits, card networks, mobile ledgers, or other infrastructures. A coordination function can be performed through hierarchy, market exchange, professional norms, algorithmic allocation, or combinations of these. A memory function can be distributed across human recollection, written records, databases, institutional routines, and technical archives. Similar manifested capacities can therefore emerge from heterogeneous relational organizations. (Fodor 1974; Kim 1992)

Definition 4.156 (Multiple realization)**.** *Multiple realization* occurs when two or more materially, organizationally, relationally, or otherwise structurally distinct configurations support a sufficiently similar function, capacity, manifestation, or higher-scale relational reality relative to explicitly specified criteria.

Definition 4.156 makes similarity criterion-dependent. Two systems can realize the same payment function for ordinary retail exchange while differing in privacy, settlement finality, resilience, energy demand, governance, legal recourse, accessibility, or exposure to surveillance. Two organizations can produce similar outputs while distributing authority, risk, labor, and recognition differently. Two subjects can produce locally indistinguishable responses while possessing different histories, internal organizations, capacities, or forms of experience. Multiple realization therefore supports local equivalence without implying general equivalence.

This distinction is continuous with the chapter's treatment of non-invertibility. Similar manifestations do not uniquely determine the relational configuration that produced them. Multiple realization provides a structured reason for this underdetermination: different realizations can converge on a similar manifested function. The inverse problem becomes especially difficult when only the higher-level output is observed and the lower-level realization is hidden, changing, or institutionally inaccessible.

Multiple realization also prevents a simple reduction of function to substrate. If the same higher-level function survives replacement of many lower-level components, the function can acquire a degree of relational autonomy at the scale where it is reproduced. This autonomy is relative rather than absolute. The higher-level reality still depends on realization, but it may not depend on one unique realization. A legal office can persist through changes in officeholders, buildings, record systems, and administrative technologies; a currency can persist through changes in physical tokens and settlement infrastructure; an organization can preserve functions through substantial turnover in members and routines.

Claim 4.157 (Locality of realized equivalence)**.** *When distinct configurations realize a similar function or manifestation, the resulting equivalence is limited to the criteria under which the similarity is established. It does not entail equivalence of causal history, internal relation, normative consequence, material dependence, or ontological status.*

Claim 4.157 gives multiple realization the same discipline that Section 4.16 gave formal equivalence. A comparison must state what is preserved. In economics, this prevents functional substitutability from becoming a claim of social or ethical substi-

tutability. An automated system can substitute for a human worker in a specified productive task while changing employment relations, accountability, knowledge distribution, bargaining power, surveillance, or the meaning of participation. Functional similarity is therefore one relation among many.

Multiple realization can also occur historically within one relational reality. A monetary system, educational institution, welfare programme, scientific practice, or communication network can preserve a recognizable higher-level function while its material and organizational realization changes over time. Historical continuity then consists partly in the reproduction of function across changing realizations. Whether the change constitutes continuity, transformation, or replacement depends on which relations and capacities are treated as constitutive at the scale of inquiry.

4.17.4 Heterogeneous Ontological Realizations

The language of multiple realization can tempt a stronger conclusion: that a higher-level reality is independent of the ontological character of its realizers. GR does not require this conclusion. Realizations can be heterogeneous without being irrelevant. Material, biological, technical, institutional, symbolic, and experiential differences can affect which functions are possible, how reliably they are sustained, what costs they impose, and what forms of causal efficacy they acquire.

For this reason, the phrase *heterogeneous ontological realization* is used cautiously. It does not assert that GR has already established a complete ontology of the realizing domains. It marks cases in which the lower-level configurations supporting a higher-level relational reality require substantially different descriptive vocabularies or ontological commitments. A legal norm can depend on texts, institutions, authorized roles, practices, sanctions, interpretations, and embodied subjects. A digital asset can depend on electrical infrastructure, software states, cryptographic operations, legal recognition, organizational governance, and user expectations. A religious object can depend on material artifacts, ritual practice, collective memory, symbolic systems, embodied experience, and institutional continuity. The higher-level relational reality can span these heterogeneous realizations without being identical to any single one.

Definition 4.158 (Heterogeneous realization)**.** A *heterogeneous realization* is a realization in which the sustaining components or processes belong to analytically distinct domains whose relevant structures cannot be adequately represented by a single homogeneous descriptive vocabulary without significant loss.

Definition 4.158 does not imply that the domains are metaphysically incommensurable. It states a methodological condition: the inquiry currently requires more than one descriptive register to preserve the organization relevant to explanation. Ontological suspension remains appropriate when stronger claims about the ultimate relation among those domains are unnecessary.

Heterogeneous realization matters for the three-register architecture because manifestation can occur through one domain while relational stabilization depends on several. A monetary balance may manifest as a number on a screen while its relational reality depends on legal claims, institutional records, technical infrastructures, settlement capacities, and expectations. A person's institutional identity may

manifest through a credential while its effects depend on legal recognition, database entries, organizational practice, social interpretation, and the subject's own history. A manifestationally simple object can therefore possess a relationally heterogeneous realization.

This point also constrains ontological inference. The fact that a higher-level function is multiply realized does not prove that the realizations are ontologically interchangeable. Conversely, the fact that realizations differ ontologically does not prevent them from supporting a locally similar relational reality. GR therefore separates at least three questions: whether a function is preserved, whether the realizing structures are relationally equivalent, and whether their ontological status is the same. These questions can receive different answers.

Heterogeneous realization has normative consequences as well. Two infrastructures that provide similar user-facing functions can distribute environmental cost, labor burden, vulnerability, control, or exclusion differently. Two organizational forms can produce similar outputs while structuring autonomy and authority differently. Ontological and relational heterogeneity can therefore matter even when manifestational equivalence is strong. GRE must resist the tendency to treat functional output as an exhaustive description of economic reality.

4.17.5 Cross-Scale Reality

The preceding arguments imply that relational reality can be distributed across scales. A higher-scale object can be realized through lower-scale configurations while becoming sufficiently stable to constrain, enable, or reorganize those very configurations. This reciprocal organization is what the present subsection calls cross-scale reality. The term does not designate a separate fourth register of reality. It describes relations among realities whose persistence and causal efficacy are distinguishable at different analytical scales.

Definition 4.159 (Cross-scale reality)**.** *Cross-scale reality* denotes a configuration in which relationally real structures identified at different analytical scales participate causally in one another's generation, stabilization, constraint, or transformation.

A legal institution provides a simple example. Repeated actions, documents, decisions, records, and recognized roles sustain the institution. Once stabilized, the institution constrains which actions count as valid, who possesses authority, what procedures are available, and which future relations can be formed. The higher-scale institution is realized through lower-scale practices, while the lower-scale practices are reorganized by the institution they sustain. A monetary system similarly depends on transactions and records while simultaneously shaping the terms under which transactions are possible. An organization depends on individual actions while roles, procedures, and collective resources constrain those actions.

Cross-scale reality therefore avoids the assumption that causal explanation must terminate at the finest scale. A finer-grained description can reveal mechanisms through which a higher-level structure is realized, but the higher-level structure can still be causally indispensable because it organizes the space of lower-level possibilities. The statement that a rule is implemented through individual actions does not eliminate the causal significance of the rule when actors orient themselves to it, insti-

tutions enforce it, and it structures future choices. The relation between realization and efficacy is recursive rather than eliminative.

This does not require a strong doctrine of "downward causation." GR can remain neutral about metaphysical debates concerning causal levels. The analytically necessary claim is weaker: descriptions at different scales can capture causally relevant organization that is lost if analysis is restricted to one scale. If changing a higher-level institutional relation systematically changes lower-level possibilities, and if lower-level interactions reproduce or transform that higher-level relation, then a cross-scale account can be explanatorily warranted regardless of how the ultimate metaphysics of causation is later formulated.

Claim 4.160 (Cross-scale causal adequacy)**.** *A cross-scale explanation is warranted when causal differences at one analytical scale cannot be adequately represented without reference to relatively stable organization identified at another scale, and when the relations connecting those scales can be specified sufficiently for the inquiry.*

Claim 4.160 places a burden on cross-scale explanation. Analysts should identify the relations connecting scales rather than invoke "macro" or "micro" levels as unexplained causes. The relevant connectors can include rules, incentives, infrastructures, information, classifications, authority, material dependencies, learning, imitation, resource flows, technical interfaces, or repeated practices. Different problems require different mechanisms.

Scale selection also affects manifestation. A pattern can be manifest at one scale while remaining invisible at another. An individual may experience a series of unrelated administrative decisions while a population-level analysis reveals a systematic distribution. A macroeconomic indicator can display stability while household-level experiences diverge sharply. A platform can appear reliable to users while infrastructural monitoring reveals growing fragility. Manifestational reality is therefore scale-sensitive, and disagreements about "what is happening" can sometimes arise because different observers, institutions, or instruments manifest different scales of the same relational system.

The graph architecture developed earlier in the chapter remains applicable. A manifestation at one scale can enter relations at another scale. A population statistic can reorganize policy; an individual case can become a symbolic event that changes institutional rules; a market index can alter firm behavior; a local failure can trigger system-wide redesign. Scale and register are therefore distinct dimensions. Ontological, relational, and manifestational realities can each be investigated at several scales, and mappings among registers can themselves operate across scale.

The consequence for GRE is methodological rather than merely ontological. Economic inquiry should specify the scale at which an object is claimed to be real, the realization relations that sustain it, the higher- and lower-scale structures omitted by the representation, and the conditions under which equivalence across realizations is asserted. A stable aggregate should not be decomposed merely because decomposition is possible, but neither should aggregation conceal heterogeneity that changes causal or normative conclusions. The appropriate scale is therefore part of the argument.

Scale-relative reality and multiple realization also clarify why ontological cat-

egories can change historically. New technologies, institutions, infrastructures, classifications, and productive arrangements can stabilize objects and functions at scales that were previously unavailable or analytically insignificant. A platform, digital identity, algorithmic market, multinational supply network, or machine-learning agent can become a relatively stable object only under historical conditions that sustain the relations required for its persistence and efficacy. The categories through which an inquiry describes economic reality can therefore acquire or lose salience as the systems themselves change.

This observation prepares Section 107. The next problem is not only that the same reality can be described at several scales, but that the categories available for identifying subjects, objects, relations, capacities, and institutions are themselves historically formed. Scale-relative analysis preserves a plurality of valid resolutions; historical materiality asks how some resolutions and categories become practically consequential in the first place. Together, the two arguments support an ontology that is structured and causally serious without being frozen into a timeless inventory of entities.

4.18 Historical Materiality of Ontological Categories

The preceding sections have progressively loosened the assumption that an ontology for economic inquiry can be given as a timeless inventory of ready-made entities. Relational realities can emerge and dissolve; manifestations can alter the systems they disclose; representations can become causally operative; subjects, institutions, and values can be stabilized through historically specific relations; and the adequacy of an entity description can vary across scale. The role of the present section is to make the historical consequence of these claims explicit. Its objective is to show that the categories through which GR and GRE distinguish subjects, objects, relations, capacities, institutions, and processes can themselves possess a historical materiality. This does not mean that reality is created at will by vocabulary, nor that every ontological distinction is merely conventional. It means that the kinds of relatively stable realities available to economic analysis, the practical boundaries through which they are reproduced, and the categories adequate to describing them can change as productive capacities, institutions, infrastructures, classifications, and forms of social organization change. The discussion proceeds through historical category formation, productive forces and ontological salience, institutional stabilization, transformation of subject and object categories, and the disciplined revisability of ontological categories.

Historical materiality therefore concerns more than the history of ideas about what exists. It also concerns the history of the relational systems within which some distinctions become materially reproducible and causally consequential. The category of a corporation, for example, is not only a word used by analysts. It is connected to legal personality, accounting, ownership, contracting, record keeping, governance, and organizational continuity. The category of a wage worker is similarly connected to historically specific relations of labor, property, contract, production, and reproduction. A category can thus be historically constituted at two levels at once: as a conceptual distinction within inquiry and as a distinction stabilized in the organization of the world being investigated. Keeping these levels

distinct is essential. A historically formed concept can refer badly to reality, while a historically stabilized relational object can remain causally real even when existing concepts represent it inadequately.

Definition 4.161 (Historical materiality of an ontological category)**.** The *historical materiality of an ontological category* denotes the dependence of a category's practical applicability, boundaries, salience, or causal relevance on historically formed generative-relational conditions, including productive capacities, institutions, infrastructures, classifications, practices, and modes of representation.

Definition 4.161 is deliberately weaker than the claim that all ontological reality is historically produced. GR does not need that stronger metaphysical thesis. The definition instead identifies a property of inquiry and of relational reality: some categories become adequate because historical processes stabilize objects or relations that satisfy the category's conditions; some lose adequacy because those objects or relations transform; and some acquire new meanings because the systems through which they operate change. Ontological suspension therefore remains compatible with historical materiality. One can investigate how a category becomes materially and institutionally operative without claiming that every aspect of the reality to which it refers is exhausted by that history.

4.18.1 Historical Formation of Categories

Economic categories have histories because economies have histories. Property, labor, money, household, firm, market, commodity, debt, employment, platform, data, and capital are not analytically interchangeable across all social formations. Some of these terms can be used at high levels of abstraction across long periods, but their concrete relations, legal forms, technical infrastructures, and causal roles can differ substantially. Historical political economy has long emphasized that economic categories can be specific to forms of production and social organization rather than natural kinds that retain an invariant content across history (Marx 1867; Polanyi 1944). GR adopts this historical discipline without requiring that every later ontological claim be reduced to a single theory of historical development.

A category can form historically in several ways. New relational objects can emerge. Existing objects can acquire new causal roles. Institutional boundaries can stabilize distinctions that were previously fluid. Measurement and recording systems can make previously diffuse differences operational. Technical infrastructures can connect dispersed processes into a new functional whole. Political and legal arrangements can create statuses with durable consequences. Repeated representation can also reorganize the object represented, producing recursive stabilization of the category itself. These pathways often overlap, but they should not be collapsed into one mechanism.

Consider the modern firm. Treating the firm as an economic subject is analytically useful because legal, accounting, organizational, technological, and contractual relations make it possible for a changing population of persons and assets to persist as a recognizable unit. The category becomes materially consequential because contracts are signed in its name, liabilities are assigned to it, accounts are kept for it, and future action is coordinated through it. Yet the category does not have one invariant

realization. A family enterprise, public corporation, cooperative, platform company, and multinational group can differ sharply in governance, ownership, scale, internal authority, and technical organization while remaining recognizable under a broader category of firm for some inquiries.

The same applies to labor. "Labor" can designate human activity at a high level of abstraction, but wage labor, coerced labor, unpaid care, self-employment, professional service, platform-mediated work, and machine-assisted production occupy different relational structures. A historical change in the organization of production can therefore alter which distinctions matter to explanation. An ontology of economic activity that treats all productive contribution as one homogeneous object may remain useful for one aggregate calculation while becoming inadequate for questions about authority, reproduction, dependency, or distribution.

Historical category formation should also be distinguished from simple linguistic change. A new word can appear without a corresponding new relational reality, and a relational reality can emerge before a stable vocabulary exists for it. Section 4.5 established that relational reality does not require prior perception or symbolization. The historical formation of an ontological category can therefore lag behind the formation of the reality it later names. Conversely, institutional naming can precede and help stabilize the object named. Legal recognition of a corporate form, administrative classification of a population, or technical standardization of a digital object can contribute to the relations through which the corresponding reality subsequently persists.

Claim 4.162 (Dual historicity of ontological categories)**.** *The historicity of an ontological category can arise both from changes in the reality to which the category is applied and from changes in the conceptual, institutional, and representational practices through which that reality is distinguished; these two histories can interact without being identical.*

Claim 4.162 prevents two reductions. One would treat categories as passive labels that simply follow changes in an independently organized world. The other would treat the world as if it were produced entirely by classification. GR instead permits recursion. A changing economic system can demand new categories, and an institutionalized category can later reorganize the relations it classifies. Hacking's historical ontology and work on classificatory practices provides a useful precedent for this latter possibility, particularly where classifications interact with the persons and practices organized around them (Hacking 2002). The present argument extends the point cautiously to a wider range of economic objects while preserving the distinction between classificatory mediation and the full generative structure of those objects.

This dual historicity also means that category boundaries can be contested. Disputes about whether a worker is an employee or independent contractor, whether a digital token is money, property, security, or access credential, whether a platform is a marketplace or an employer, or whether an artificial system counts as an economic agent can be partly conceptual and partly institutional. Such disputes often matter because different classifications activate different rights, liabilities, measurements, expectations, and causal pathways. The contest is therefore not merely semantic. Once linked to institutions, a category can become a mechanism through which resources and possibilities are distributed.

4.18.2 Productive Forces and Ontological Salience

Historical materiality becomes especially visible when productive capacities change. The term *productive forces* is used here in a broad and deliberately non-exclusive sense to include techniques, skills, infrastructures, tools, scientific knowledge, organizational capacities, energy systems, computational resources, and other means through which production and coordinated activity become possible. Marxian traditions give productive forces a central place within historically specific relations of production, but GRE need not adopt a deterministic sequence in which technical development alone explains institutional or ontological change. Productive capacities interact with law, ownership, culture, ecology, political authority, knowledge, and social reproduction. Their relevance in this section is narrower: changes in productive capacity can alter which objects, relations, and scales become stable enough to acquire ontological salience for economic inquiry.

Definition 4.163 (Ontological salience)**.** *Ontological salience* denotes the degree to which a kind of object, relation, process, or capacity becomes sufficiently persistent, causally consequential, and differentiable within a historical system that distinguishing it materially improves explanation, intervention, or evaluation.

Ontological salience is not identical to ontological reality. Something can be real while remaining marginal to the inquiry, and something can be highly salient in representation while its underlying reality is weak or mischaracterized. Salience concerns why a distinction becomes difficult to omit without explanatory loss. When railways, electrical grids, telecommunications networks, digital platforms, or large computational systems become infrastructures of economic coordination, categories corresponding to network position, interoperability, platform access, computational capacity, or data dependency can acquire a practical importance that was absent under earlier productive arrangements.

Technical change can also create new scales of stable organization. A geographically dispersed supply chain becomes a tractable economic object only when transport, communication, contracting, standards, finance, and information systems sustain coordination across distance. A real-time algorithmic market presupposes technical and institutional infrastructures through which orders, prices, identities, risk controls, and settlement can be processed at speeds and scales unavailable to earlier markets. A machine-learning agent can become an operationally significant economic object only when computational infrastructures, training processes, interfaces, institutional permissions, and organizational practices support sustained action. These objects are not made real by technology alone; technology participates in the generative-relational configurations that allow them to persist and act.

Productive forces can also alter the salience of older categories. Mechanization changes the relation between labor time, skill, machinery, and output. Automation can separate productive contribution from direct human execution. Digital replication changes the relation between use and scarcity for some informational goods. Remote communication changes the spatial organization of work. Large-scale data processing changes the practical role of classification and prediction. None of these transformations automatically invalidates categories such as labor, property, commodity, or firm, but each can change what must be specified for those categories to

remain analytically adequate.

The relation between productive forces and ontological salience is therefore generative rather than deterministic. New capacities can open a possibility space without fixing the institutional form that will stabilize within it. Similar technologies can be embedded in different ownership structures, legal regimes, organizational forms, cultural practices, and normative orders. Conversely, institutions can delay, redirect, or selectively amplify technical possibilities. GR therefore treats productive forces as one set of historically material conditions among several, not as an autonomous engine that determines the ontology of the economy.

Remark 4.164 (Material possibility and historical stabilization). A productive capacity can make a relational form possible without making that form inevitable. Ontological salience emerges when technical possibility becomes joined to sufficiently stable institutional, organizational, symbolic, ecological, and practical relations to produce durable causal effects.

Remark 4.164 is particularly important for contemporary AI. The existence of a model capable of generating language does not by itself settle whether it constitutes an economic subject, an instrument, an organizational component, an autonomous service, or some combination of these under different conditions. Those categories depend on the relations through which the system is authorized, controlled, represented, contracted with, integrated into workflows, and made responsible or nonresponsible for consequences. Technical capability changes the category problem; institutional stabilization helps determine which category becomes operative.

4.18.3 Institutions and Stabilized Reality

Institutions give historical categories durability by linking distinctions to recurrent practices, rules, records, sanctions, rights, expectations, and authorized procedures. Section 4.14 treated institutions as relationally real when they satisfy the full criterion of persistence, stability, and causal efficacy. The present concern is how institutionalization contributes to the historical materiality of the categories through which such realities are recognized and reproduced.

Institutional categories do more than describe. A property title establishes a recognized relation among persons, objects, claims, and authorities. A corporate registration makes a legal subject available for contracting and liability. An employment classification can activate wage rules, insurance obligations, tax treatment, bargaining rights, or exclusions. A national-accounting category can shape how economic activity is measured and compared. A technical standard can determine which objects interoperate. Once these classifications are embedded in durable procedures, their consequences extend beyond the moment of naming.

North's institutional analysis emphasizes that formal rules, informal constraints, and enforcement characteristics structure incentives and economic interaction (North 1990). Searle's account of institutional facts likewise draws attention to how socially recognized statuses can support powers, rights, duties, and functions that are not reducible to the physical properties of the objects involved (Searle 1995). GR need not adopt either framework as a complete ontology of institutions to retain the insight that institutional recognition can stabilize relational realities and make

category boundaries causally consequential.

Institutional stabilization can produce what might be called category infrastructure. Registries, legal codes, accounting systems, databases, credentials, standards, forms, identifiers, professional practices, and administrative routines make categories reproducible across time and across many local interactions. They reduce the need to renegotiate the existence and meaning of a category in each encounter. A corporation need not be recreated conceptually whenever it enters a contract; a recognized currency unit need not be redefined in each payment; a credential can travel across organizations because institutional infrastructures preserve enough of its meaning to make it actionable.

Definition 4.165 (Category infrastructure)**.** A *category infrastructure* is a relatively persistent assemblage of rules, records, standards, practices, technologies, and authorized interpretations through which a classificatory distinction is reproduced and made causally operative across situations.

Category infrastructure helps explain why some classifications become relationally real while others remain ephemeral. A spontaneous label may influence a local interaction but disappear quickly. A classification linked to records, eligibility rules, technical interfaces, and repeated organizational practice can persist and reorganize future relations. Its materiality lies partly in the infrastructures that carry it. This does not make the classification epistemically correct or normatively legitimate. A mistaken, discriminatory, or obsolete category can remain causally powerful when institutions continue to act upon it.

Institutional stabilization also produces inertia. Once organizational routines, contracts, software systems, forms, statistical series, and legal rights are built around a category, revising that category can become costly. Historical categories can therefore outlive the conditions under which they were initially useful. A classification may persist because infrastructures presuppose it, even as the underlying relational reality becomes more heterogeneous. This lag creates a recurring epistemic and political problem: the category remains materially real in its effects while becoming increasingly inadequate as a description.

The recursive architecture of Sections 4.10 and 4.11 is visible here. A category becomes symbolized and institutionalized; institutions then act through the category; those actions reshape subjects, resources, and opportunities; the altered relations generate new manifestations; and subsequent representations may either reinforce or challenge the category. Historical materiality therefore includes the accumulated consequences of prior classifications. Categories carry histories not only because their meanings change, but because earlier meanings leave infrastructures and distributions behind.

4.18.4 Historical Transformation of Subject and Object Categories

The distinction between subject and object is itself historically articulated within economic systems. GR does not imply that every subject is reducible to a role or that every object is created by institutions. It does, however, treat practical subjecthood and objecthood as potentially relationally stabilized. Section 4.12 already distinguished ontological subjecthood, relationally effective subjecthood, manifestational subject-

hood, and institutionally represented subjecthood. Historical materiality adds that the conditions under which particular forms of subjecthood become economically operative can change.

The wage worker, consumer, shareholder, debtor, insured person, welfare recipient, platform user, data subject, content creator, contractor, and machine operator are not simply different names for a timeless economic individual. Each role selects different relations, rights, obligations, capacities, vulnerabilities, and forms of representation. A person can occupy several of these positions simultaneously, and the same person can move among them over time. Historical change can create new subject positions or reorganize the causal importance of old ones.

Classifications of persons can also be recursive. Hacking's analysis of interactive kinds is especially relevant where classifications enter institutions and self-understanding, although GR does not assume that every economic category behaves in this way (Hacking 2002). A credit category can alter borrowing opportunities and future financial behavior. An employment category can alter legal protection and bargaining position. A professional credential can alter access to institutions and the subject's own expected trajectory. A platform reputation score can mediate visibility and opportunity. In each case a representation of the subject becomes part of the relational system through which later subjecthood is produced.

Objects undergo analogous transformations. Land can be a lived environment, territory, ecological system, taxable parcel, commodity, collateral, commons, sacred site, or development asset under different relational configurations. Data can be treated as record, evidence, asset, input, personal information, property-like resource, public infrastructure, or object of governance. A digital account can become an access credential, payment instrument, identity proxy, contractual interface, or bundle of institutional claims. The physical or informational substrate can remain partly similar while the relational object changes because different institutions and practices stabilize different causal roles.

Claim 4.166 (Historical transformation of economic objecthood)**.** *An economic object's relational reality can transform when the relations that stabilize its boundaries, capacities, rights, uses, or causal roles change, even where some underlying material substrate remains continuous.*

Claim 4.166 helps avoid two extremes. One would assume that the stable material substrate fixes the economic object once and for all. The other would imply that a change of description alone creates a new object. GR instead asks whether the change in relations is sufficient to alter persistence, causal capacities, recognized boundaries, or the possibilities generated by the object. Reclassification matters most when it becomes embedded in relations that materially change what can happen next.

Subject and object categories can also exchange analytical roles. A firm can be a subject in a market model and an object of regulation. A worker can be an agent in a labor-supply model and an object of algorithmic classification. An algorithm can be treated as an object owned by a firm, a process embedded in organizational decision making, or an operational subject when it performs sustained actions within authorized interfaces. These shifts do not by themselves settle metaphysical subjecthood. They show that the subject/object distinction used in economic inquiry is partly task-

and relation-dependent, and that historical changes can make previously marginal orientations practically important.

This point becomes particularly significant under automation and AI. A system can manifest outputs associated with human economic agency while remaining embedded in ownership, infrastructural dependence, governance, and technical realization that differ substantially from human subjecthood. GRE therefore needs categories capable of recognizing artificial operational agency without inferring experiential, moral, juridical, or ontological equivalence from functional similarity. The historical emergence of such systems makes the inadequacy of a simple human-agent/tool dichotomy increasingly visible, but the appropriate replacement categories remain open to empirical and normative development.

4.18.5 Ontological Categories as Historically Revisable

If ontological categories possess historical materiality, they must also be revisable. Revisability, however, should not be confused with conceptual voluntarism. Analysts cannot simply redefine an inconvenient reality out of existence. A useful revision must respond to changes in causal organization, evidential access, institutional structure, explanatory purpose, or normative problem. Historical revisability is disciplined by the realities the categories are intended to track.

Definition 4.167 (Historical revisability of ontological categories)**.** The *historical revisability of an ontological category* is the requirement that its boundaries, criteria, and explanatory role remain open to modification when changes in relational organization, manifestation, evidence, institutional practice, or analytical purpose materially alter the adequacy of the category.

Several forms of revision are possible. A category can be subdivided when previously compressed differences become causally significant. Several categories can be joined for a particular higher-scale analysis when their differences cease to matter to the inquiry. A category can change its defining criteria. Its temporal or spatial scope can be narrowed. A formerly central category can become secondary while another becomes more salient. A category can also remain in use while its ontological interpretation becomes more restrained. Revisability therefore does not imply constant replacement; it includes refinement, rescaling, qualification, and explicit limitation.

Historical revisability is especially important where administrative and analytical categories have become infrastructures. Because institutional categories can shape the reality they classify, revision can change the object of inquiry as well as the representation of that object. Altering an employment classification can change rights and organizational incentives. Revising a monetary definition can change reported aggregates and policy interpretation. Changing a diagnostic or eligibility category can reorganize access to resources. The epistemic act of revision can thus become an intervention in relational reality.

This recursive possibility makes provenance important. Analysts should be able to ask when a category was introduced, through which institutions it became operative, what relations it compresses, which populations or objects it excludes, what technical or legal infrastructures depend on it, and how its meaning has changed. Historical ontology in this sense is not an antiquarian supplement to economic analysis. It is

part of understanding what present categories do.

Claim 4.168 (Discipline of historical revision)**.** *Revision of an ontological category is warranted when an alternative distinction preserves or improves causal, relational, manifestational, or evaluative adequacy for the inquiry, and when the reasons for altering the category can be traced to changes in evidence, organization, scale, purpose, or historically material conditions rather than to terminological preference alone.*

Claim 4.168 gives revisability a burden of argument. A new category should show what explanatory difference it makes. An old category should not be discarded merely because it is historically constituted; historical constitution is compatible with durable causal reality. Money, firms, legal persons, markets, and institutional roles can remain indispensable objects of analysis even when their forms are historically specific. Conversely, long use does not guarantee continuing adequacy. A category can be deeply institutionalized and still fail to represent emerging relations that have become causally significant.

The distinction between relational reality and normative validity is again essential. A historically stabilized category can be unjust, exclusionary, or misleading while remaining causally real. Its normative criticism does not erase its effects. Likewise, a normatively attractive category does not become relationally real merely because it would be desirable for institutions to recognize it. GRE must therefore be able to analyze categories that ought to change without pretending that they have already changed, and to analyze emergent categories without treating emergence as justification.

Historical materiality also places a limit on claims of universal ontology within economics. Categories that function well in one historical configuration may require translation elsewhere. “Household,” “property,” “employment,” “market,” or “firm” can refer to relationally different arrangements across institutional and cultural contexts. Comparative analysis therefore needs to establish which structural correspondences justify using a common category and which differences require separate treatment. Shared terminology should not silently produce equivalence.

At the same time, historical materiality does not eliminate the possibility of cross-historical abstraction. Some categories can be useful precisely because they capture recurring relational forms at a sufficiently general level. Exchange, constraint, dependency, production, reproduction, coordination, obligation, and causal efficacy can sometimes travel across contexts more readily than narrower institutional categories. The appropriate level of abstraction depends on the question. GR’s methodological primitives and the three-register architecture are intended to support this movement across levels without claiming that every concrete economic object has a timeless form.

The resulting position is a historically responsive ontology rather than either a fixed catalogue or unrestricted constructivism. Reality constrains categories; categories can mediate reality; institutions can stabilize categories; productive capacities can change what becomes materially possible and salient; and historical transformation can require new distinctions. Ontological suspension remains active throughout: the historical emergence of a relational object does not decide whether it possesses some stronger ontological status, while the absence of a final metaphysics does not

weaken the claim that historically formed objects and categories can be causally real.

This historical perspective prepares the next methodological step. If categories, scales, and even some objects of inquiry are historically conditioned, relational-generative analysis should be treated as a disciplined analytical expedient rather than as a declaration that all reality possesses one final relational form. Section 108 therefore turns from the historical materiality of categories to the methodological standing of relational-generative analysis itself: what it enables, when it is warranted, and where its use should remain provisional.

4.19 Methodological Standing of Relational-Generative Analysis

The preceding sections have developed an ontological architecture in which relational realities can emerge, persist, stabilize, and exercise causal efficacy; manifestations can disclose and transform those realities; representations can become operative within subsequent relations; categories can vary across scale and history; and formal languages can clarify selected structural features without exhausting the realities they represent. The role of the present section is to state the methodological consequence of that architecture for Generative Relational Theory (GR) and Generative Relational Economics (GRE). Its objective is to clarify the standing of relational-generative analysis as a disciplined analytical expedient: a way of selecting relations, histories, transformations, and downstream consequences for inquiry when those selections improve explanation, without converting the analytical selection into a universal metaphysical thesis. The discussion proceeds through relational selection, generative selection, methodological economy, ontological plurality, and the limits of relational-generative abstraction.

The term *expedient* is used here in a technical and non-pejorative sense. An analytical expedient is a constructed mode of access whose adequacy depends on the problem, scale, evidence, and explanatory purpose. Scientific and interpretive inquiry routinely proceed through such constructions: a boundary is drawn around a system, a variable is selected, a comparison class is defined, a temporal interval is chosen, a mechanism is isolated, or a representation is adopted because the resulting description makes some pattern or causal relation intelligible. The construction can be highly disciplined and empirically constrained while remaining different from a claim that reality possesses exactly the same boundaries or form independently of inquiry. (Fraassen 1980; Giere 2004)

Definition 4.169 (Relational-generative methodological expedient)**.** A *relational-generative methodological expedient* is an explicitly scoped analytical construction that represents an object, process, or domain through selected relations, generative histories, constraints, transformations, and downstream effects in order to improve explanation, comparison, interpretation, or intervention, while leaving stronger ontological claims open unless they receive independent warrant.

This definition preserves two commitments simultaneously. Relational-generative analysis can make substantive claims about causal organization, persistence, historical formation, and transformation. At the same time, the analytical grammar through

which these claims are organized remains answerable to the inquiry rather than automatically elevated into the final structure of reality. Relation and generativity therefore function as strong analytical commitments where they carry explanatory work and as revisable selections where another representation better addresses the problem.

This position extends the open ontological commitment established in Section 4.1. Ontological suspension concerns the strength of reality claims; methodological expedience concerns the form through which inquiry approaches those realities. The two disciplines reinforce one another. A researcher can take relations seriously enough to explain causal organization while suspending the stronger proposition that relations are metaphysically prior to every relatum. A researcher can analyze generative histories without assuming that every relevant property is best explained by tracing its production. GR therefore gains explanatory depth from relational and generative reasoning while retaining room for substance-oriented, process-oriented, phenomenological, institutional, formal, or domain-specific descriptions when those descriptions are locally adequate.

4.19.1 Relational Selection

Relational analysis begins by selecting relations as explanatory objects. This selection directs attention toward dependence, coupling, positioning, mediation, recognition, exchange, constraint, coordination, conflict, transmission, inheritance, and other structures through which the capacities or trajectories of an object depend partly on its situation within a wider configuration. The selection is especially useful where isolating an entity would conceal the mechanisms through which its apparent properties are produced or maintained.

A firm provides a familiar example. Treating the firm as a unit can be entirely appropriate for questions about aggregate output, accounting performance, or contractual liability. A relational analysis becomes useful when the inquiry concerns how the firm's capacities depend on employees, suppliers, legal rules, infrastructures, creditors, platforms, customers, data flows, ownership, organizational routines, and political conditions. The relational description does not abolish the firm as an entity. It changes the resolution of the inquiry so that some of the relations constituting or conditioning the entity become analytically explicit.

The same principle applies to subjects. Section 4.12 distinguished ontological, relationally effective, manifestational, and institutionally represented subjecthood. A relational analysis of a worker, consumer, debtor, citizen, researcher, or artificial operational subject asks which capacities are produced, recognized, constrained, or amplified through relations. Such analysis can reveal dependencies that are obscured when the subject is treated as a self-contained bearer of fixed preferences or capabilities. Yet the usefulness of the relational view does not require the stronger claim that the subject possesses no reality apart from relations. The analytical question is whether relational organization contributes materially to the phenomenon under investigation.

Claim 4.170 (Relational selection)**.** *A relational representation is methodologically warranted when differences in relations, positions, interfaces, or configurations make*

a material explanatory difference to the capacities, persistence, manifestation, or transformation of the object under study.

Claim 4.170 places a burden on relational vocabulary. Merely redescribing an entity with the word "relation" adds little. The analysis should identify which relations are relevant, how they are distinguished, what evidence supports their relevance, and what explanatory difference follows from including them. A relation can be direct or mediated, persistent or transient, symmetric or asymmetric, material or symbolic, institutional or interpersonal, observable or inferred. The selection should match the mechanism and scale of the inquiry.

Relational selection also involves boundary choice. Any empirical analysis includes some relations while treating others as background. A study of labor relations may foreground contract, supervision, wage dependence, household reproduction, or platform mediation while leaving distant ecological or geopolitical relations outside the immediate model. The excluded relations do not thereby become unreal. They remain outside the chosen analytical boundary unless evidence shows that they materially alter the phenomenon being explained. The adequacy of a relational analysis therefore depends partly on whether its boundary captures the relations that make a consequential difference to the local question.

This boundary discipline matters because an indefinitely expanded relational description can become analytically empty. Every object can be placed within an enormous history of material, biological, social, institutional, linguistic, and ecological relations. Inquiry requires selection. GR contributes by making the selection explicit and revisable rather than by demanding maximal relational inclusion. The relevant relation is the relation that carries explanatory, interpretive, evaluative, or intervention significance at the scale being studied.

The three-register architecture further constrains relational selection. An analyst should distinguish relations inferred from manifestations from the relational reality being inferred, and should identify where symbolic or institutional representations mediate the evidence. Section 4.9 showed that reverse inference from manifestation can remain underdetermined. Relational analysis therefore gains rigor when it states which relations are directly observed, which are institutionally recorded, which are reconstructed historically, and which are hypothesized as latent generative structures.

4.19.2 Generative Selection

Generative analysis introduces a second selection. It asks how a configuration produces, enables, constrains, stabilizes, transforms, or dissolves subsequent objects, capacities, relations, manifestations, meanings, and possibilities. The focus therefore extends beyond the description of a present relational structure toward the consequences and historical trajectories that the structure helps generate.

Generativity is particularly useful when an apparently static allocation has dynamic consequences. A distribution of income, ownership, educational access, computational capability, legal status, or institutional authority can alter what actors are later able to learn, build, negotiate, represent, preserve, or contest. The initial configuration may therefore matter not only because of what is distributed at one moment

but because it changes the field of later generation. GRE uses this perspective to investigate trajectories of capability, value, power, knowledge, institutional formation, and relational reproduction.

The generative perspective should remain scoped. Some questions are adequately answered by description, classification, or equilibrium comparison. Others require historical explanation of formation. Still others require causal analysis of what follows from a configuration. The value of generative analysis appears when downstream production or transformation is part of the substantive problem. It is therefore a methodological choice oriented toward a class of questions rather than a requirement that every analysis be converted into a genealogy of everything that preceded it.

Definition 4.171 (Generative relevance)**.** A relation, configuration, event, or representation has *generative relevance* for an inquiry when its presence, organization, persistence, or transformation contributes materially to the production, stabilization, modification, or suppression of later states, capacities, relations, manifestations, or possibilities that fall within the inquiry's explanatory scope.

Definition 4.171 connects generativity to causal and historical significance while preserving scale. A minor interaction may have generative relevance for a local relation and little relevance for a national institution. A legal classification may reorganize one market while leaving another largely unaffected. A technological infrastructure may generate new operational capacities without substantially altering some normative relations. The analyst therefore specifies the downstream object and timescale rather than treating generativity as an undifferentiated property.

Generative selection also introduces temporal asymmetry into analysis. A present structure can be understood partly through the trajectories it opens and closes. This does not imply deterministic prediction. Generative systems can contain contingency, feedback, path dependence, critical transitions, heterogeneous responses, and interactions with conditions outside the analytical boundary. The claim that a configuration generates possibilities is therefore compatible with multiple future trajectories. GRE's interest lies in how the configuration changes the distribution, accessibility, or organization of those possibilities.

This distinction is useful for intervention. A policy may improve a manifest outcome at one moment while weakening capacities required for later adaptation. Another intervention may have modest immediate effects while changing institutional relations that support later generation. A generative analysis brings these temporal consequences into view. It remains possible that another method captures the same phenomenon more efficiently; the methodological status of generativity therefore depends on the explanatory gain it provides for the problem at hand.

Generative analysis also requires attention to the history of the mechanisms it studies. Section 4.18 established that categories and causal organizations can themselves possess historical materiality. A generative mechanism observed in one institutional configuration may change when legal rules, productive capacities, classifications, infrastructures, or symbolic regimes change. The method therefore treats mechanisms as potentially historical objects rather than assuming invariant laws merely because a recurrent pattern has been identified.

4.19.3 Methodological Economy and Provisional Use

A useful analytical framework should explain enough while assuming only what the inquiry requires. Relational-generative analysis follows this principle of methodological economy. It introduces relations when relational organization changes the explanation, generativity when downstream formation matters, and stronger formal or ontological commitments only when they provide additional warranted explanatory value. This economy protects the framework from accumulating conceptual machinery that exceeds the question.

Proposition 4.172 (Local sufficiency of relational-generative analysis)**.** *For a specified inquiry, relational-generative analysis is locally sufficient when the selected relations, generative mechanisms, boundaries, scales, and temporal horizons support the explanatory or interpretive task without requiring stronger commitments whose addition would not materially improve the analysis.*

Proposition 4.172 parallels the principle of local ontological sufficiency developed earlier in the chapter. The aim is neither theoretical minimalism for its own sake nor maximal formal completeness. The aim is proportionality between the analytical apparatus and the problem. A study of institutional trust may need historical relations, symbolic mediation, and recursive feedback without requiring category theory. A study of manifestation mappings may benefit from category-theoretic language without requiring a field-theoretic model. A study of pricing dynamics may use quantitative causal models while leaving questions about ultimate social ontology suspended.

Provisional use follows from this proportionality. An analytical representation can be adopted because it works well for a defined purpose and later revised when the purpose, evidence, or system changes. Provisionality concerns the standing of the representation rather than the seriousness of the inquiry. A provisional model may support strong local findings when its assumptions and scope are explicit. Conversely, a model presented with metaphysical confidence can remain weak if its empirical or conceptual fit is poor.

This stance is particularly important for interdisciplinary work. GR draws on economics, political economy, sociology, philosophy, law, complex systems, computation, history, and other domains. Each discipline carries characteristic objects and methods. Methodological economy allows GRE to borrow a representation for a specified task without absorbing the entire ontology of the source discipline. A network can represent interaction structure; a dynamical system can represent temporal evolution; an institutional analysis can represent rule-bound organization; a phenomenological account can clarify manifestation; a historical reconstruction can establish path-dependent formation. Their local contributions can coexist even where their background assumptions differ.

Provisionality also protects cumulative research. A framework that requires every contribution to settle the full ontology of its objects would impose an unrealistic burden and discourage empirical work. Researchers can instead state the level of commitment required by their study. One contribution may establish that a classification has relational reality because it is persistent and causally efficacious. Another may investigate the manifestation mechanisms through which that classification becomes salient. A third may contest its normative legitimacy. A fourth may propose a

stronger ontology. The contributions can accumulate because the shared analytical distinctions remain clear even where metaphysical commitments differ.

Methodological economy therefore favors modularity. Claims about relational reality, manifestation, representation, value, subjecthood, scale, and historical category formation can be connected without requiring that every module be used in every study. GRE functions more effectively as a research programme when investigators can select the components required by the question while preserving compatibility with the larger architecture.

4.19.4 Relational Analysis and Ontological Plurality

Treating relation as an analytical choice also guards against relational reductionism. Relational reductionism would arise if a successful relational explanation were taken to establish that entities, properties, experiences, material structures, or domain-specific mechanisms possess no analytically independent significance. GR has no methodological need for that extension. An entity can be relationally constituted in some respects and still require description at the level of its internal organization. A process can depend on relations while retaining material constraints that are poorly represented through relational vocabulary alone. A manifestation can be relationally generated while possessing phenomenological features that require another mode of access.

The three-register architecture itself supports this plurality. Ontological reality exceeds what any one manifestation or representation captures. Relational reality identifies one criterion of causal reality within generative-relational systems. Manifestational reality identifies conditions of availability. These distinctions already imply that one analytical vocabulary is unlikely to exhaust every relevant question. Relational-generative analysis therefore operates within an ontology that permits plural modes of access.

Caution 4.173 (Relational reductionism)*.* Relational reductionism occurs when explanatory success at the level of relations is extended into the unsupported conclusion that other analytically relevant structures, properties, experiences, or domain-specific mechanisms can be fully replaced by relational description.

Caution 4.173 is distinct from the ontological inflation identified in Section 4.1. Ontological inflation concerns movement from analytical success to stronger reality claims. Relational reductionism concerns compression of heterogeneous explanatory objects into one preferred vocabulary. The two can occur together, but each requires separate discipline.

Consider monetary reality. A relational analysis can explain how legal recognition, expectations, accounting, payment infrastructures, state capacities, and exchange practices stabilize money. This does not make the material and technical properties of payment systems irrelevant. A banknote has physical constraints; a digital payment system depends on hardware, energy, code, security, and communication infrastructure; monetary policy operates through institutionally specific mechanisms. Relational explanation is strongest when it articulates these components rather than translating them into an abstract relation that loses their causal specificity.

The same applies to subjectivity. The relational reality of a continuing sense of self can be analyzed through memory, recognition, bodily continuity, narrative, institutional identity, and interaction. Such analysis leaves room for psychological, neurological, phenomenological, and philosophical accounts that address different dimensions of the same subject. Relational analysis can identify coupling among these dimensions without claiming jurisdiction over every question they raise.

Ontological plurality also preserves the possibility of domain-specific primitives. Physics, biology, law, economics, and phenomenology may require different operational distinctions. GR can investigate relations across those domains while allowing each to retain objects that are locally indispensable. Cross-domain translation therefore becomes an empirical and conceptual task. Similar relational patterns can support analogy without implying that the underlying objects are of the same ontological kind.

This position is consistent with the non-necessary comparability established in Section 4.5. Two relationally real objects can remain structurally incommensurable. A methodological commitment to relation does not create a common metric merely because both objects are represented relationally. The analyst must establish the mapping, equivalence criterion, or comparison space independently. Relational vocabulary supplies a grammar for asking about correspondence; it does not guarantee correspondence.

4.19.5 Limits of Relational-Generative Abstraction

The final methodological task is to identify where relational-generative abstraction loses information or explanatory traction. Every abstraction suppresses detail. The relevant question is whether what has been suppressed matters to the inquiry. GR therefore treats limitations as part of the specification of an analysis rather than as an external objection added after the model is complete.

Several limits recur. First, relation selection can omit materially consequential internal structure. A network representation may capture who interacts with whom while missing the content, temporality, embodiment, or institutional meaning of the interaction. Second, generative analysis can become overly expansive if every remote historical antecedent is treated as part of the mechanism. Third, system boundaries can hide external dependencies that later prove causally important. Fourth, manifestation data can underdetermine the relational structure from which they arose. Fifth, symbolic representations can impose commensuration on realities whose differences matter. Sixth, scale selection can stabilize an entity that dissolves when examined at another resolution. These are not reasons to abandon relational-generative analysis; they are conditions under which its claims require qualification or supplementation.

Definition 4.174 (Abstraction boundary)**.** An *abstraction boundary* specifies the relations, internal structures, scales, timescales, manifestations, and contextual conditions that an analysis treats as outside its active explanatory representation while recognizing that some excluded elements may remain real and potentially causally relevant.

Definition 4.174 gives methodological exclusion a positive form. An analysis can

say what it brackets. A model of market transactions may bracket household care relations; a study of household reproduction may bracket global financial structure; a formal manifestation mapping may bracket embodied phenomenology; an institutional analysis may bracket molecular mechanisms. The boundary becomes problematic when excluded elements materially change the results while remaining unacknowledged. Explicit abstraction boundaries make such revision easier.

A second limit concerns normative inference. Generative success, relational stability, persistence, and causal efficacy remain descriptive or explanatory properties until a normative argument is supplied. A highly stable institution can generate severe exclusion. A powerful symbolic regime can coordinate activity while distorting recognition. A generative process can expand one form of value while destroying another. GRE therefore keeps evaluative judgment distinct from the fact that a system reproduces itself effectively.

A third limit concerns epistemic access. Relational-generative models often infer structures from traces, outcomes, records, classifications, or manifestations. Sections 4.8 and 4.9 established that manifestation mappings can be relationally real and still non-invertible. An analytically elegant relational structure can therefore remain underdetermined by available evidence. Methodological expedience does not license filling this gap with preferred theory. The model should mark where inference depends on assumptions, priors, idealizations, or inaccessible historical conditions.

A fourth limit concerns performativity and recursion. Once a relational-generative representation enters institutions, it can begin to alter the reality it describes. A risk model can change lending; a labor classification can change rights and incentives; a measure of productivity can reorganize work; a theory of markets can influence market design. The analytical expedient can therefore become a manifestational or relational object within the system. Reflexive monitoring is required when representation changes the generative field.

Claim 4.175 (Revisability of abstraction)**.** *A relational-generative abstraction should be revised, supplemented, or replaced when excluded structures, alternative scales, changing historical conditions, new manifestations, or competing representations materially alter the explanatory conclusions for which the abstraction was adopted.*

Claim 4.175 gives methodological pluralism an operational criterion. The question is not whether relational-generative analysis is universally correct. The question is whether it remains adequate for the inquiry and whether another representation captures consequential structure that it omits. Revision can deepen the relational model, combine it with another method, change scale, alter boundaries, or suspend the relational-generative representation altogether for a particular task.

The resulting methodological position is therefore strong without being exclusive. GR and GRE use relations to investigate dependence, organization, mediation, and position; they use generativity to investigate emergence, reproduction, transformation, and future possibility. These selections support substantive claims when the relevant structures are evidenced and causally consequential. Their success does not require a final declaration that reality consists only of relations or that every phenomenon is best understood through its generative history. Relational-generative analysis earns its place through explanatory performance, explicit scope, and capacity for revision.

Section 108 thus clarifies the methodological standing of the framework developed throughout Chapter 4. Relation and generativity function as disciplined analytical selections; ontological suspension preserves room for stronger or alternative ontologies; methodological economy limits conceptual machinery to what the question requires; and explicit abstraction boundaries make the costs of simplification visible. The next section develops the positive implication of this position by examining compatibility with alternative ontological commitments, including substance-oriented, process-oriented, relation-oriented, and domain-specific ontologies.

4.20 Compatibility with Alternative Ontological Commitments

The ontological architecture developed in Chapter 4 is intended to support substantive inquiry without requiring every investigation to adopt one comprehensive metaphysical doctrine. The role of the present section is to specify how Generative Relational Theory (GR) and Generative Relational Economics (GRE) can remain compatible with alternative ontological commitments while preserving the analytical distinctions already established among ontological reality, relational reality, manifestational reality, representation, scale, and historical emergence. Its objective is to replace a vague appeal to pluralism with explicit conditions of compatibility. The discussion proceeds through ontological pluralism, substance-oriented, process-oriented, relation-oriented, and domain-specific ontologies, followed by criteria for translation, coexistence, and operative disagreement.

Compatibility in this context is weaker than identity and stronger than mere tolerance. Two ontological frameworks can be compatible for a specified inquiry when their commitments can coexist without contradiction at the level required by that inquiry, when their vocabularies can be related through an explicit translation or division of explanatory labor, or when disagreement concerning stronger claims remains non-operative for the local analysis. Compatibility can therefore be partial, asymmetric, scale-dependent, or question-dependent. A framework may be compatible with GR for one class of claims while conflicting with it for another. (Whitehead 1929; Quine 1948; Archer 1995)

Definition 4.176 (Local ontological compatibility)**.** Two ontological commitments are *locally compatible* with respect to a specified inquiry when their jointly retained claims do not generate an operative contradiction for the objects, scales, causal relations, manifestations, or explanatory tasks under study, and when any translation between their terms is stated at the level actually warranted.

Definition 4.176 places scope at the center of compatibility. It avoids treating ontological frameworks as packages that must be accepted or rejected in their entirety. A substance-oriented account may provide a useful specification of relatively enduring entities while a process-oriented account explains their transformation. A relation-oriented account may clarify dependence among those entities while a legal ontology specifies institutionally recognized persons, offices, rights, and obligations. The resulting analysis can be coherent when the commitments are assigned clear roles and when a local translation does not silently become a claim of universal equivalence.

This position extends the methodological standing established in Section 4.19. Relational-generative analysis earns its place through explanatory performance, explicit scope, and revisability. Compatibility with alternative ontologies follows from the same discipline. GR can use an ontology strongly where its commitments matter and suspend stronger disputes where they do not. Such suspension preserves disagreement rather than dissolving it. A physicalist, phenomenological, processual, institutional, or relation-oriented account can therefore remain distinct even when each contributes to a shared analysis.

4.20.1 Ontological Pluralism

Ontological pluralism, as used here, concerns the possibility that different domains, scales, questions, or modes of access require different ontological vocabularies. It does not entail that every ontology is equally adequate, that contradictions are harmless, or that reality changes freely with description. Pluralism instead recognizes that an inquiry can encounter heterogeneous kinds of object and that one vocabulary may illuminate some structures while obscuring others.

The three-register architecture already creates a disciplined form of plurality. Ontological reality concerns what obtains independently of a particular manifestation; relational reality concerns what emerges, persists with sufficient stability, and exercises causal efficacy within a generative-relational system; manifestational reality concerns what becomes available under a specified manifestational configuration. These distinctions do not determine whether the ultimate constituents of a domain are substances, processes, relations, fields, events, organisms, informational structures, or something else. They organize questions that can be posed across several such commitments.

Pluralism also appears across scale. Section 4.17 showed that a configuration can be represented as an entity at one scale and as a distributed process or relation at another. The availability of both descriptions does not imply that each is equally useful for every task. A corporation may be treated as a juridical entity for contract and liability, as an organizational process for internal coordination, as a network for supply-chain dependence, and as a historical institution for long-run transformation. Each view can identify real features while selecting a different resolution.

Claim 4.177 (Plurality with constraint)**.** *Ontological plurality is analytically productive when each adopted vocabulary identifies a specified object or scale, preserves the causal and evidential constraints relevant to that object, and exposes rather than conceals the points at which translation across vocabularies becomes uncertain or fails.*

Claim 4.177 makes pluralism answerable to evidence and explanation. A plurality of models does not provide a license to move opportunistically among incompatible claims. Where two ontologies produce different causal expectations, different identity criteria, or different accounts of persistence, the disagreement becomes operative and should be investigated. Where they differ only in stronger metaphysical commitments that do not change the local analysis, ontological suspension can preserve both possibilities.

This approach also guards against premature synthesis. A translation between two ontologies can be useful without establishing that they refer to the same structure

in the same way. The category-theoretic language introduced in Section 4.16 offers one formal illustration: a mapping can preserve selected structures while leaving other structures unmapped. Ontological comparison should be treated similarly. The analyst should identify what is preserved, what changes, and what remains outside the translation.

4.20.2 Substance-Oriented Ontologies

Substance-oriented ontologies give analytical priority to entities that possess some degree of persistence, identity, or bearer-like continuity across change. GR can accommodate such entities when their identification is empirically or conceptually useful. Relational-generative analysis does not require every object to dissolve into relations. It asks whether the capacities, persistence, or transformation of the object depend materially on relations and generative histories.

This compatibility is especially important in economics. Persons, firms, assets, commodities, contracts, infrastructures, and states are frequently treated as units with relatively stable identities. Many economic questions require precisely such units. Accounting, ownership, liability, inventory, demographic measurement, and contractual analysis become difficult when every entity is redescribed at every moment as a fully decomposed relational configuration. A substance-oriented representation can therefore provide an appropriate local ontology for a specified task.

GR adds two questions to that representation. First, what supports the persistence and identity criteria by which the entity remains identifiable? Second, which capacities attributed to the entity are generated or transformed through relations? These questions can deepen a substance-oriented analysis without invalidating the entity. A firm can remain a firm while its productive capacity depends on labor, law, finance, technology, suppliers, and customers. A person can remain an embodied individual while economic agency depends partly on education, recognition, legal status, infrastructure, and social reproduction.

Remark 4.178 (Entity persistence and relational constitution). A relatively enduring entity can be treated as an analytical bearer of properties while some of those properties, capacities, or identity conditions are explained relationally. Compatibility therefore depends on distinguishing the persistence of the entity from the provenance of every feature attributed to it.

This distinction prevents two opposite reductions. Entity-centered analysis can become insufficient when it treats relationally generated capacities as intrinsic and history-free. Relational analysis can become insufficient when it treats the identification of entities as analytically dispensable even where persistent units carry causal, legal, biological, or institutional significance. Local compatibility permits the two descriptions to coexist when their scopes are explicit.

A stronger metaphysical substance doctrine may eventually conflict with a stronger metaphysical relational doctrine. GR need not resolve that conflict in advance. Under ontological suspension, the operative question is whether the dispute changes the causal, historical, or manifestational claims required by the inquiry. If it does, the disagreement should be made explicit. If it does not, the analysis can proceed while preserving the stronger disagreement for another level of inquiry.

4.20.3 Process-Oriented Ontologies

Process-oriented ontologies emphasize becoming, transformation, activity, event, and temporal organization. Section 4.15 already established that GR can treat processes and events as analytically primary where extended transformation carries the explanatory burden. This orientation is highly compatible with generative analysis because generativity concerns how configurations produce, reproduce, transform, and dissolve subsequent configurations over time.

Compatibility nevertheless requires precision. A generative account need not claim that process is metaphysically prior to every object. An entity can be analyzed through the processes that sustain it while retaining an entity-level identity for other purposes. Dynamic persistence provides one bridge. A phenomenon can remain sufficiently stable to count as a relationally real object even when its stability depends on ongoing processes of maintenance, repair, reproduction, recognition, or exchange.

Economic institutions illustrate this point. Money, organizations, markets, property arrangements, and occupational categories persist through repeated practices, legal acts, accounting routines, infrastructural operations, and expectations. Their persistence can therefore be processually sustained. A process-oriented view helps explain how stability is achieved rather than treating stability as a primitive fact. GR can adopt that explanation while continuing to refer to money, organizations, or institutions as relationally real objects at the scale where their causal efficacy is coherent.

Process orientation also supports the historical dimension of GRE. Generative consequences may unfold across multiple timescales, and later relations can incorporate the products of earlier processes. The recursive architecture of Section 4.11 becomes especially useful here: manifestations and representations can enter subsequent processes and alter the conditions of later emergence. Historical becoming is therefore compatible with temporary stabilization.

Claim 4.179 (Process-compatible persistence)**.** *The persistence required for relational reality is compatible with process-oriented ontology when stability is produced through sufficiently continuous or recurrent processes that preserve an object's causal efficacy over the relevant spacetime interval.*

Claim 4.179 avoids equating persistence with immobility. It also preserves the strict relational-reality criterion. A transient process can be manifestationally real without yet constituting a persistent relational object; a recurrent or self-maintaining process may itself satisfy the persistence, stability, and causal-efficacy conditions required for relational reality. The relevant analytical unit can therefore be an enduring object, an organized process, or a coupled object-process description.

4.20.4 Relation-Oriented Ontologies

Relation-oriented ontologies assign strong explanatory or metaphysical significance to relations, relational positions, or structures of dependence. GR has an obvious affinity with this family of views because relational emergence is central to its analytical vocabulary. The affinity remains deliberately limited by ontological suspension. Relational analysis can be indispensable without establishing that relations are uni-

versally prior to relata or that every domain is exhaustively relational.

A relation-oriented ontology becomes especially useful where objects acquire capacities through position, coupling, recognition, dependence, or interaction. Trust, authority, institutional office, market access, indebtedness, legal standing, and organizational role provide examples in which the relevant reality cannot be adequately specified through isolated intrinsic properties alone. The relational configuration contributes directly to what the object can do and to how it affects subsequent processes.

GR's definition of relational reality, however, is more selective than a general declaration that everything is relational. An object becomes relationally real when it emerges within a generative-relational system, persists with sufficient stability over a relevant region or interval of spacetime, and exercises causal efficacy within that system. The criterion therefore identifies a mode of reality within a system rather than asserting a complete metaphysical inventory of the world.

This selectivity allows GR to remain compatible with weaker and stronger relation-oriented ontologies. A weak relational ontology may claim that some properties are essentially relational. A stronger version may treat relations as ontologically fundamental. GR can work with either where the local analysis concerns structures both frameworks recognize. The stronger dispute can remain suspended until it becomes operative.

The distinction between relational reality and manifestational reality is also important here. A relation can be causally operative before a subject perceives or symbolizes it. Conversely, manifestations and symbols can enter the relation and reshape it. Relation-oriented ontology therefore gains a historical and recursive dimension without requiring manifestation to constitute all relational reality. The graph architecture among the registers remains available under several strengths of relational metaphysical commitment.

4.20.5 Domain-Specific Ontologies

Many inquiries rely on ontologies whose terms are specific to a domain. Law distinguishes persons, offices, rights, duties, jurisdictions, instruments, procedures, and recognized acts. Economics distinguishes assets, liabilities, commodities, firms, households, prices, contracts, and forms of capital. Biology, psychology, computation, ecology, and engineering each employ their own objects and identity criteria. These domain ontologies can carry substantial explanatory and practical force even when their relations to ultimate ontology remain unsettled.

GRE therefore requires a disciplined interface between domain-specific ontology and GR's broader analytical architecture. Domain terms should retain the distinctions that make them operationally meaningful. A legal person should not be translated automatically into a network node; a price should not be reduced automatically to a symbol; a corporation should not be reduced automatically to a set of interpersonal relations; an artificial operational subject should not be assumed to share the ontology of a human subject because both can occupy similar economic interfaces.

The three-register architecture can organize these domain terms without replacing

them. A legal status can be analyzed as relationally real when institutional relations stabilize it and it causally affects what actors can do. Its certificates, registry entries, judgments, and identifiers belong to manifestational and representational processes. Questions about the ultimate ontology of personhood, normativity, or institutional facts can remain open where the economic analysis does not require their resolution.

Domain-specific ontologies also matter for intervention. Institutions act through operational categories. Tax systems, courts, firms, welfare agencies, payment networks, and computational platforms require classifications that determine eligibility, ownership, responsibility, access, or transfer. Such categories can become relationally real because they structure subsequent action. Their practical necessity does not guarantee epistemic adequacy or normative legitimacy. GRE can therefore study the generative effects of domain categories while keeping their truth, justice, and ontological fundamentality distinct.

Definition 4.180 (Domain-ontology interface)**.** A *domain-ontology interface* is an explicit mapping between a domain's operational objects and GR's analytical distinctions that preserves the domain-specific identity conditions required for the inquiry while identifying where relational emergence, manifestation, representation, scale, or historical transformation materially affect those objects.

Definition 4.180 treats translation as selective. The objective is to preserve enough structure for cross-domain inquiry without erasing what makes the source domain distinctive. Some translations may be close; others may preserve only a few relations; still others may fail because the relevant objects lack a warranted common comparison space. The non-necessary comparability developed earlier in the chapter therefore applies equally to ontological vocabularies.

4.20.6 Conditions of Compatibility

The compatibility developed in this section can be summarized through a set of conditions. These conditions are methodological criteria for joint use rather than axioms of a final ontology. They specify when alternative commitments can enter a GR or GRE analysis without conceptual collapse.

First, the object and scale of each ontology should be explicit. A vocabulary suited to embodied persons may operate differently from one suited to organizations, legal offices, or computational agents. Second, identity and persistence criteria should be stated where they matter. What counts as the same firm, subject, institution, process, or relation can vary across domains and scales. Third, causal claims should remain attached to the mechanisms recognized by the relevant ontology rather than being translated into a generic relational idiom that loses mechanism-specific content.

Fourth, mappings across ontologies should specify what they preserve. A translation may preserve causal ordering, functional role, legal status, manifestational form, organizational position, or selected relational structure while losing other dimensions. Fifth, residual structure should remain visible. A successful local correspondence does not imply global equivalence. Sixth, stronger disagreements should be classified by whether they are operative for the inquiry. Ontological suspension is appropriate where disagreement does not alter the retained claims; explicit adjudication becomes necessary where competing commitments generate different expec-

tations, identity conditions, or interventions.

Claim 4.181 (Compatibility discipline)**.** *Alternative ontological commitments can be jointly used within GR or GRE when their scopes, identity criteria, causal roles, translation rules, and residual disagreements are explicit, and when stronger metaphysical disagreements are suspended only to the extent that they remain non-operative for the inquiry.*

Claim 4.181 makes compatibility an active analytical task. It requires more than placing several vocabularies side by side. The analyst must specify how they interact and where they diverge. This requirement is especially important in interdisciplinary research, where the same term can carry different identity criteria across law, economics, computation, psychology, or political theory.

Compatibility also has temporal conditions. An ontology that is locally adequate at one historical stage may become less adequate when new entities, infrastructures, practices, or manifestations emerge. Section 4.18 showed that ontological categories can possess historical materiality. The compatibility relation among ontologies can therefore change as well. A distinction that once aligned across institutional and technical domains may later fracture; new interfaces can create forms of subjecthood or organization that require revised mappings.

A final condition concerns normativity. Ontological compatibility does not settle normative compatibility. Two frameworks may describe the same institution coherently while supporting different judgments about legitimacy, justice, welfare, or responsibility. GRE should preserve that distinction. The ontological question concerns what kinds of objects and relations the analysis recognizes and how they persist or act. Normative evaluation requires additional premises and arguments.

The resulting position is a constrained ontological pluralism. GR offers a common analytical architecture for distinguishing ontological, relational, and manifestational reality; tracing generative histories; identifying causal efficacy; and examining recursive mediation. That architecture can interface with substance-oriented, process-oriented, relation-oriented, and domain-specific ontologies without treating them as interchangeable. Compatibility is earned locally through explicit scope, preservation of relevant structure, and disciplined treatment of residual disagreement.

Section 109 therefore extends ontological suspension into a positive method of interdisciplinary coexistence. Alternative ontologies can contribute different resolutions of the same domain, or address different domains altogether, while GR provides a vocabulary for asking how those resolutions connect, where they fail to connect, and when their disagreements become causally or analytically operative. The next section narrows the chapter's claims by specifying the limits of GRE's ontological commitments and the kinds of metaphysical, empirical, and normative conclusions that the present architecture does not by itself establish.

4.21 Limits of GRE Ontological Claims

The ontological architecture developed in this chapter makes substantive claims about emergence, persistence, stability, causal efficacy, manifestation, representation, scale, and historical transformation. Its usefulness depends equally on

specifying the claims that do not follow from those commitments. The role of the present section is therefore to establish the boundary of GRE's ontological claims before the chapter turns from reality to knowledge. Its objective is not to weaken the three-register architecture, but to distinguish what the architecture warrants from stronger conclusions that require additional metaphysical, empirical, epistemic, or normative argument. The discussion proceeds through the boundary of established claims, ontological underdetermination, the limits of formal ontology, limits of cross-domain generalization, and openness to ontological revision.

A theory can become less precise when the scope of its strongest concepts expands faster than the evidence supporting them. This risk is particularly important for a framework that uses terms such as *reality*, *emergence*, *causal efficacy*, and *subjecthood*. GRE therefore treats explicit limitation as part of ontological discipline. A claim that money, an institution, a self-model, a form of trust, or another object is relationally real says something substantive: the object has emerged within a generative-relational system, persists with sufficient stability over a relevant spacetime region or interval, and exercises causal efficacy within that system. The claim does not by itself determine the object's ultimate ontological constitution. Similar restraint applies to manifestational reality, symbolic representation, formal modeling, and cross-scale analysis. (Fraassen 1980; Giere 2004; Longino 1990)

Definition 4.182 (Ontological claim boundary)**.** An *ontological claim boundary* is the explicitly stated limit separating the commitments warranted by a GR or GRE analysis from stronger claims concerning ultimate constitution, exhaustive classification, universal applicability, epistemic truth, or normative validity that require additional argument.

Definition 4.182 makes limitation internal to the method rather than an afterthought. A strong local claim can coexist with restraint concerning stronger questions. GRE can, for example, assert the causal reality of a monetary institution while suspending the question of whether institutional reality is reducible to physical, psychological, informational, legal, or other structures. It can analyze the relational reality of an experienced continuity of self without claiming to have settled the ontology of consciousness. It can treat a religiously mediated object as relationally real within a system when the persistence, stability, and causal-efficacy conditions are satisfied without inferring from that relational reality either the independent ontological existence or non-existence of the object in question.

This distinction is also important for the architecture of the three registers. Ontological reality, relational reality, and manifestational reality organize different questions. They are not asserted to be an exhaustive partition of everything that can exist, nor are they three substances from which reality is composed. Their graph-like relations are likewise analytical commitments rather than a universal causal diagram imposed on every domain. The framework earns explanatory force by preserving these distinctions while allowing their concrete realization to remain open.

4.21.1 Boundary of Established Claims

The first limit concerns what the chapter has actually established. The three-register architecture distinguishes ontological, relational, and manifestational questions; it

specifies a strict criterion for relational reality; it treats manifestation as condition-dependent and potentially recursive; and it allows representations, mappings, institutions, categories, and subjects to become causally operative within generative-relational systems. These commitments provide a disciplined ontology for GRE inquiry. They leave several stronger questions unresolved.

GRE does not establish that relation is the fundamental substance of reality. Relational-generative analysis can be indispensable for a specified economic object while stronger metaphysical questions remain suspended. Section 4.19 therefore treated relational-generative analysis as a scoped methodological commitment, and Section 4.20 showed how this commitment can coexist locally with substance-oriented, process-oriented, relation-oriented, and domain-specific ontologies. The explanatory importance of relations does not by itself establish their metaphysical priority.

The chapter also does not establish that every persistent pattern is relationally real. Persistence and stability are necessary components of the criterion developed in Section 4.5, but causal efficacy within the relevant generative-relational system remains essential. A regularity that merely recurs in an analyst's description may lack the causal participation required for relational reality. Conversely, a relational reality can be dynamically maintained rather than static. Stability concerns maintained organization over an inquiry-relevant region or interval, not immobility.

Causal efficacy does not establish epistemic truth. Section 4.10 showed that representations can become relationally real through their consequences even when they are partial, inaccurate, or false concerning their targets. A classification can alter eligibility, a mistaken belief can reorganize conduct, and an inaccurate metric can redirect resources. Their effects are real without making their representational content true. The same distinction applies to manifestational salience: what becomes strongly visible or institutionally legible need not provide an exhaustive or privileged disclosure of the underlying relational configuration.

Causal efficacy also does not establish normative validity. Money, legal categories, institutional hierarchies, identities, classifications, and value regimes can become highly stable and causally powerful while remaining ethically contested or unjust. Persistence can indicate successful reproduction rather than justification. The ontology developed here therefore supplies objects for normative analysis but does not convert historical survival, institutional recognition, or generative power into moral endorsement.

Nor does relational reality require prior perception, awareness, or symbolization. This point creates a limit in the opposite direction: the absence of manifestation to a particular subject does not justify the conclusion that no relationally real structure exists. Contingency provides an important example. A historical-generative configuration through which a contingent encounter becomes possible can already be relationally organized before that contingency is consciously recognized, aesthetically judged, or symbolically articulated. The later manifestation may reveal, select, amplify, or transform part of that structure without creating the entire relational reality at the moment of perception.

Claim 4.183 (Non-entailment discipline)**.** *Within GRE, persistence does not by itself*

entail relational reality; relational reality does not entail ontological fundamentality; manifestation does not entail exhaustive disclosure; causal efficacy does not entail epistemic truth; and historical stabilization does not entail normative validity.

Claim 4.183 is a compact statement of the chapter's claim boundary. Its purpose is not skeptical. Each term remains capable of supporting strong conclusions within its appropriate domain. The discipline lies in resisting movement from one kind of warranted claim to another without an explicit bridge.

The same restraint applies to comparison. Two objects can both satisfy the criterion for relational reality without occupying a common metric space, a common ordering, or even a justified common comparison domain. The hallucinatory flower discussed earlier and an ordinarily perceived physical flower may each be relationally real in relevant systems while differing radically in generative structure. Shared reality-status therefore establishes neither structural similarity nor commensurability. Any comparison must specify what relation, mapping, invariant, or practical criterion makes the comparison meaningful.

4.21.2 Ontological Underdetermination

The second limit arises because the evidence available to an inquiry may support several ontological interpretations. The non-invertibility of manifestation developed in Section 4.9 provides one route to this result. Different relational configurations can generate similar manifestations, while similar relational configurations can manifest differently under changing conditions. Even when an observed pattern is robust, reconstruction from manifestation toward underlying organization can remain underdetermined.

Ontological underdetermination is broader than manifestational non-invertibility. The same relationally effective organization can sometimes be described through different ontological vocabularies. A firm can be modeled as a juridical entity, an organizational process, a contractually structured nexus, a network of dependencies, or a historically reproduced institution. These descriptions need not be equivalent, and each can reveal structures hidden by the others. Yet available evidence may fail to determine which vocabulary, if any, captures the ultimate constitution of the object.

Definition 4.184 (Ontological underdetermination)**.** *Ontological underdetermination* obtains when the evidence, causal regularities, manifestations, and successful explanatory relations available within a specified inquiry remain compatible with more than one materially distinct ontological interpretation.

Definition 4.184 is inquiry-relative. Additional evidence, a different scale, a new intervention, or a stronger explanatory demand can reduce underdetermination. The concept therefore differs from a permanent declaration that ontological questions are undecidable. It identifies a present relation between evidence and claim strength.

Underdetermination is especially relevant to the examples that motivate ontological suspension. Consider the continuity of the experienced "I." GRE can investigate how bodily continuity, memory, recognition, narrative, institutional identity, and repeated action participate in stabilizing a relationally real self. Such analysis can explain important causal consequences of selfhood while several ontologies of con-

sciousness and personal identity remain compatible with the retained evidence. The relational analysis is not empty because the metaphysical question remains open; neither does explanatory success in the relational domain settle that question automatically.

A similar point applies to money. Monetary reality can be studied through institutional authority, legal designation, accounting systems, expectations, payment infrastructures, conventions, and material tokens. These relations can sustain an object with substantial persistence and causal efficacy. Several ontological interpretations of institutional facts can nevertheless remain available. GRE needs to resolve among them only when their differences become operative for the economic question under study.

Underdetermination also explains why the ontological register cannot be identified with whatever remains after relational and manifestational analysis. Ontological reality is not a residual box containing an unknown substrate. It names the question of what obtains beyond the commitments licensed by a particular manifestation or relational model. In some inquiries, stronger ontological claims can be justified; in others, suspension remains the more disciplined position.

Claim 4.185 (Strength calibration under underdetermination)**.** *When materially distinct ontological interpretations remain compatible with the evidence and explanatory relations available to an inquiry, GRE should calibrate its claims to the structure jointly supported by those interpretations unless the stronger disagreement becomes operative for explanation, prediction, intervention, or evaluation.*

Claim 4.185 preserves both explanatory ambition and metaphysical restraint. It permits the analysis to advance where common structure is well supported while keeping stronger disagreements visible for later investigation.

4.21.3 Limits of Formal Ontology

Formal languages can sharpen ontological reasoning by making identity criteria, mappings, compositional rules, invariants, state spaces, constraints, and transformation structures explicit. This chapter has used such resources selectively, including dynamical language, mapping notation, scale-relative descriptions, and a category-theoretic view. Their precision can expose assumptions that ordinary prose leaves implicit. Their limits are equally important.

A formal representation does not establish that its mathematical objects are the literal constituents of the domain. A graph can represent relational dependence without implying that a society is fundamentally a graph. A state space can represent possible configurations without implying that the represented system possesses that space as an independent metaphysical object. A category can encode objects and morphisms relevant to an inquiry without establishing categorical ontology. A field model can capture distributed interaction without proving that the social domain is fundamentally a field.

This distinction follows from the chapter's treatment of mappings. Formalization selects objects, relations, equivalence criteria, boundaries, and admissible transformations. Those selections can be analytically justified while remaining choices of

representation. Different formalisms can preserve different structures of the same domain. Their comparative success is an empirical and explanatory matter rather than a direct route from mathematical elegance to ontological truth.

Formal ontology also encounters the problem of representation-induced identity. Once an analyst chooses a state description or category of objects, elements that differ outside that formalization may become identical inside it. This can be useful. An economic model may intentionally treat two heterogeneous realizations as equivalent because they perform the same relevant function. Section 4.17 described such local equivalence under multiple realization. The loss of distinction should nevertheless remain visible. Formal equality inside a model can represent a justified abstraction without entailing ontological identity outside it.

Remark 4.186 (Formal exactness and ontological strength)*.* Greater exactness within a formal representation increases clarity concerning the commitments of that representation. It does not, by itself, increase the ontological strength of the claim connecting the representation to the world.

Remark 4.186 is especially important in interdisciplinary work. Mathematical sophistication can make assumptions more precise while leaving the empirical warrant for those assumptions unchanged. A beautifully defined equivalence relation, functor, potential function, attractor, or metric still requires a defensible interpretation linking it to the domain.

Formal systems can also create commensurability that the source domain did not possess in advance. Section 4.10 described symbolic commensuration; mathematical representation can perform an analogous operation. Assigning values to a common coordinate, metric, utility, score, or latent space can make comparison possible for a specified purpose. The resulting comparison may be operationally powerful and even institutionally consequential. Its existence inside the formalism does not prove intrinsic commensurability among the represented realities.

GRE therefore treats formal ontology as an instrument for disciplined representation, inference, and comparison. It can contribute to ontological inquiry by exposing structure, generating testable implications, and revealing invariant or transformational relations. It remains answerable to the domain and to the evidential conditions under which its objects are interpreted.

4.21.4 Limits of Cross-Domain Generalization

A further limit concerns the transfer of ontological categories across domains. GR is intentionally broad enough to support inquiry into economic, legal, political, educational, technological, ecological, and other relational systems. Breadth creates the temptation to assume that concepts established in one domain transfer unchanged to another. GRE resists that inference.

The criterion for relational reality is deliberately general, but its operationalization is domain-sensitive. Persistence for a market convention can have a different temporal scale from persistence for an ecological relation, a legal office, a computational process, or an interpersonal trust relation. Causal efficacy can also take different forms: changing resource flows, altering legal possibilities, constraining behavior,

reorganizing attention, modifying biological processes, or transforming symbolic expectations. The general criterion gains content only through domain-specific mechanisms.

The same limitation applies to subjecthood. Human persons, corporations, states, algorithms, animals, and collective organizations can occupy causally important positions in economic systems. Similarity in economic function or manifestational output does not establish identical forms of subjecthood. Section 4.12 therefore distinguished human subjecthood from artificial operational subjecthood and treated manifestational equivalence as local. Cross-domain generalization should preserve such differences rather than elevate a shared interface into universal identity.

Value and meaning provide another case. A common symbolic scale can create practical commensuration among heterogeneous values, while the underlying value structures remain non-equivalent. Likewise, a concept of meaning developed for linguistic interpretation cannot automatically be extended to every biological, computational, or institutional process that exhibits patterned response. Domain transfer requires an explicit account of what is preserved and what changes.

Definition 4.187 (Cross-domain transfer condition)**.** A *cross-domain transfer condition* specifies the properties, relations, causal roles, identity criteria, scales, and evidential assumptions that must be preserved for an ontological or relational concept to be used across distinct domains without silently changing its meaning.

Definition 4.187 makes generalization a constructive task. A concept can travel, but its travel requires a map. Sometimes the transfer will preserve a substantial common structure. Sometimes only an analogy survives. Sometimes the domains lack a warranted common space of comparison. The possibility of failure is part of disciplined generalization.

This restraint also protects GR from becoming a vocabulary that redescribes everything in the same terms. If every phenomenon is called a relation, field, attractor, emergence, or generative process without domain-specific criteria, explanatory content diminishes. A broad framework remains useful when its general concepts constrain inquiry while allowing local sciences and disciplines to supply mechanisms, measurements, categories, and evidence that cannot be derived from the framework alone.

For GRE, the economic domain remains primary. Connections to law, politics, ecology, psychology, computation, education, and other domains can be necessary because economic relations cross those boundaries. The ontological interface should nevertheless respect the concepts through which those domains identify their own objects. Cross-domain synthesis is warranted where the interfaces are explicit; conceptual annexation is not.

4.21.5 Openness to Ontological Revision

The final limit is temporal. GRE's ontological categories are intended to remain revisable when new evidence, new forms of organization, new scales, new modes of manifestation, or new conceptual distinctions alter what the framework can adequately describe. This openness follows from the historical materiality developed

in Section 4.18 and from ontological suspension developed in Section 4.3. A historically situated research programme should not treat its present ontology as immune to the processes it studies.

Ontological revision can occur at several levels. A previously useful object category can become inadequate when its internal heterogeneity becomes causally important. A relation once treated as background can become a central mechanism. A manifestational distinction can cease to track the relational structure it was designed to represent. A new technological or institutional configuration can generate objects for which existing identity criteria are unstable. A formal model can reveal overlooked invariants, while empirical evidence can show that an assumed invariant is historically contingent.

Revision does not require abandoning earlier concepts whenever novelty appears. Many categories remain useful across substantial historical change. The relevant question is whether the retained category continues to preserve the distinctions needed for explanation, intervention, and evaluation. Revision becomes warranted when anomalies are systematic, when causal mechanisms fall outside the existing object structure, when previously excluded differences become consequential, or when alternative ontological descriptions achieve materially stronger explanatory adequacy.

Claim 4.188 (Ontological revisability)**.** *GRE should revise an ontological commitment when sustained evidence or explanatory failure shows that the commitment no longer preserves distinctions necessary for identifying relevant objects, causal relations, persistence conditions, manifestations, scales, or transformations within the inquiry.*

Claim 4.188 makes revisability conditional rather than fashionable. Ontological novelty is not inferred merely from new terminology, new technology, or a new representation. Revision should answer to changes in explanatory adequacy and to the realities under investigation.

The three-register architecture itself is subject to this principle. Ontological reality, relational reality, and manifestational reality currently provide a productive set of distinctions for the GR research programme. Their usefulness does not grant them immunity from criticism. Future inquiry may require finer subdivisions, different mappings among registers, domain-specific extensions, or alternative concepts that preserve relevant phenomena more adequately. Such revision would be compatible with the framework's present commitments because openness has been built into those commitments from the beginning.

This openness also prevents ontological restraint from becoming intellectual passivity. Suspension is provisional where inquiry can proceed, and stronger ontological questions can be reopened when they become operative. Formalization can be strengthened when measurement and mechanism justify it. Cross-domain concepts can be generalized when preservation conditions are demonstrated. Alternative ontologies can be compared more sharply when they generate different empirical or practical consequences. The boundary established in this section therefore marks a frontier for further inquiry rather than a prohibition against stronger claims.

Section 110 completes the chapter's explicit account of ontological scope. GRE commits to enough reality to analyze generative systems seriously: relations can produce

stable and causally efficacious objects; manifestations and representations can participate recursively in later reality; subjects, institutions, value, meaning, processes, and categories can acquire historically situated forms of reality; and these structures can be compared across scales when warranted. The framework simultaneously leaves ultimate constitution, exhaustive ontology, universal commensurability, complete formal capture, and unrestricted cross-domain transfer open to additional argument. With that boundary in place, the remaining problem is epistemic: given realities that can exceed, precede, and be transformed by their manifestations, how can an inquiry responsibly know them? Section 111 turns to that transition.

4.22 Reality, Access, and Epistemic Reconstruction

The ontological work of this chapter produces an epistemic problem rather than an epistemic solution. GR has distinguished ontological reality, relational reality, and manifestational reality; specified the conditions under which an object may be treated as relationally real; shown that manifestation is generated through historically and relationally formed conditions; and established that manifestations and representations can recursively alter subsequent relational reality. These commitments clarify what kinds of realities an inquiry may address, but they also make clear why knowing those realities cannot be reduced to reading their visible expressions at face value. The role of this final section is therefore to state the epistemic consequences of the three-register architecture and to prepare the research programme developed in Chapter 5. Its objective is not to provide a complete epistemology in advance, but to identify the structure of the problem: reality can exceed manifestation, manifestation can disclose without exhausting, representation can mediate without transparently copying, and inference must reconstruct relations through historically situated traces.

This transition matters because ontological restraint changes what counts as an adequate epistemology. Once GRE suspends stronger claims about ultimate constitution where they are unnecessary, knowledge cannot be defined as possession of a final metaphysical description. At the same time, ontological suspension does not license a retreat to unconstrained interpretation. Relational realities remain capable of persistence, stability, and causal efficacy; manifestations remain constrained by the configurations through which they emerge; and representations can be compared with evidence, revised, and tested against subsequent consequences. The epistemic task is consequently neither transparent access nor arbitrary construction. It is the disciplined reconstruction of realities whose accessibility is mediated, partial, historical, and potentially recursive. (Giere 2004; Longino 1990; Hacking 2002)

The chapter's preceding distinctions also imply that epistemology must preserve the difference between an object and the conditions under which that object becomes knowable. A monetary relation is not identical to an accounting entry that records it. A legal position is not exhausted by the administrative category through which it becomes legible. A configuration of trust may already be relationally real before it is explicitly acknowledged. A contingent structure can shape what later becomes aesthetically salient before a subject recognizes the encounter as contingent or beautiful. In each case, evidence may arise through manifestation, but the evidential form and

the relational reality to which it refers remain analytically distinct. Knowledge therefore requires attention not only to what appears, but also to the relations that make appearance possible and to the transformations introduced by observation, symbolization, measurement, and representation.

Claim 4.189 (Epistemic consequence of the three-register architecture)**.** *If relational reality can precede particular manifestations, if manifestation is generated through condition-dependent relations, and if manifestations and representations can alter subsequent relational reality, then knowledge of a generative-relational system requires inquiry into both the realities under study and the relations through which evidence of those realities becomes available.*

Claim 4.189 gives the transition its basic form. The manifestation relation is not an invisible channel that epistemology can ignore. It becomes part of the object of inquiry. A trace can be informative because of how it was generated; a classification can be evidentially limited because of what its institutional production excludes; a repeated manifestation can acquire diagnostic value because the relevant mapping is sufficiently stable; and the same manifestation can become misleading when the mapping changes historically. Epistemic evaluation therefore extends from the manifested content to the generative conditions of manifestation itself.

4.22.1 Reality and Access

The first epistemic consequence concerns access. The three-register architecture does not assume that what is real is immediately available to inquiry. Ontological reality may remain partly or substantially under suspension. Relational reality can exist without having been perceived, named, measured, or symbolized by a particular subject. Manifestational reality marks a mode in which some aspect of a configuration becomes available under specified conditions, but availability itself is selective. What becomes accessible depends on embodiment, instrumentation, institutions, categories, interfaces, histories of attention, scales of observation, temporal position, and other relations that condition manifestation.

Access is therefore better treated as a relation than as a binary possession. An inquiry can have strong access to one aspect of a relational configuration and weak access to another. It can observe current outcomes while lacking historical trajectories. It can possess detailed administrative records while missing informal relations that organize those records' production. It can measure transactions precisely while having limited access to care, coercion, tacit obligation, fear, trust, or unrecorded exchange. It can encounter a stable manifestation while remaining uncertain about the multiplicity of relational structures compatible with it. The epistemic problem is shaped by the configuration of access rather than merely by the amount of information accumulated.

Definition 4.190 (Relational epistemic access)**.** *Relational epistemic access* denotes the historically and materially situated set of relations through which an inquiry can obtain, preserve, compare, interpret, or intervene upon manifestations and traces relevant to a specified epistemic target.

Definition 4.190 treats access itself as analyzable. It can be widened by new instruments, archives, institutions, languages, computational methods, or relationships

of trust. It can be narrowed by secrecy, destruction of records, strategic concealment, exclusion from institutions, measurement design, linguistic barriers, unequal resources, or the disappearance of the relevant manifestations. Access can also be distributed. Different actors can hold different traces of the same relational configuration, while no single observer possesses a complete view. The conditions under which evidence is collected thus become part of the history of what can later be known.

This conception also separates absence of access from absence of reality. A relation can be hidden, latent, weakly manifested, or manifest through forms unavailable to a particular inquiry. The absence of a recorded manifestation may therefore have several possible interpretations. The relevant relation may not exist; it may exist without producing the expected trace; the trace may have been produced but not preserved; the observer may lack access to it; or the manifestation rule itself may have changed. The epistemic significance of absence depends on the manifestation and recording relations that connect the target to the evidential field.

The converse problem also matters. Abundant access to manifestations does not necessarily yield correspondingly strong access to relational structure. A platform can generate billions of behavioral observations while leaving motivations, external relations, unobserved constraints, institutional conditions, and counterfactual possibilities underdetermined. Administrative systems can accumulate detailed categories whose precision exceeds the adequacy of the ontology they presuppose. Computational abundance can increase the resolution of a manifestational field while reproducing the same blind spots at greater scale. Epistemic strength therefore depends on the relation between evidence and target, not merely on the volume of evidence.

Ontological suspension intensifies rather than weakens this requirement. When GRE declines to settle what an object ultimately is, it must be particularly explicit about what is actually accessible and what inferential bridge connects that access to the claim being made. The framework can know a relational reality through its persistence, causal consequences, historical traces, responses to intervention, or convergent manifestations without pretending that such knowledge exhausts the object's ontology. Knowledge can therefore be substantive while remaining scoped.

4.22.2 Manifestation and Evidential Access

Manifestation supplies a principal interface through which relational realities become evidentially accessible. The term *interface* is useful only if it is not mistaken for a neutral screen. Section 4.7 showed that manifestations emerge through generative-relational conditions, while Section 4.8 showed that sufficiently stable manifestation mappings can themselves become relationally real. An evidential manifestation therefore carries information about a target through a process whose own structure, stability, and history can affect what the evidence means.

Definition 4.191 (Evidential interface)**.** An *evidential interface* is a manifestation relation, or organized set of manifestation relations, through which features of a specified epistemic target become available for observation, recording, comparison, interpretation, or intervention.

An evidential interface can be bodily, linguistic, institutional, legal, statistical, com-

putational, material, or composite. Pain may become accessible through speech, gesture, physiology, clinical examination, or patterns of action. Monetary relations may become accessible through prices, account balances, contractual records, settlement systems, observed exchanges, or institutional interventions. Trust may become accessible through repeated cooperation, expressed commitments, vulnerability, withdrawal, testimony, or responses under changing conditions. None of these manifestations is identical to the relational reality under study, and each preserves some distinctions while transforming or omitting others.

The evidential value of a manifestation consequently depends partly on knowledge of its production. A stable thermometer reading is informative because a sufficiently understood relation connects relevant physical conditions to the displayed value under specified conditions. A legal registry is informative because institutions generate, preserve, and update entries according to rules whose operation can be investigated. A survey answer is informative under a different manifestation regime involving question wording, interpretation, memory, incentives, social desirability, sampling, and response conditions. Treating all three simply as "observations" would conceal important differences in their generative pathways.

This approach also clarifies why directness is often a poor measure of epistemic quality. A manifestation can feel immediate while being generated through complex learned, embodied, institutional, or technological mediation. Conversely, a highly mediated trace can provide strong evidence when the relevant mapping is well characterized and independently tested. GRE therefore gives priority to reconstructing the evidential relation over ranking evidence by an intuitive scale from direct to indirect. The important questions concern what generates the trace, under what conditions, with what stability, and which relational differences the interface can preserve.

Manifestational plurality can strengthen inquiry when partially independent interfaces constrain the same target from different directions. Testimony, behavior, administrative records, historical documents, material traces, and intervention responses may each preserve different features and possess different failure modes. Convergence among them can reduce the compatibility set described in Section 4.9. Yet convergence is not automatic confirmation. Several manifestations can share the same upstream classification system, institutional incentive, database, or cultural convention and therefore reproduce a common error. Epistemic plurality requires attention to dependence among evidential interfaces rather than merely counting the number of observations.

The historical character of interfaces is equally important. The same symbol, indicator, behavior, or institutional record can change meaning when its manifestation relation changes. A category can persist linguistically while its legal criteria are revised. A price series can span periods in which market institutions, currencies, quality standards, or reporting practices differ. An expression of identity can operate differently after new institutions make that expression consequential. Historical epistemology therefore requires reconstruction not only of traces but of the changing rules through which those traces became possible.

Remark 4.192 (Evidence and manifestation)*.* A manifestation becomes evidence for a specified claim only through an inferential account linking the manifestation, its generative conditions, and the epistemic target. Manifestational reality is therefore

broader than evidence, while evidence is manifestation interpreted within a warranted epistemic relation.

Remark 4.192 prevents the ontology of manifestation from silently becoming an epistemology. A manifestation can be real without being evidentially useful for a particular question. It can also be causally powerful while epistemically misleading. The transition to epistemology begins when inquiry asks what a manifestation licenses us to infer.

4.22.3 Representation and Inference

Representation introduces another layer of mediation. Section 4.10 distinguished symbolization from manifestation and showed that symbolic forms can stabilize categories, produce practical commensurability, and become causally effective in their own right. For epistemology, the central problem is that representations do not merely store already settled knowledge. They select variables, categories, units, scales, boundaries, temporal resolutions, equivalence relations, and conventions through which manifestations become inferentially tractable.

An economic model, statistical indicator, legal category, archival description, qualitative code, graph, narrative, database schema, or computational state representation therefore participates in the structure of inference. Each makes some distinctions explicit and leaves others implicit or unavailable. A representation can preserve the relations relevant to one problem while distorting those relevant to another. The adequacy of representation is consequently task-sensitive without becoming arbitrary: the relevant question is whether the representation preserves, transforms, or suppresses differences that matter for the claim under investigation.

The non-entailment discipline of Section 4.21 applies directly here. Formal exactness does not establish ontological identity. Predictive success does not by itself establish unique causal reconstruction. Institutional uptake does not establish truth. A representation can become relationally real because decisions, expectations, rights, or resource allocations are organized around it while remaining epistemically inadequate concerning its target. This possibility is particularly important in economics, where prices, ratings, rankings, risk scores, classifications, forecasts, and models can feed back into the systems they describe.

Inference must therefore distinguish at least three relations: the relation between a relational reality and its manifestations, the relation between manifestations and their representations, and the relation between those representations and the conclusions drawn from them. Weakness or transformation can enter at each stage. A model can faithfully encode a dataset whose measurement process is biased. A dataset can accurately preserve recorded manifestations while those manifestations are weak indicators of the target. A representation can preserve relevant evidence while an inferential procedure overstates what the evidence supports. Epistemic assessment requires locating uncertainty rather than compressing it into a single undifferentiated confidence judgment.

Claim 4.193 (Layered inferential accountability)**.** *An epistemic claim concerning relational reality should remain accountable to the conditions that generated the relevant manifestations, the operations that represented those manifestations, and the inferen-*

tial rules through which the representation supports the claim.

Claim 4.193 does not require every inquiry to reconstruct an unlimited chain of mediation. It requires the chain to be extended far enough that omitted transformations are unlikely to reverse or materially alter the conclusion. This boundary is itself inquiry-relative. A descriptive task may require only a stable reporting relation. A causal claim may require intervention, temporal ordering, mechanism, or comparison among competing generative accounts. A normative decision may additionally require explicit value assumptions, legitimacy conditions, and treatment of affected subjects whose realities are poorly represented by the available data.

Representation can also change the object of inference. Once a category is published, a score assigned, a forecast circulated, or a model institutionalized, agents can respond. The representation then becomes part of the generative-relational system and can alter later manifestations. An epistemology adequate to GRE must therefore track performativity and recursion. Evidence generated after a representation becomes operative may partly reflect the representation itself. The line between observation and intervention can become historically entangled.

This entanglement is not an exceptional defect of social inquiry. It is a structural possibility wherever manifestational and representational forms enter subsequent causal relations. The epistemic task is to identify when that recursion is material. Chapter 5 will therefore treat representation not only as a medium of knowledge but also as a possible generator of later reality.

4.22.4 Inverse Reconstruction

The preceding points converge on an inverse problem. Inquiry commonly encounters manifestations, traces, records, behaviors, symbols, and outcomes and seeks to reconstruct the relational realities, histories, and generative mechanisms compatible with them. Section 4.9 established that manifestation can be non-invertible: multiple relational configurations may produce similar manifestations, while one relational configuration may produce different manifestations under changing conditions. Epistemology must determine what can responsibly be reconstructed despite that non-uniqueness.

The inverse problem is not simply a technical difficulty produced by insufficient data. Additional data can narrow a compatibility set, but non-invertibility can arise from the structure of the manifestation relation itself. Distinct histories may converge on the same current state. Different institutional arrangements may produce the same aggregate statistic. Different motivations can yield the same observed action. Different causal pathways can generate the same outcome. A single relation can manifest differently across cultural, historical, technological, or bodily conditions. Even an extremely detailed manifestational description may therefore leave relational structure underdetermined.

Definition 4.194 (Relational inverse problem)**.** A *relational inverse problem* arises when an inquiry seeks to reconstruct one or more relational configurations, histories, or generative mechanisms from available manifestations and traces for which more than one materially distinct reconstruction remains compatible with the evidence and maintained assumptions.

Definition 4.194 shifts the epistemic aim away from an automatic demand for unique inversion. Sometimes unique reconstruction can be achieved under strong and justified constraints. In other cases, the appropriate epistemic object is a set of plausible relational configurations, an equivalence class, a partially ordered family of explanations, a distribution over possibilities, or a set of invariants shared across competing reconstructions. The form of knowledge should match the identifiability permitted by the evidence.

This point is especially important for historical and social inquiry. A surviving archive is not the past itself. It is a historically generated manifestational field shaped by preservation, destruction, classification, institutional power, material durability, access, and later interpretation. A current institution can preserve traces of earlier relations while also reorganizing them. A subject's present testimony can carry memory, reinterpretation, later categories, and current stakes. Reconstruction therefore requires attention to the history of the evidential interface, not only the content of surviving evidence.

Intervention can sometimes strengthen inverse reconstruction because different candidate relational structures can respond differently when conditions change. Comparative cases, natural variation, experiments, policy changes, historical discontinuities, and perturbations can expose differences hidden under ordinary conditions. Yet intervention itself can transform the system, and the relation between intervention response and antecedent structure requires argument. GRE therefore treats intervention as one epistemic resource among others rather than a universal solution to non-invertibility.

The inverse problem also explains why heterogeneous methods can be epistemically complementary. Historical reconstruction can identify trajectories concealed by cross-sectional data. Ethnographic or interpretive inquiry can recover meanings and relations compressed by administrative categories. Statistical methods can estimate regularities across cases. Network and dynamical models can expose structural dependencies. Computational simulation can test whether proposed mechanisms are capable of generating observed patterns. Legal analysis can reconstruct institutional rules that shape manifestational regimes. None of these methods possesses automatic priority. Their contribution depends on which dimensions of the compatibility set they constrain and which assumptions they introduce.

Claim 4.195 (Epistemic adequacy under non-invertibility)**.** *When unique reconstruction is not warranted, epistemic adequacy consists partly in preserving the plurality of materially compatible relational explanations, identifying the evidence that distinguishes among them, and calibrating claims to the invariants or differences that the available access can support.*

This claim makes uncertainty structurally informative. Multiple compatible explanations indicate where manifestation fails to preserve distinctions, where access is limited, or where additional assumptions are carrying the inference. The objective is not to celebrate indeterminacy but to locate it. An explicit compatibility set can guide new observation, archival search, intervention, comparison, or model revision more effectively than a premature single reconstruction.

The inverse problem also returns us to the example of relational realities that need

not share a common metric space. If two objects are both relationally real, epistemic comparison still requires a warranted comparison relation. Reconstruction cannot assume in advance that heterogeneous domains can be reduced to one metric, one ranking, or one common representation. Sometimes the relevant knowledge concerns structural correspondence; sometimes temporal dependence, functional equivalence, causal interaction, or qualitative difference; sometimes no defensible comparison is yet available. Epistemology must justify the comparison structure rather than inheriting it from the convenience of representation.

4.22.5 Relational Epistemology

The resulting epistemic orientation can now be stated provisionally. GRE requires an epistemology capable of knowing relationally generated, historically changing, multiply manifested, and recursively represented realities without assuming transparent access or final ontological settlement. Such an epistemology must treat evidence, observation, categories, models, archives, and methods as situated within relations while still allowing disciplined claims about realities that exceed those relations of access.

Definition 4.196 (Relational epistemology in GRE)**.** *Relational epistemology in GRE* denotes the study and practice of warranted knowledge concerning relational and generative realities through situated manifestations, traces, representations, comparisons, interventions, and historical reconstructions, together with explicit analysis of the relations that make those forms of access possible and consequential.

Several commitments follow from Definition 4.196. First, knowledge claims are situated without being reduced to perspective. The position of an observer, institution, instrument, archive, or model affects access, but relational reality can constrain and correct the account produced from that position. Second, mediation is epistemically constitutive rather than merely contaminating. Instruments, languages, institutions, categories, and representations can make otherwise inaccessible realities knowable; their mediation must be analyzed rather than imagined away. Third, historical change applies to epistemic relations themselves. Methods, categories, observation systems, and standards of evidence can acquire histories, and their adequacy can change as the realities under study and the interfaces of manifestation change.

Fourth, epistemic plurality can be productive when methods preserve different dimensions of the relational configuration and expose one another's blind spots. This plurality does not mean that all interpretations are equally warranted. Claims remain answerable to evidence, causal structure, internal coherence, historical reconstruction, comparative performance, and the consequences of intervention where relevant. Fifth, uncertainty should be located and structured. The inquiry should distinguish uncertainty about the target, uncertainty about the manifestation relation, uncertainty introduced by representation, uncertainty arising from missing evidence, and uncertainty created by competing explanations.

Sixth, epistemology in GRE is recursively connected to praxis. Research can change what it studies by classifying, measuring, publishing, intervening, allocating attention, or altering institutional expectations. The production of knowledge can therefore generate new relational realities. This fact does not eliminate the possibility of

knowledge; it adds another causal relation that must sometimes be included in the analysis. Epistemic responsibility includes attention to how inquiry enters the generative field.

The three-register architecture developed in this chapter consequently supplies neither a metaphysical closure nor a simple ladder from reality to knowledge. It supplies a structured problem-space. Ontological reality marks questions whose final settlement can remain open. Relational reality identifies emergent, sufficiently persistent and stable, causally efficacious objects within generative-relational systems. Manifestational reality identifies modes through which aspects of those realities become available under particular conditions. Manifestation can precede neither relation nor ontology by conceptual necessity, and manifestation can recursively reshape the relational field once it becomes operative. Symbolic representations can stabilize, compare, compress, transform, and institutionalize manifestations while acquiring causal efficacy of their own. Across these registers, mappings can be partial, plural, historically variable, and non-invertible.

The epistemic problem follows directly. How can an inquiry identify relations that are only partly manifest? How can it distinguish traces from the structures that generate them? How can it learn manifestation rules and detect when those rules change? How can it reason across boundaries and scales, reconstruct the identity and persistence of relations, analyze higher-order or field-like organization, attribute generative effects, and preserve historical trajectories? How should it treat unequal access, strategic concealment, missing records, performative classifications, computational representations, and evidence that changes because the system has learned to respond to observation? These are not secondary methodological details. They are consequences of the ontology developed here.

Chapter 5 takes these consequences as its starting point. It begins with the epistemic problem created by ontological suspension, then develops the inverse problem of manifestation, knowledge of manifestation relations, the distinction between relation and trace, symbolization and representation, performative representation, partial observation, boundary and scale, relational identity, higher-order relations, relational fields, generative relations, attribution, trajectories, uncertainty, comparison, and epistemic revision. The movement of Part II is therefore complete at the level required for transition: Chapter 4 has clarified the kinds of reality GRE permits itself to discuss and the limits of those claims; Chapter 5 asks how warranted knowledge of those realities can be constructed under conditions of mediation, plurality, history, and incomplete access.

The transition can be stated compactly. GRE begins neither with the expectation of transparent reality nor with the conclusion that mediation makes reality inaccessible. It begins with a more demanding proposition: reality and access are related but distinct; the relations between them are themselves historically generated and potentially knowable; and responsible knowledge requires reconstructing those relations with the same care that GRE brings to the economic realities they disclose.

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Chapter 5

Epistemology of Generative Relational Economics

This chapter develops the epistemology required for Generative Relational Economics (GRE) after the ontological distinctions of the preceding chapter have been established. Its role within Part II is to move from a view of reality to a disciplined account of knowledge of that reality. The previous chapter distinguished ontological, relational, and manifestational reality while preserving ontological suspension where stronger commitment is unnecessary. The present chapter asks how inquiry can move from manifestations, traces, representations, observations, records, models, and interventions toward warranted claims about relations and generative processes. Its objective is to specify the epistemic conditions under which GRE can make claims that are sufficiently warranted, appropriately scoped, historically situated, contestable, and revisable, while leaving broader theories of knowledge and stronger claims of transparent access outside the commitments required here.

The central difficulty arises from mediated access. Relational realities can become manifest through bodily, institutional, legal, linguistic, statistical, technological, or other conditions of manifestation, yet manifestation does not uniquely reveal the relational structure from which it arises. Similar manifestations may be compatible with different relational configurations, and similar relations may become manifest differently across contexts, scales, historical periods, or representational systems. The epistemic task therefore has the structure of an inverse problem. Inquiry often encounters what has become observable or representable and attempts to reconstruct the relations, fields, trajectories, and generative processes that may have contributed to it. Such reconstruction can be rigorous, but its warrant depends on explicit assumptions concerning manifestation, evidence, representation, boundary, scale, temporality, and alternative explanation.

Ontological suspension makes this epistemic discipline especially important. GRE can investigate relations without deciding in advance whether every analytically useful relation corresponds to an independently fundamental entity. It can also acknowledge relational realities whose persistence and causal efficacy depend partly on institutions, recognition, convention, classification, or symbolic mediation. These freedoms increase rather than reduce the burden of epistemic specification. A relation that is legally recognized, statistically represented, administratively legible,

behaviorally enacted, or computationally inferred can be real in one relevant sense while remaining misrepresented in another. A representation can be causally effective without being epistemically adequate, and a relation can be weakly represented while still being relationally consequential. The chapter accordingly separates questions of existence, manifestation, representation, causal efficacy, generativity, and normative evaluation wherever their conflation would strengthen a claim beyond its evidence.

The chapter's method is architectural. It begins from the target claim and identifies recurring epistemic problems that research designs may have to address when they study relational or generative phenomena, allowing different evidential forms and methodological traditions to enter according to their claim-relative contribution. These include non-invertibility of manifestation, partial observation, unequal access, boundary and scale selection, relational identity through change, higher-order structure, field reconstruction, generative attribution, historical trajectory, evidential heterogeneity, uncertainty, epistemic justice, machine mediation, and revisability. Formal definitions and propositions are introduced where they clarify the structure of these problems, but they remain analytical devices whose usefulness depends on the empirical and interpretive context in which they are applied.

The first movement, Sections 5.1–5.9, establishes the conditions of epistemic access to relations. Section 5.1 formulates the epistemic problem that follows from ontological suspension and identifies relational reality as an epistemic target reached through manifestational and representational mediation. Section 5.2 develops the inverse problem of manifestation and the consequences of non-invertibility, manifestational equivalence, contextual dependence, and multiple relational explanations. Section 5.3 then makes manifestation relations themselves objects of inquiry, because inference from manifestation to relation depends partly on what is known about the processes through which manifestation occurs. Sections 5.4 and 5.5 distinguish relations from their traces and from the symbolic, legal, administrative, statistical, linguistic, and computational representations through which those traces become usable in inquiry.

That movement also treats representation and observation as active conditions rather than neutral windows. Section 5.6 examines circumstances in which representations become performative: classifications, legal categories, administrative records, statistical descriptions, or algorithmic outputs can enter the relational system and affect subsequent relations. Section 5.7 develops partial observation, observer position, unequal access, distributed observation, concealment, and temporal gaps. Section 5.8 then shows that relational claims are indexed to boundaries and scales whose selection can materially alter what becomes visible and what remains outside the analysis. Section 5.9 closes the first movement by addressing identity and persistence, because longitudinal knowledge requires criteria for deciding when a changing relation should be treated as continuous, transformed, newly formed, or dissolved.

The second movement, Sections 5.10–5.14, extends epistemic inquiry beyond individual relations toward relational configurations and generative processes. Section 5.10 distinguishes relations among relations, collective relations, nested relations, multilayer configurations, and hyperrelational forms while preserving the additional uncertainty introduced by higher-order reconstruction. Section 5.11 devel-

ops the epistemology of relational fields and requires a field claim to establish more than relational density: distributed organization and position must matter to the target under investigation. These discussions provide the structural basis for Section 5.12, which defines generative relations relative to specified effects such as capacity formation, relation formation, structural transformation, constraint generation, altered future possibilities, or changes in the conditions of subsequent transformation.

The distinction between relational existence and generative effect is central to the chapter. Evidence that a relation exists does not by itself establish what the relation generates. Section 5.13 therefore develops the epistemic problem of generative attribution through mechanisms, counterfactual dependence, multiple causation, distributed generation, delayed effects, branching pathways, and emergent outcomes. The chapter therefore uses a plural architecture of causal and generative warrant. The appropriate burden depends on the kind and strength of the attribution being made. Section 5.14 then adds historical depth by distinguishing relational trajectories, generative trajectories, path dependence, genealogy, historical counterfactuals, and re-epistemization. Historical knowledge is treated as revisable reconstruction under changing evidence and categories rather than as retrospective access to a fixed and fully recoverable past.

The third movement, Sections 5.15–5.22, turns from the objects of relational and generative knowledge toward the evidential and institutional conditions of warranted inquiry. Section 5.15 differentiates documentary, administrative, legal, behavioral, testimonial, ethnographic, network, longitudinal, and computationally inferred evidence according to the relational properties they can support and the characteristic mediations through which they are produced. Section 5.16 then specifies the additional evidential burden associated with generative claims, including downstream effects, capacity formation, structural transformation, value propagation, recirculation, and foreclosure. Evidential pluralism in these sections requires claim-sensitive judgment about what each evidential form can reveal, what it may conceal, and how convergent or conflicting evidence should alter the warranted claim while preserving differences among evidential forms.

Section 5.17 organizes uncertainty into a multidimensional confidence profile rather than a single undifferentiated score. Relational, manifestational, generative, boundary, scale, temporal, model, and explanatory uncertainty can vary independently, and a defensible claim should preserve those differences where they matter. Section 5.18 adds epistemic justice by examining how visibility, voice, representational authority, classification, institutional legibility, evidence-production capacity, and generative attribution are unequally distributed. Justice-sensitive inquiry retains evidential standards while asking whether the conditions under which evidence becomes producible, preservable, credible, and actionable systematically exclude relevant relations or contributors.

Machine mediation intensifies several of these concerns. Section 5.19 examines machine observation, algorithmic classification, computationally inferred relations, AI-assisted reconstruction, machine-generated representation, epistemic asymmetry, representational authority, and contestability. Computational scale and precision can enlarge epistemic reach while also introducing opacity, inherited categories, uneven

provenance, and new recursive effects when outputs become operational within the systems being studied. Machine systems are therefore treated as components of an epistemic architecture rather than as independent guarantors of knowledge.

The chapter closes by making revisability an explicit property of GRE inquiry. Section 5.20 develops revision through new evidence, intervention, historical transformation, category failure, reflexive observation, and preservation of serious alternative interpretations. Section 5.21 consolidates the chapter into a set of epistemic commitments: partial knowledge, explicit representation, explicit boundary and scale, explicit uncertainty, mechanism-sensitive attribution, evidential pluralism, historical sensitivity, revisability, and epistemic humility. Section 5.22 then translates these commitments into methodological design burdens. The transition is deliberate. Epistemology specifies what a defensible relational or generative claim requires; methodology must organize inquiry so that evidence capable of supporting, qualifying, contesting, or revising such claims can actually be produced.

Across these movements, the chapter advances a position of bounded epistemic ambition. GRE is permitted to ask large questions concerning distributed relations, historically evolving institutions, heterogeneous forms of evidence, and generative transformations across scales. It is also required to state the conditions under which those questions become answerable. Strong formalization, extensive data, institutional recognition, computational sophistication, or representational precision can improve inquiry while the mediations through which knowledge is produced remain explicit. A narrow claim with explicit scope and strong evidential fit can therefore possess greater epistemic warrant than a more comprehensive claim whose boundary, representation, or inferential pathway remains obscure.

The resulting epistemology is demanding while remaining compatible with incomplete knowledge. It permits provisional relational maps, partial reconstruction, competing explanations, graded generative attribution, and historically revisable knowledge while preserving criteria by which stronger and weaker claims can be distinguished. The chapter therefore supplies GRE with an epistemic position appropriate to an open research programme: knowledge can be situated while preserving standards of warrant, plural while preserving evidential differentiation, formally articulated while retaining ontological restraint, and revisable while retaining epistemic content. With this architecture in place, the book can move from the conditions of warranted knowledge to the practical organization of research praxis and methodology.

5.1 The Epistemic Problem after Ontological Suspension

Chapter 4 established an ontological architecture that is deliberately strong enough to support substantive inquiry and deliberately restrained enough to avoid converting analytical usefulness into final metaphysical settlement. Ontological reality, relational reality, and manifestational reality identify distinct registers of analysis; relational reality can precede perception and symbolization; manifestation is generated through historically and materially conditioned relations; and representations can enter the systems they describe and alter subsequent relations. These commitments

create the starting problem of the present chapter. If reality can exceed what is manifest, if manifestation can be selective and non-invertible, and if representation can be both evidential and performative, then epistemology cannot be reduced to the accumulation of visible facts. The role of this section is to formulate that problem precisely. It develops five connected tasks: knowledge under ontological suspension, specification of relational reality as an epistemic target, the evidential role of manifestational reality, representation as mediated access, and disciplined inference across the three registers.

The argument proceeds from a distinction between *ontological settlement* and *epistemic warrant*. GRE does not require a final account of what an object ultimately is before inquiry can establish that some configuration persists, exhibits a sufficiently stable organization, produces causal effects, or changes under specified interventions. Scientific and philosophical debates concerning ontological commitment, empirical adequacy, model-based representation, and the social conditions of evidential judgment already show that useful inquiry can distinguish the strength of an empirical or representational claim from the strength of a metaphysical one (Quine 1948; Fraassen 1980; Giere 2004; Longino 1990). GRE extends that discipline into a relational setting. The absence of final ontological settlement does not erase the possibility of knowledge; it increases the need to state what is being claimed, through which evidential relations, and with what residual uncertainty.

Claim 5.1 (Epistemic consequence of ontological suspension)**.** *Ontological suspension permits substantive epistemic claims when the epistemic target, evidential access, inferential relation, and scope of the claim are sufficiently specified. Suspension limits the strength of ontological conclusion; it does not by itself diminish the evidential strength of a well-supported relational or manifestational claim.*

Claim 5.1 provides the chapter's initial discipline. A researcher may be highly confident that a monetary arrangement structures access to resources, that a legal category alters feasible action, that an institutional ranking changes subsequent behavior, or that a trust relation has stabilized across repeated interactions while remaining agnostic about the ultimate metaphysical constitution of money, law, institutional identity, or selfhood. The claim can be strong at the level it addresses and suspended at another. Epistemic restraint therefore concerns the calibration of claims rather than a generalized weakening of knowledge.

This calibration also prevents a recurrent movement from uncertainty at one level to skepticism at every level. Uncertainty about ontological fundamentality does not imply uncertainty about observed manifestations. Uncertainty about the unique relational structure underlying a manifestation does not imply that the manifestation itself is doubtful. Conversely, confidence in a manifestation does not establish confidence in a unique relational explanation. The three-register architecture therefore supplies an epistemic differentiation: different claims can carry different degrees and kinds of warrant even when they concern the same event, object, or process.

5.1.1 Knowledge under Ontological Suspension

Ontological suspension is epistemically productive when it prevents an inquiry from demanding stronger settlement than its explanatory task requires. The relevant ques-

tion is not whether inquiry can proceed in the absence of any ontology; Chapter 4 has already rejected such a position. GRE identifies objects, relations, persistence conditions, causal effects, manifestations, scales, and historical transformations, and each of these choices carries ontological commitments. The epistemic question is narrower: which of those commitments must be settled for a particular claim to become warranted, and which may remain open without damaging the inference?

This distinction can be understood through the difference between *target commitment* and *ultimate commitment*. A target commitment identifies what the inquiry is attempting to know: for example, the organization of a labor relation, the persistence of a monetary convention, the distribution of access to computational capacity, or the institutional reproduction of a legal status. An ultimate commitment would answer a stronger question concerning what kind of being such an object finally possesses. The first is unavoidable for research. The second becomes necessary only when competing ontological accounts alter explanation, measurement, intervention, or evaluation.

Definition 5.2 (Epistemic target)**.** An *epistemic target* is the explicitly delimited object, relation, process, configuration, mechanism, trajectory, or property about which an inquiry seeks warranted knowledge under specified spatial, temporal, scalar, and conceptual conditions.

Definition 5.2 makes delimitation part of epistemic responsibility. A statement such as "trust increased" remains under-specified until the inquiry clarifies whose trust, within which relational domain, across what interval, through what manifestations, and relative to which criteria of persistence or change. The same requirement applies to economic claims. "Capital became more powerful" can refer to ownership concentration, control over future investment, institutional claims on income streams, influence over technological development, command over generative infrastructure, or several interacting mechanisms. The epistemic target must therefore be constructed with enough precision that evidence can bear on it.

Ontological suspension then operates selectively. If two metaphysical interpretations generate the same expectations for the target under the inquiry's present scale, evidence, and intervention possibilities, their disagreement can remain suspended. If they imply different persistence conditions, different causal mechanisms, or different responses to intervention, the disagreement becomes epistemically operative and must be reopened. This preserves the distinction developed in Chapter 4 between non-operative and operative ontological disagreement while giving it a direct epistemological consequence.

The approach differs from a simple instrumentalism. GRE does not treat objects and relations as disposable fictions merely because their ultimate ontology remains unsettled. A relational reality may possess stable causal efficacy within the system under study. The monetary unit used in an accounting system, the institutional category through which a person receives or loses an entitlement, or the recognized identity of an organization can produce consequences that remain explanatorily indispensable. Epistemic warrant can therefore attach to a relationally real object without requiring that object to be fundamental in a stronger metaphysical sense.

A second consequence concerns historical change. The categories through which

an epistemic target is identified can themselves have histories. Hacking's work on historical ontology and Kuhn's account of historically organized scientific practice provide different precedents for taking the historical formation of concepts, objects, and problem structures seriously (Hacking 2002; Kuhn 1962). GRE therefore treats target specification as revisable. A category that once captured the relevant organization can become inadequate when new relations, technologies, scales, or manifestations become causally important. Revisability does not make the target arbitrary; it makes the history of its adequacy part of epistemic inquiry.

Remark 5.3 (Scoped knowledge)*.* A claim can be strongly warranted within a specified epistemic target and evidential domain while stronger claims concerning ultimate ontology, exhaustive mechanism, universal scope, or normative validity remain suspended.

Remark 5.3 will recur throughout this chapter. GRE's epistemology is intended to support strong local knowledge without quietly converting local warrant into universal closure.

5.1.2 Relational Reality and Epistemic Targeting

Relational reality introduces a distinctive epistemic target because the relevant object need not be directly observable, consciously recognized, or symbolically articulated. Chapter 4 defined a relationally real object through emergence within a generative-relational system, sufficient persistence and stability across a relevant spacetime domain, and causal efficacy within that system. Each component creates an evidential burden. An inquiry must identify evidence of emergence, evidence of continuity or patterned persistence, evidence that the object retains enough organization to be distinguished across change, and evidence that it makes a difference to subsequent processes.

The epistemic target is therefore rarely an isolated entity. It includes the relational configuration through which the object emerges and the domain within which its causal efficacy is assessed. Consider money. A token, inscription, or account balance can be observed directly, but the relational reality of money depends on broader arrangements of recognition, law, exchange, accounting, expectation, institutional enforcement, and practical use. Observing a note or a number is evidence of a manifestation. Knowing the monetary relation requires reconstruction of the system in which that manifestation acquires persistence and efficacy.

The same point applies to objects with less obvious material manifestation. Trust can become relationally real before either party states that trust exists. A sense of continuing self can organize action before it is reflectively narrated. A religious object can organize obligations, spaces, temporal rhythms, and collective practices while its ultimate ontological status remains suspended. A contingent configuration can shape what later becomes aesthetically salient before the subject recognizes the contingency or articulates an aesthetic judgment. In each case, the epistemic challenge is to avoid identifying the absence of explicit manifestation with the absence of relational reality.

Definition 5.4 (Relational epistemic target)**.** A *relational epistemic target* is an epistemic target whose identity, persistence, causal role, or transformation depends ma-

terially on the generative-relational configuration within which it emerges and acts.

Definition 5.4 does not imply that every relevant cause is relational in the same sense. Bodies, infrastructures, material resources, ecological conditions, computational hardware, and other objects may enter the configuration under domain-specific ontologies. The definition concerns what must be reconstructed for the target to be adequately known. If the economic reality of a firm's authority depends on legal recognition, contracts, organizational routines, labor relations, financing, and expectations, then knowledge of that authority cannot be reduced to inspection of any single component.

Relational targeting also changes how absence is interpreted. Failure to observe an explicit claim of authority does not show that authority is absent. Failure to observe monetary exchange does not show that monetary dependence is absent. Failure to record a relation in an administrative database does not show that the relation does not organize action. At the same time, the framework does not authorize inference of hidden relations whenever evidence is missing. The relevant burden is constructive: an inquiry should specify what manifestations or traces a proposed relational reality would be expected to generate, under what conditions those manifestations may fail to appear, and which alternative relational structures remain compatible with the available evidence.

This requirement places mechanism and history near the center of epistemic targeting. A relational reality can be identified more securely when different evidential routes converge on its persistence and causal role: repeated behavior, institutional records, testimony, counterfactual variation, intervention, historical traces, and changes that follow the relation's stabilization or dissolution. Convergence does not guarantee unique reconstruction, but it can narrow the compatible relational field and strengthen a scoped claim.

The target may also be distributed. No participant need possess a complete representation of the relation in which they participate. Markets, administrative systems, infrastructures, supply chains, reputational fields, and scientific communities can contain locally informed actors whose combined practices generate structures that exceed each actor's explicit knowledge. Epistemology must therefore distinguish the knowledge possessed by participants from the knowledge an inquiry attempts to reconstruct about the relational configuration as a whole.

5.1.3 Manifestational Reality and Evidential Access

Manifestational reality supplies the principal domain through which inquiry encounters relational reality, but manifestation and evidence are not synonymous. A manifestation becomes evidence only relative to an epistemic target and an account of how the manifestation is generated. A market price can be evidence about exchange conditions, but its interpretation depends on institutional rules, market structure, temporal aggregation, strategic behavior, and what the price fails to record. A legal document can be evidence of a recognized status, but knowledge of effective legal power may also require enforcement practice, administrative discretion, and access to remedies. A behavioral trace can be evidence of interaction without uniquely revealing intention, trust, coercion, or preference.

The distinction can be stated explicitly.

Definition 5.5 (Evidential status of a manifestation)**.** The *evidential status of a manifestation* is the warranted relation by which a manifestation is treated as bearing information about a specified epistemic target under an articulated account of its generation, preservation, selection, and interpretation.

Definition 5.5 places the evidential burden on the relation between manifestation and target. The same manifestation can have different evidential significance for different questions. A wage payment can provide strong evidence that a payment occurred, moderate evidence concerning a contractual employment relation, weaker evidence concerning the worker's experienced autonomy, and almost no direct evidence concerning the complete structure of household care or future bargaining power. Evidential strength therefore cannot be assigned to the datum independently of the claim.

This position is compatible with a broader philosophy-of-science distinction between observed phenomena and stronger claims concerning the structures that explain them. Van Fraassen's constructive empiricism emphasizes the difference between empirical adequacy and stronger realist commitment, while Giere's model-based account treats representation as purposive and selective rather than as simple identity between model and world (Fraassen 1980; Giere 2004). GRE does not adopt either position wholesale. Their relevance lies in a shared caution: evidential accessibility and ontological exhaustiveness should not be conflated.

Manifestational access is also conditioned. Instruments, categories, languages, administrative rules, interfaces, bodily capacities, and historical circumstances determine what can become legible. Longino's contextual empiricism is useful here because evidential relevance depends partly on background assumptions and on the critical contexts through which those assumptions can be challenged (Longino 1990). In GRE, such background conditions are not merely external philosophy-of-science considerations. They can themselves be relationally real parts of the system under investigation. A statistical classification can determine which people become visible to an institution; an interface can determine which actions can be registered; a legal category can determine which harms become actionable; a platform metric can determine which activities are recognized as valuable.

Consequently, an inquiry should examine the conditions under which manifestations are produced, not only the manifested content. A stable manifestation relation can support repeated inference. A changing manifestation relation can make an apparently stable time series epistemically misleading. A new measurement technology can reveal previously inaccessible differences while simultaneously changing behavior. The same symbolic category can preserve continuity in records even when the relational reality it once tracked has transformed. Evidential access therefore has a history.

Claim 5.6 (Manifestation-evidence distinction)**.** *A manifestation acquires evidential force for a relational claim only through a warranted account of the relations connecting the manifestation to the epistemic target. Manifestational presence alone does not determine the strength or uniqueness of the inference.*

Claim 5.6 does not make evidence inaccessible. It clarifies where evidential work

occurs. Repeated manifestations, independent traces, intervention responses, mechanism knowledge, and historical continuity can strengthen the relation between manifestation and target. The later sections of this chapter will differentiate direct, indirect, latent, hidden, documentary, behavioral, testimonial, ethnographic, formal, and computational forms of evidence. Section 112 establishes the common structure within which those differences matter.

5.1.4 Representation and Mediated Access

Representation introduces another layer between manifestation and epistemic claim. A manifestation can be recorded, classified, translated, measured, aggregated, modeled, narrated, visualized, or encoded. Each operation can preserve some relations, suppress others, create new comparabilities, and add assumptions that were not present in the manifestational field itself. Representation is therefore an epistemic resource and an epistemic transformation.

A distinction between manifestation and representation is particularly important in economic inquiry. A transaction is one event; an administrative record of the transaction is another object; a statistical aggregation of many recorded transactions is another; a model estimated from the aggregate is another; and a policy interpretation of the model introduces yet another representational layer. These layers can be tightly connected, but they should not be treated as interchangeable. An error, selection rule, classification change, or aggregation procedure introduced at one stage can propagate through the later stages while leaving the final representation internally precise.

Quine's holistic account of empirical testing and Longino's contextual account of evidential relevance both provide precedents for treating observation and inference as embedded within wider conceptual and social structures rather than as isolated pairings between single statements and neutral facts (Quine 1951; Longino 1990). GRE adds a generative-relational concern: the representational apparatus can become causally active within the domain it represents. A credit score can alter access to credit; a ranking can alter applications and funding; a diagnosis can reorganize self-understanding and institutional treatment; a forecast can alter investment; and a legal classification can change the feasible actions of the classified subject. Representation can therefore mediate knowledge and later become part of the relational reality whose future manifestations are observed.

Definition 5.7 (Representational mediation)**.** *Representational mediation* denotes the set of operations through which manifestations or traces are selected, encoded, classified, transformed, aggregated, modeled, narrated, or otherwise organized into forms used for epistemic inference.

The definition makes representation analyzable without assuming that every representation is distorting. Mediation can increase epistemic capacity. A map can reveal spatial relations that are difficult to perceive locally. A statistical model can expose patterns across large populations. An archive can preserve traces beyond the lifetime of their producers. A legal record can stabilize a claim across institutional contexts. A simulation can make counterfactual structure explorable. The epistemic value of representation depends on what relations are preserved, what transforma-

tions are introduced, and what target the representation is used to investigate.

This also means that representational accuracy has several dimensions. A representation can reproduce observed manifestations accurately while mischaracterizing the relations that generated them. It can preserve a causal mechanism while omitting distributive consequences. It can capture average behavior while suppressing heterogeneity. It can represent a historical configuration adequately for one period and poorly after the underlying relations change. Epistemic evaluation should therefore specify the dimensions along which adequacy is claimed rather than treating representation as globally faithful or unfaithful.

In GRE, representational mediation acquires particular importance because the objects of political economy are frequently constituted partly through the representations used to govern them. Prices, property titles, balance sheets, national accounts, credit ratings, legal statuses, employment categories, performance indicators, and algorithmic scores are simultaneously representations and operative institutional objects. The epistemology of such domains must therefore distinguish evidence about a relational reality from representations that participate in producing that reality.

5.1.5 Inference across Registers and Epistemic Restraint

The final problem concerns inference across the three registers. The architecture developed in Chapter 4 permits several legitimate inferential movements, but none is automatically reversible. A manifestation can support a claim about relational reality when the manifestation relation is sufficiently understood. A relational configuration can support predictions about likely manifestations under specified conditions. A representation can preserve selected features of manifestations and permit comparison across cases. Evidence concerning persistent causal organization can also motivate stronger ontological questions. The epistemic danger appears when a warranted movement in one direction is silently converted into identity across registers.

Three forms of overreach are especially important. The first is *manifestational overreach*: treating what appears under one set of conditions as an exhaustive account of the relational reality. The second is *representational overreach*: treating a successful symbolic, statistical, computational, or formal representation as identical with the target. The third is *ontological overreach*: treating a well-supported relational explanation as sufficient proof of ultimate metaphysical constitution. The nonentailment discipline of Chapter 4 becomes an epistemic discipline here.

Definition 5.8 (Cross-register inference)**.** A *cross-register inference* is an inference in which evidence or claims articulated primarily at one register of reality are used to support a claim concerning another register. Its warrant depends on the explicitly or implicitly posited relations connecting the registers under the relevant historical, material, and manifestational conditions.

Definition 5.8 makes the inferential bridge visible. For example, inferring relational trust from repeated cooperative behavior requires assumptions about the relation between behavior and trust. Inferring institutional authority from legal documentation requires assumptions about recognition and enforcement. Inferring preference from choice requires assumptions concerning feasible alternatives, information, strategic behavior, and constraint. Inferring an underlying generative structure

from a statistical pattern requires assumptions about causal architecture and alternative explanations. Each inference can be warranted, but the warrant is located in more than the observed manifestation alone.

Non-invertibility makes this problem systematic. Different relational realities can generate similar manifestations, and one relational reality can generate heterogeneous manifestations across contexts. The inverse problem therefore produces a set of compatible explanations rather than a guaranteed unique solution. Epistemic progress can consist in reducing that set, discriminating among alternatives, identifying invariants, discovering new manifestations, changing the conditions of observation, or intervening on the system. Complete inversion is only one possible epistemic achievement and often an unrealistic one.

Claim 5.9 (Epistemic restraint across registers)**.** *The strength of a claim inferred across registers should be limited by the demonstrated stability, specificity, and scope of the relations that connect the evidential manifestation or representation to the epistemic target.*

Claim 5.9 gives GRE a practical rule for epistemic calibration. A highly specific and stable manifestation relation can support comparatively strong inference. A historically unstable, institutionally mediated, strategically manipulated, or weakly understood relation requires wider uncertainty. Multiple independent evidential routes can strengthen the claim when their errors and assumptions are sufficiently distinct. Apparent convergence among representations generated from the same underlying classification or dataset provides less independent support than its numerical multiplicity might suggest.

The rule also preserves room for knowledge that is historical and partial. A past relation may be reconstructable only through surviving traces whose production was unequal. A marginalized actor's experience may be poorly represented in official archives but partially recoverable through testimony, material traces, later records, or the consequences of institutions. A new scientific instrument can disclose structures inaccessible to earlier observers. An AI system can reorganize vast amounts of evidence while inheriting the exclusions embedded in its sources. Epistemic warrant therefore depends partly on understanding the history and distribution of access to manifestations.

Section 112 establishes the basic epistemic problem that follows from the ontology of Chapter 4. GRE can pursue knowledge without final ontological settlement because epistemic claims can be targeted, scoped, and warranted at different levels. Relational reality supplies an object of inquiry whose evidence may precede explicit recognition; manifestational reality provides access without guaranteeing exhaustive disclosure; representation expands and transforms that access; and inference across registers requires explicit bridges rather than assumed identity. The next section develops the most immediate technical consequence of this architecture: the inverse problem of manifestation, in which an inquiry must reconstruct relational configurations from manifestations that may be compatible with more than one generative history.

5.2 The Inverse Problem of Manifestation

Section 5.1 established that manifestation supplies epistemic access without guaranteeing exhaustive disclosure of relational reality. The present section develops the most immediate consequence of that position: inquiry frequently proceeds in the inverse direction, beginning from what has become manifest and attempting to reconstruct the relational configurations, histories, and generative conditions compatible with it. The role of this section is to formulate that reconstruction problem as an epistemic problem rather than merely a formal property of manifestation mappings. Its objective is to clarify what can be known when several relational configurations remain compatible with the same manifestation, when one configuration can manifest differently across contexts, and when the mapping itself changes historically. The discussion proceeds through relational reconstruction, non-invertibility, manifestational equivalence, multiple relational explanations, contextual dependence, and historical dependence. The method is inferential: it treats reconstruction as a constrained comparison among compatible relational accounts whose warrant can increase without requiring unique recovery of a single complete antecedent configuration.

The inverse problem should be distinguished from ordinary uncertainty about whether an observation is correct. A manifestation can be accurately recorded and still fail to identify uniquely the relational configuration that generated it. A price can be measured precisely while remaining compatible with heterogeneous market structures, expectations, constraints, and institutional conditions. A legal status can be documented unambiguously while leaving open several paths through which it was produced and several relations through which it is maintained. A behavioral regularity can be reproducible while admitting different accounts of trust, coercion, habit, incentives, or institutional filtering. The epistemic difficulty therefore concerns the relation between manifestation and reconstruction, not simply noise in the manifestation itself. This problem belongs to a wider family of underdetermination problems in which evidence constrains explanation without necessarily selecting a unique account (Duhem 1954; Quine 1951; Stanford 2023).

Definition 5.10 (Inverse epistemic problem of manifestation)**.** The *inverse epistemic problem of manifestation* is the problem of determining which claims about relational reality are warranted from one or more manifestations when the relations connecting relational configurations to those manifestations may be selective, many-to-one, one-to-many, context-dependent, historically variable, or only partially known.

Definition 5.10 makes the epistemic target central. An inquiry need not reconstruct every relation that participated in the history of a manifestation. It may seek only the relations relevant to a specified causal question, institutional mechanism, distributional pattern, or generative consequence. Invertibility is therefore too strong as a universal standard. The more appropriate question is whether the target of inquiry is *identifiable enough* under the available manifestations, assumptions, and conditions to support the intended claim.

5.2.1 From Manifestation to Relational Knowledge

Movement from manifestation to relational knowledge requires an inferential bridge. Section 5.1 called such movement a cross-register inference. The inverse problem makes its structure explicit. Let Y denote a selected manifestational domain, X a selected domain of relational configurations, and C the material, historical, institutional, perceptual, or technical conditions under which manifestation occurs. For an observed manifestation $y \in Y$, the epistemic task is to determine which elements of X remain compatible with y under C and which features of those elements can be warranted from the available evidence.

A useful starting object is the compatibility set developed in Chapter 4. For present epistemic purposes, however, the set should include the evidential and modeling assumptions through which compatibility is judged. Let E denote the available evidential corpus and A the explicit auxiliary assumptions of the inquiry. The epistemically admissible compatibility set is represented in Equation 5.1.

$$\mathcal{K}(y \mid C, E, A) = \{x \in X \mid x \text{ remains compatible with } y \text{ under } C, E, A\}. \tag{5.1}$$

Equation 5.1 is intentionally general. It does not assume that compatibility is probabilistic, metric, deterministic, or reducible to one formal model. In one inquiry, compatibility may be defined by a causal model and a likelihood. In another, it may depend on archival consistency, institutional sequence, legal records, qualitative traces, or process evidence. The equation serves to expose the epistemic structure: the observed manifestation constrains the candidate relational domain, but auxiliary assumptions and available evidence also shape what remains admissible.

This formulation makes two kinds of epistemic progress visible. The first is *eliminative progress*: additional evidence or stronger constraints remove relational configurations from $\mathcal{K}$. The second is *structural progress*: even when several configurations remain, inquiry discovers features shared across them. A researcher may be unable to identify one complete generative history while becoming highly confident that every serious account requires, for example, a particular institutional dependency, a threshold effect, a gatekeeping relation, or a temporal ordering. Relational knowledge can therefore increase through identification of invariants across compatible reconstructions.

Definition 5.11 (Relational identifiability)**.** An epistemic target is *relationally identifiable* relative to manifestations, conditions, evidence, and auxiliary assumptions when the admissible compatibility set is sufficiently constrained that the target property or relation takes a determinate, or appropriately bounded, form across the configurations that remain epistemically viable.

Relational identifiability in Definition 5.11 is weaker than complete inversion. A target can be identifiable even when the full configuration is not. If every viable reconstruction contains the same access restriction, the restriction can be well supported despite disagreement about other relations. If several histories produce the same observed institution but all require a durable asymmetry in control over a resource, that asymmetry may be identifiable even when the exact historical pathway

is not. The epistemic aim is therefore calibrated reconstruction rather than maximal reconstruction by default.

This also places model choice under scrutiny. Models can narrow the compatibility set by imposing structure, but narrowing through assumption should not be confused with narrowing through evidence. A representation can produce a unique estimate because the model excludes alternatives by construction. The uniqueness of the output then reflects both evidence and imposed structure. Model-based scientific representation is therefore epistemically powerful precisely when the relation between target, idealization, and representational purpose remains explicit (Giere 2004).

5.2.2 Non-Invertibility

Non-invertibility becomes epistemically significant when the manifestations available to inquiry fail to support unique recovery of the target relational configuration at the required scale. Chapter 4 treated this as a structural property of manifestation mappings. Chapter 5 adds the inferential consequence: non-invertibility creates a disciplined space of possible reconstructions and therefore requires explicit management of underdetermination.

Several sources of non-invertibility should be distinguished. *Compression* occurs when the manifestation preserves fewer distinctions than the relational configuration contains. *Aggregation* occurs when several units or relations contribute to a common manifest value. *Convergence* occurs when different generative trajectories reach similar manifest states. *Contextual transformation* occurs when the same relational configuration becomes manifest differently under changing conditions. *Selective observation* occurs when only some relations generate traces accessible to the inquiry. *Representational standardization* occurs when heterogeneous manifestations are translated into a common administrative, statistical, legal, or computational form. These mechanisms can coexist.

The epistemic implication is not that every explanation is equally plausible. Evidence can sharply constrain the compatibility set while leaving more than one serious relational account. The classical problem of underdetermination is useful here because it separates multiplicity of compatible explanation from unrestricted arbitrariness (Duhem 1954; Quine 1951; Stanford 2023). GRE adds two qualifications. First, the competing accounts may differ not only in theory but in the relational histories they reconstruct. Second, the mappings that produce evidence can themselves be historically generated and causally operative within the system under investigation.

Claim 5.12 (Non-invertibility and calibrated knowledge)**.** *Manifestational non-invertibility limits the uniqueness and scope of relational reconstruction, while remaining compatible with strong knowledge of properties that are stable across the admissible compatibility set or independently supported through additional evidential relations.*

Claim 5.12 prevents two opposite errors. One error treats a determinate manifestation as if it carried a unique relational antecedent. The other treats non-unique reconstruction as if it eliminated knowledge altogether. The appropriate response is to state which parts of the reconstruction are stable, which remain conditional, and

which depend on assumptions that alternative accounts do not share.

Intervention can sometimes improve identifiability by generating new manifestations under deliberately altered conditions. Comparative cases can serve a similar function when they vary relations that competing explanations treat differently. Historical evidence can discriminate between mechanisms that predict the same present manifestation but require different sequences. Qualitative evidence can reveal relations erased by standardized indicators. Formal analysis can characterize equivalence classes of models or mechanisms. These methods do not share a single epistemic form, yet each can reduce or reorganize the compatibility set. Methodological plurality therefore becomes a response to relational underdetermination rather than a generic preference for variety.

5.2.3 Manifestational Equivalence

The inverse problem becomes especially difficult when distinct relational configurations are manifestationally equivalent relative to the criteria of an inquiry. Chapter 4 defined manifestational equivalence as local indistinguishability under a specified manifestation regime. The epistemic task is to determine what, if anything, that equivalence licenses about the underlying relations.

Definition 5.13 (Epistemic manifestational equivalence)**.** Two relational configurations are *epistemically manifestationally equivalent* for an inquiry when the manifestations available under the inquiry's operative conditions and distinctions do not provide sufficient grounds to discriminate between them with respect to the specified epistemic target.

This definition is deliberately inquiry-relative. Two configurations can be equivalent for a narrow target and distinguishable for another. Two firms may be equivalent with respect to an observed quarterly profit while differing sharply in debt exposure, labor organization, ecological dependence, and technological trajectory. Two households may have the same income while differing in unpaid care burdens, legal vulnerability, asset ownership, and access to social networks. Two AI systems may produce indistinguishable outputs on a benchmark while relying on different training histories, architectures, compute requirements, or governance arrangements. The manifestation criterion determines the domain of equivalence; it does not erase relational difference outside that domain.

Manifestational equivalence should also be distinguished from measurement error. Perfect measurement of the operative manifestation may leave the equivalence intact. Increasing precision can reduce uncertainty around y without reducing multiplicity in $\mathcal{K}(y \mid C, E, A)$. If the measurement captures only a projection of the relational configuration, more precise measurement of that projection does not automatically recover omitted dimensions. Epistemic improvement may require a different manifestation, a new intervention, a changed scale, or access to another trace rather than greater precision of the same indicator.

This distinction is important for political economy because standardized measures often become authoritative precisely through their apparent comparability. Prices, incomes, productivity measures, credit scores, rankings, standardized legal categories, and algorithmic classifications create manifestational domains in

which heterogeneous relations become comparable for practical purposes. Such comparability can be administratively or economically powerful while remaining epistemically incomplete. A common scale can organize action without establishing that the underlying relational configurations are commensurable in every dimension.

Remark 5.14 (Equivalence and epistemic humility)*.* Manifestational equivalence warrants restraint concerning relational difference; it does not warrant a presumption of relational identity. The absence of discriminating manifestation is an epistemic condition, not proof that no relevant difference exists.

Remark 5.14 is especially important where some relations are systematically less likely to leave durable traces. Informal labor, care work, coercion, tacit exclusion, undocumented exchange, affective dependence, and relations involving actors with limited institutional voice can be weakly represented in official records. A manifestational regime can therefore produce equivalence partly because it lacks distinctions through which certain relational differences become legible. The inverse problem is consequently linked to the social distribution of epistemic visibility.

5.2.4 Multiple Relational Explanations

When several relational explanations survive the available evidence, GRE requires criteria for comparing them without pretending that one must always be selected immediately. The objective is neither permanent suspension nor premature closure. It is to make the remaining alternatives explicit and identify what additional evidence, interventions, or conceptual distinctions would materially discriminate among them.

Multiple explanations can differ in several ways. They can identify different relations as causally central, assign different roles to the same relation, specify different historical sequences, draw boundaries around the system differently, or treat a manifestation as generated at different scales. They can also agree on a local mechanism while disagreeing about its wider embedding. Two explanations of wage change, for example, might agree that bargaining institutions matter while differing on whether technological change, labor-market concentration, legal structure, organizational strategy, or macroeconomic conditions explain the institutional shift that preceded the observed outcome.

A relational comparison should therefore examine more than goodness of fit to the manifestation. It should ask whether the explanation preserves relevant temporal order, accommodates independent traces, survives comparison across contexts, specifies the mechanism through which relations generate the manifestation, and remains coherent when the analysis changes scale. Explanations should also expose rather than hide their auxiliary assumptions. Longino's account of evidential reasoning is useful here because it emphasizes that the relevance and interpretation of evidence depend on background assumptions that become more reliable when subjected to critical scrutiny from alternative perspectives (Longino 1990).

Proposition 5.15 (Comparison of relational reconstructions)**.** *When several relational reconstructions remain compatible with the available manifestations, GRE should compare them through the target-relevant structure they preserve, the independent evidence they accommodate, the assumptions they require, their sensitivity*

to scale and context, and the discriminating consequences they generate for further inquiry or intervention.

Proposition 5.15 allows several outcomes. One reconstruction may become substantially better supported. Several may remain viable but share a common relational core. Different reconstructions may be useful at different scales or for different targets. A disagreement may remain unresolved because the surviving evidence does not discriminate among the alternatives. These outcomes should be reported differently. The epistemic vocabulary should preserve the difference between identification, bounded inference, comparative support, and unresolved plurality.

The possibility of a common core is particularly important. Suppose several explanations disagree about the exact mechanism through which a platform acquired market dominance, but every viable account requires asymmetric control over access to a critical infrastructure. The broader claim about infrastructural asymmetry may then be better supported than any single complete historical reconstruction. GRE can therefore advance through partial relational invariants even where the full inverse problem remains open.

5.2.5 Context Dependence

Inverse reconstruction is conditioned by the context in which manifestation occurs. A manifestation relation that is highly discriminating in one context can become weakly informative in another. The same behavior can indicate trust where exit is feasible and indicate compliance where sanction is severe. The same price can emerge under competitive exchange, administered pricing, scarcity, speculation, subsidy, or strategic restriction. The same legal category can carry different practical consequences depending on enforcement, institutional capacity, and adjacent rights. Context therefore enters the inverse problem as part of the generative conditions of manifestation.

Context should not be treated as an unlimited residual category. For epistemic purposes, relevant context consists of conditions whose variation materially changes the relation between the target configuration and the manifestation. These conditions can be institutional, technological, cultural, ecological, legal, spatial, temporal, or relational. Identifying them is part of the reconstruction problem. A good explanation should specify which contextual differences are expected to alter manifestation and which are irrelevant to the target claim.

This requirement also limits unrestricted transfer of inference across populations or domains. A manifestation relation established in one institutional setting cannot be assumed to retain the same specificity elsewhere. A survey item, performance indicator, transaction record, or behavioral proxy can acquire different meanings when incentives, classifications, norms, or available alternatives change. Perspectival and model-based accounts of scientific representation are relevant because representations are constructed for purposes and from positions that select some relations while omitting others (Giere 2004; Longino 1990).

Claim 5.16 (Contextual portability of inverse inference)**.** *An inverse inference is portable across contexts only to the extent that the conditions governing the relevant manifestation relation remain sufficiently stable, or the differences among contexts are*

explicitly modeled and supported by evidence.

The claim prevents an observed regularity from being elevated too quickly into a context-independent relational law. It also permits legitimate generalization when invariants are demonstrated. GRE is not committed to contextual uniqueness. It is committed to making the conditions of portability part of the epistemic claim.

Context can also be actively altered by inquiry. Publication of a metric can change the behavior measured by that metric. A legal classification can reorganize conduct. A forecast can alter expectations. An AI-generated representation can modify subsequent decisions. In such cases, the manifestation relation at a later time partly reflects earlier epistemic activity. The inverse problem must therefore account for reflexive contexts in which observation, representation, and intervention become part of the generative field.

5.2.6 Historical Dependence

Historical dependence gives the inverse problem a further dimension. The same manifest form can arise from different historical sequences, and the same symbol or category can change its relational meaning over time. Reconstruction therefore concerns not only which configuration is compatible with a manifestation, but which trajectory could have generated and sustained that configuration under historically specific conditions.

A present manifestation frequently contains only compressed traces of its history. An institution can preserve rules whose originating conflict is no longer visible. A market convention can remain stable after the conditions that first produced it have changed. A category can continue to be recorded even while its institutional meaning shifts. A relation can become self-reinforcing, so that its present persistence depends less on the mechanism that initiated it than on later feedbacks. Present-state evidence therefore may be insufficient for distinguishing origin, stabilization, and reproduction.

Historical reconstruction expands the evidential field by incorporating sequence, timing, archival traces, testimony, material residues, prior classifications, and changes in the manifestation regime itself. It also introduces losses that cannot always be repaired. Records can be destroyed, never created, selectively preserved, or generated through institutions that gave some actors far greater capacity to leave durable traces than others. The compatibility set for a historical inverse problem can therefore remain permanently wider than the set that would have been available to a contemporary observer with richer access.

Definition 5.17 (Historically indexed inverse problem)**.** A *historically indexed inverse problem* reconstructs a relational configuration or trajectory from manifestations whose production, preservation, interpretation, and evidential significance are themselves functions of historical conditions that may change across the period under study.

Definition 5.17 prevents current interpretive categories from being projected backward without qualification. A record must be understood partly through the manifestation and representational relations under which it was produced. A category

recorded identically at two dates can refer to different institutional realities. A silence in an archive can mean absence, non-recording, suppression, destruction, or lack of institutional recognition. Historical evidence therefore requires reconstruction of the conditions under which traces became possible.

Historical dependence also makes revision an ordinary feature of knowledge. New archives can become available, new techniques can make previously inaccessible traces legible, later events can reveal relations whose earlier significance was unclear, and new concepts can permit distinctions that prior inquiry did not formulate. Such revision does not imply that historical claims are arbitrary. It means that the admissible compatibility set and the criteria for comparing reconstructions can change as evidence and epistemic resources change.

The inverse problem of manifestation consequently provides a bridge between the ontology of Chapter 4 and the more detailed epistemology developed in the remainder of Chapter 5. Relational knowledge begins from manifestations that constrain without necessarily determining their antecedent configurations. Non-invertibility produces underdetermination but still permits strong claims about identifiable properties and shared relational structure. Manifestational equivalence is local to an epistemic regime rather than proof of relational identity. Multiple explanations can be compared through preserved structure, independent evidence, explicit assumptions, and discriminating consequences. Context governs the portability of inverse inference, while history governs both the production of manifestations and the survival of traces. The next section turns from the inverse problem itself to knowledge of the manifestation relations on which such reconstruction depends.

5.3 Knowledge of Manifestation Relations

Sections 5.1–5.2 established that manifestation can provide evidential access to relational reality while leaving the inverse reconstruction problem underdetermined. The present section develops a further requirement that follows from this position: inquiry must seek knowledge not only of manifestations and relational targets, but also of the *relations through which those manifestations are generated*. The role of this section is to make manifestation relations themselves objects of epistemic inquiry. Its objectives are to distinguish knowledge of manifest content from knowledge of the manifestation relation, identify evidence that can support claims about such relations, specify when manifestation rules may be treated as sufficiently stable for inference, analyze changes in those rules, reconstruct them historically, and represent uncertainty about the mapping between relational and manifestational reality. The discussion proceeds methodologically from object specification to evidence, stability, change, history, and uncertainty. Throughout, manifestation relations are treated as historically situated and potentially causally operative components of generative-relational systems rather than as transparent channels standing outside the realities they mediate.

The need for this distinction can be seen whenever the same observed quantity, category, behavior, or representation changes its epistemic meaning because the process that produces it has changed. A stable unemployment rate can arise under al-

tered definitions of labor-force participation. A legal classification can retain the same label while the procedures through which it is assigned change. A platform metric can preserve its numerical form after an algorithmic ranking system has been revised. A recurring expression of trust can be generated by voluntary confidence in one setting and strategic conformity in another. In each case, accurate knowledge of the manifestation does not by itself establish knowledge of the manifestation relation. The epistemic relation between a manifestation and its target therefore depends partly on whether the inquiry understands how, under what conditions, and with what transformations the manifestation is produced.

Definition 5.18 (Manifestation relation as an epistemic target)**.** A *manifestation relation as an epistemic target* is the delimited set of conditions, mechanisms, transformations, selections, mediations, and response regularities through which a specified relational configuration contributes to a specified manifestation within a stated spatial, temporal, scalar, and institutional domain.

Definition 5.18 avoids treating the manifestation relation as a universal function whose form is known in advance. In some domains the relation may be well approximated by a measurement model, response function, or probabilistic mapping. In others it may involve legal procedures, classificatory conventions, organizational routines, interpretive practices, material affordances, or historically accumulated symbolic forms. The epistemic task is to identify the relevant mediations at the level needed by the inquiry. A manifestation relation can therefore be known partially and locally without being reduced to a single formal expression.

This formulation also preserves the graph architecture established in Chapter 4. A manifestation relation is not merely a one-way conduit from relational reality to appearance. The institutions, instruments, categories, and practices through which manifestation occurs can themselves be relationally real and causally consequential. Quantification, standardization, and classification are especially clear cases: the procedures that make social or economic realities legible can organize later conduct, stabilize categories, and alter the very relations subsequently observed. Historical studies of quantification and statistical classification show that apparently neutral representational infrastructures can be institutionally produced and historically variable (Porter 1995; Desrosières 1998). Knowledge of manifestation relations must therefore include, where relevant, knowledge of their participation in subsequent generation.

5.3.1 Manifestation Relations as Objects of Knowledge

Treating manifestation relations as objects of knowledge changes the structure of epistemic inquiry. A researcher ordinarily asks what a manifestation indicates about a target. GRE adds a prior and recurrent question: what warrants the assumption that this manifestation is related to that target in the way the inference requires? The question is not answered merely by naming an indicator, instrument, category, or observation protocol. It requires an account of the relation that makes the manifestation evidentially relevant.

At least four components should be distinguished. The first is the *source domain*: the relational configurations or properties capable of contributing to the manifestation. The second is the *mediating domain*: the material, institutional, perceptual,

computational, symbolic, or procedural conditions that transform or select aspects of the source. The third is the *manifest domain*: the traces, measurements, classifications, behaviors, records, or appearances accessible to inquiry. The fourth is the *scope condition*: the domain within which the inferred relation is expected to hold. These components need not be independent. A legal procedure can belong to the mediating domain while also changing the source relations it classifies; an observer can generate a record while participating in the relation being observed; a statistical standard can produce comparability and thereby alter institutional decisions.

Knowledge of a manifestation relation is therefore not equivalent to possession of a fixed codebook. A codebook can state how categories are currently assigned while leaving the historical emergence, practical implementation, discretionary variation, and feedback effects of classification unspecified. Likewise, an algorithmic documentation page can state an output rule while omitting data-generation processes, upstream filtering, model updates, organizational overrides, and strategic responses by users. The epistemic object is the operative relation in context, not only its official representation.

Claim 5.19 (Manifestation-relation dependence of evidential inference)**.** *The warrant of an inference from a manifestation to a relational target depends partly on the warrant for the manifestation relation presupposed by that inference. Strong confidence in the manifest content cannot by itself compensate for weak knowledge of how that content is generated, selected, transformed, or recorded.*

Claim 5.19 does not require complete knowledge of the manifestation relation before any inference is possible. Many successful inquiries proceed with partial knowledge of measurement mechanisms, institutional processes, or behavioral responses. The claim instead makes the missing knowledge explicit. Where the inference is insensitive to plausible variation in the manifestation relation, partial knowledge may be sufficient. Where small changes in the relation would reverse the conclusion, the relation becomes an especially important epistemic target.

This dependence can itself be scale-relative. At one scale, a standardized price index may function as a sufficiently stable manifestation relation between sampled prices and an aggregate inflation measure. At another, the inquiry may concern how substitution rules, quality adjustments, sampling frames, or consumption heterogeneity shape the index. The first inquiry may legitimately treat the mapping as provisionally fixed; the second makes its internal construction the object of analysis. Epistemic adequacy therefore depends on whether the manifestation relation is specified at the scale at which it materially affects the claim.

5.3.2 Evidence for Manifestation Relations

Evidence for a manifestation relation differs from evidence carried through that relation. Observing that a metric changes is evidence about the metric's value. Establishing that the metric reliably tracks a relational property requires additional evidence about the production of the metric and its connection to the target. This distinction is familiar in scientific modeling and measurement, where representational adequacy depends on purposive relations between models, targets, and selected respects of similarity rather than identity between representation and world (Giere 2004). GRE

generalizes the distinction to institutional, historical, symbolic, and social manifestations.

Several evidential routes can support a manifestation relation. *Repeated covariation* can show that changes in a target-relevant configuration are regularly accompanied by changes in the manifestation. *Intervention evidence* can test whether changing a source condition alters the manifestation in the expected direction. *Mechanism evidence* can identify the mediating process through which the source contributes to the manifest outcome. *Cross-context comparison* can reveal which components of the relation remain stable when surrounding conditions vary. *Calibration* can compare the manifestation against an independently accessible reference. *Process and documentary evidence* can reconstruct institutional procedures, classificatory decisions, instrument design, and implementation. *Negative and discrepant cases* can identify circumstances in which the presumed relation fails. No single route has universal priority; their relevance depends on the epistemic target and the type of manifestation relation involved.

The evidential problem becomes particularly important when the manifestation relation is partly strategic. Survey respondents can adapt answers to perceived expectations. Firms can change reported categories after regulatory thresholds are announced. Platform participants can optimize behavior to ranking metrics. States and organizations can reorganize records in response to performance indicators. In such settings, the manifestation relation contains endogenous responses to observation or evaluation. What appears to be a measurement of an antecedent relation can become part of a feedback process that changes the target itself.

Evidence for manifestation relations should therefore be triangulated where possible. A behavioral trace, an institutional record, a participant account, and an intervention response may each be incomplete, yet their conjunction can constrain the plausible mapping more strongly than repeated observation of one manifestation alone. Longino's emphasis on the role of background assumptions in evidential reasoning is relevant here: evidence becomes more reliable when the assumptions linking observation and conclusion are exposed to criticism from alternative perspectives and bodies of knowledge (Longino 1990). For GRE, manifestation relations are among the central background structures that should be made contestable.

Definition 5.20 (Manifestation-relation warrant)**.** *Manifestation-relation warrant* is the degree to which available evidence supports a specified account of how a relational configuration contributes to a manifestation under stated conditions, including the relevant mediations, scope conditions, and known failure modes.

The definition deliberately avoids reducing warrant to a single numerical confidence score. Some manifestation relations can be estimated probabilistically; others may be supported by process evidence, institutional documentation, historical comparison, or qualitative reconstruction. What matters is that the basis of the warrant is inspectable. A claim about a stable manifestation relation should state what kind of evidence supports stability, what contexts have been examined, and which plausible changes could undermine the inference.

5.3.3 Stability of Manifestation Rules

Inference commonly relies on some degree of stability in manifestation rules. A rule is stable when sufficiently similar relational configurations under sufficiently similar conditions continue to generate manifestations in a way that preserves the distinctions relevant to the epistemic target. Stability does not require exact invariance. Measurement error, contextual modulation, observer variation, and stochastic response may coexist with a mapping that remains stable enough for a particular inference.

The epistemic importance of stability is straightforward. If the relation between target and manifestation changes unpredictably while the inquiry assumes it is fixed, temporal comparison can become misleading. Apparent change in the target can be generated by a changed manifestation rule; apparent continuity can be produced by compensating changes in the source and the mapping. Conversely, a stable manifestation relation can support stronger comparison across observations even when the target itself is dynamic.

Stability should be specified with respect to what is preserved. A classification rule may preserve category membership while changing the threshold by which membership is assigned. A statistical series may preserve its name while changing data sources. A linguistic expression may remain lexically stable while its institutional meaning changes. A market price may remain continuously observable while the microstructure generating it changes. Epistemic claims should therefore avoid treating nominal continuity as evidence of mapping stability.

Definition 5.21 (Epistemic stability of a manifestation rule)**.** A manifestation rule is *epistemically stable* for a specified inquiry when variation in the rule across the relevant domain remains sufficiently bounded that the target-relevant distinctions carried by the manifestation are preserved to the degree required by the claim.

Definition 5.21 makes stability claim-relative. The same mapping can be stable for one inquiry and unstable for another. A survey item may be adequate for tracking broad directional change while too unstable for fine cross-cultural comparison. An administrative category may support short-run monitoring while failing across a major legal reform. A model may preserve local ranking while failing to preserve cardinal magnitude. The relevant standard is whether the manifestation relation preserves the information required by the epistemic target.

Repeated successful use can increase confidence in stability, but historical repetition alone is insufficient. A rule can appear stable because the range of conditions encountered so far has been narrow. Stability claims therefore gain strength when they survive meaningful variation in context, scale, population, institutional setting, or intervention. This is one reason comparative and historical analysis matter even for apparently technical measurement systems.

5.3.4 Change in Manifestation Rules

Manifestation rules can change because instruments change, institutions revise procedures, categories acquire new meanings, observers alter practices, populations adapt strategically, or the underlying relational system reorganizes the mediations

through which it becomes manifest. Such change is epistemically consequential because a discontinuity in the mapping can be mistaken for a discontinuity in the target, while transformation in the target can be hidden by a compensating change in the mapping.

Several forms of change should be separated. *Parametric change* alters the strength or threshold of a familiar relation while leaving its broad structure recognizable. *Procedural change* alters the steps through which the manifestation is produced. *categorical change* alters the distinctions encoded by the manifestation. *infrastructural change* alters the technical or institutional system that makes the manifestation possible. *reflexive change* occurs when actors adapt to the manifestation regime itself, thereby changing the relation between underlying activity and observed trace. These changes need not occur independently.

Historical accounts of scientific and administrative categories provide useful precedents for taking such transformations seriously. Kuhn's account of historically organized scientific practice and Hacking's work on historical ontology both emphasize, in different ways, that concepts, objects of inquiry, and styles of reasoning can change with the practices through which they are constituted and investigated (Kuhn 1962; Hacking 2002). Statistical and administrative histories similarly show that classification and quantification regimes can change the terms through which populations and activities become comparable (Desrosières 1998; Porter 1995). GRE treats these observations as reasons to make the history of manifestation rules part of epistemic analysis rather than as grounds for generalized relativism.

Claim 5.22 (Manifestation-rule change and apparent target change)**.** *Observed change in a manifestation can reflect change in the relational target, change in the manifestation relation, or interaction between both. Epistemic attribution of change therefore requires evidence capable of distinguishing these possibilities to the degree relevant to the inquiry.*

The claim has direct consequences for time-series reasoning. Longitudinal comparability requires more than repeated use of the same label or numerical format. The inquiry should identify whether definitions, sampling frames, measurement technologies, legal procedures, data-generating practices, or strategic responses have changed. Where they have, continuity may need to be reconstructed rather than assumed. In some cases no defensible adjustment can restore comparability, and the epistemically appropriate result is a documented discontinuity.

Rule change can also be a substantive object of GRE. A new manifestation regime may redistribute visibility, recognition, and institutional consequences. When a platform introduces a new reputation score, when a state changes a legal classification, or when an organization adopts a new performance metric, the alteration can change who becomes visible, which relations count, and which actions become consequential. The epistemic history of the mapping therefore intersects with the generative history of the system.

5.3.5 Historical Reconstruction of Manifestation

Historical reconstruction becomes necessary when present manifestations are interpreted through relations that have changed over time. The task is not merely to re-

cover earlier observations. It is to reconstruct, as far as evidence permits, the conditions under which those observations were generated and the distinctions that they could legitimately support at the time. A historical series assembled from surviving records may contain values whose apparent uniformity conceals changes in classification, collection, administrative purpose, or institutional coverage.

Historical reconstruction should therefore treat manifestation relations as trajectories. An archive records not only events but the effects of selection, preservation, categorization, institutional purpose, and survival. A legal register reflects the rules under which statuses were recorded. A price series depends on which exchanges became observable and comparable. A corpus of published research reflects publication practices, disciplinary categories, and technical capacities. Present access to these traces is further mediated by later preservation, digitization, indexing, and interpretation. The epistemic object is thus a historically layered relation between past relational configurations, past manifestation practices, surviving traces, and present reconstruction.

This layered view prevents two opposite errors. The first is *presentist projection*: assuming that a present category had the same meaning, boundary, or measurement relation in the past. The second is *historical skepticism*: concluding that because manifestation relations changed, disciplined comparison is impossible. Reconstruction can often identify periods of relative stability, explicit breaks, overlapping regimes, conversion rules, and residual uncertainty. The goal is to preserve warranted comparability where possible and preserve documented non-comparability where it is not.

Definition 5.23 (Historical reconstruction of a manifestation relation)**.** The *historical reconstruction of a manifestation relation* is the evidence-guided recovery of the conditions, rules, mediations, scope, and transformations through which a past relational configuration became manifest and through which its traces became available to present inquiry.

The definition includes the history of preservation because surviving evidence is itself selective. An event may have generated many manifestations, only some of which were recorded; only some records may have survived; and only some surviving records may be accessible or legible under present categories. Knowledge of the historical manifestation relation therefore includes knowledge of loss, silence, and differential preservation where those factors materially affect inference.

This is also where historical reconstruction connects to later questions of epistemic justice. Some manifestation systems systematically privilege actors with greater institutional visibility, literacy, administrative recognition, or control over record-making. The resulting archive can reproduce those asymmetries. Section 115 will distinguish relation, trace, and evidence more finely; the present point is that the evidential status of a historical trace depends partly on knowledge of the manifestation and preservation relations through which it exists.

5.3.6 Uncertainty about Manifestation Mapping

Manifestation relations are often only partly known. Uncertainty can concern which source relations matter, which mediators intervene, whether the rule is stable, how

actors respond to observation, whether different contexts share the same mapping, or how the mapping changed historically. This uncertainty should be represented explicitly because it propagates into the inverse reconstruction problem developed in Section 5.2.

At least three forms of uncertainty are useful to distinguish. *Structural uncertainty* concerns the form of the manifestation relation: which mediators and transformations belong in the account. *parametric uncertainty* concerns the magnitude, threshold, probability, or sensitivity of a relation whose broad form is accepted. *historical uncertainty* concerns when and how the relation changed, including uncertainty generated by incomplete documentation. A fourth form, *scope uncertainty*, concerns the domain across which a relation can be transported without substantial alteration.

These uncertainties can combine. A researcher may know that an administrative indicator is generated from a defined set of records while remaining uncertain about discretionary implementation across offices. A model may be well calibrated in one period while facing scope uncertainty after institutional reform. Historical sources may document a category change without revealing how quickly practice changed on the ground. GRE should therefore avoid representing mapping uncertainty as a single generic error term when the structure of the uncertainty matters to interpretation.

Claim 5.24 (Propagation of manifestation-mapping uncertainty)**.** *Uncertainty about a manifestation relation propagates into claims inferred through that relation. The propagated uncertainty need not invalidate the claim, but the claim's strength should reflect the range of target-relevant conclusions compatible with serious alternatives concerning the mapping.*

Claim 5.24 creates a direct connection between Sections 5.2 and 5.3. The compatibility set in the inverse problem should expand when several plausible manifestation relations remain open and contract when evidence rules them out. A reconstruction that appears unique under one fixed mapping may become non-unique once mapping uncertainty is admitted. Conversely, some target properties may remain invariant across plausible mappings and can therefore retain strong warrant despite uncertainty about the complete relation.

Epistemic progress can accordingly take several forms. Inquiry can improve knowledge of the target while holding the mapping provisionally fixed; improve knowledge of the mapping while leaving the target uncertain; identify properties robust across several plausible mappings; or discover that an earlier inference depended on a manifestation relation that no longer holds. Such revision is not an embarrassment to relational epistemology. It is one of its expected modes of development.

Knowledge of manifestation relations thus occupies a central position between ontology and empirical method. The three-register architecture makes manifestation possible without reducing reality to what appears; the inverse problem shows why manifestations do not uniquely reconstruct their sources; and the present section shows that the mapping connecting source and manifestation is itself historically situated, evidentially investigable, and uncertain. The next section turns from knowledge of the mapping to the traces through which relations become evidentially accessible. That transition shifts the emphasis from the rules of manifestation to the heteroge-

neous traces that those rules produce, preserve, obscure, or fail to generate.

5.4 Relation, Trace, and Evidence

The preceding sections established that GRE often encounters relational reality indirectly: manifestations are generated through historically variable manifestation relations, and reconstruction from manifestation toward relational structure is generally non-invertible. The present section introduces the evidential vocabulary required to proceed under those conditions. Its role is to distinguish the relation under inquiry from the traces through which that relation becomes accessible and from the evidential status later assigned to those traces. The section develops eight connected distinctions: relation and evidence of relation, direct and indirect traces, observable and inferred relations, latent and hidden relations, and the difference between absence of evidence and evidence of absence. The method is deliberately relational. A trace is treated neither as a transparent fragment of reality nor as an arbitrary sign; its evidential force depends on the generative relation through which it arose, the conditions under which it was preserved or observed, and the inferential target for which it is being used.

This distinction matters because the same material or symbolic object can occupy different epistemic roles. A contract, message log, transfer record, testimony, administrative category, network edge, or repeated behavioral pattern may be produced by a relation, record a relation, mediate a relation, or become part of the relation's later reproduction. Its existence alone therefore does not determine what it evidences. The evidential question concerns how that object was generated, what relation it bears to the target, what alternative relations could have generated a similar trace, and which relevant traces could have failed to appear or survive. Work on scientific objectivity, statistics, historical classification, and contextual empiricism likewise shows that evidence acquires significance through conventions of production, background assumptions, and institutionalized practices of comparison rather than through mere presence alone (Porter 1995; Desrosières 1998; Hacking 2002; Longino 1990).

Definition 5.25 (Trace)**.** A *trace* is a material, behavioral, institutional, symbolic, statistical, computational, testimonial, or other manifestational remainder whose existence or form was generated, conditioned, or made more probable by a relation, process, event, or configuration relevant to an epistemic target.

Definition 5.25 intentionally keeps the category broad. A trace can be intentionally produced, as in a signed agreement or recorded payment, or unintentionally left, as in a pattern of repeated co-presence, a change in resource flows, a sequence of revisions, or a residue in a technical system. It can be contemporaneous with the relation or generated later by consequences of that relation. It can also be partial: a trace may preserve one dimension of a relation while omitting the dimensions most important to another inquiry.

Definition 5.26 (Evidence)**.** *Evidence* is a trace, manifestation, observation, record, testimony, measurement, comparison, or intervention result that is assigned an inferential role with respect to a specified epistemic target under an articulated account of relevance, reliability, and alternative explanation.

The distinction between Definitions 5.25 and 5.26 is foundational for this chapter. A trace can exist without yet functioning as evidence. It becomes evidence only relative to a claim and an inferential practice. Conversely, evidence need not consist of a single preserved object. A pattern across several weak traces can support a relational claim even when none is individually decisive. Evidence is therefore not a substance attached permanently to an item; it is a role that an item or pattern can occupy within an inquiry.

5.4.1 Relation and Evidence of Relation

A relation and evidence of that relation belong to different analytical categories. The relation is part of the target reality under inquiry; the evidence is part of the epistemic access through which a claim about that reality is evaluated. Confusing the two can produce both false confidence and false skepticism. A recorded edge in a database can be mistaken for the social relation itself, while a relation lacking a convenient record can be treated as if it did not exist. GRE therefore preserves a strict distinction between relational existence and evidential manifestation.

The distinction remains necessary even when the relation is highly formalized. A legal record may be constitutive of a legal relation under a given institutional order, yet the record and the relation are still analytically distinguishable. The record may establish status within one domain while failing to capture informal dependence, effective control, lived meaning, or later transformation. Likewise, an account balance can participate in constituting a monetary relation while still remaining only one manifestational component of a wider system of claims, expectations, institutional enforcement, and access. Constitutive traces are therefore possible, but constitution does not eliminate the need to specify which dimension of the relation the trace supports.

Claim 5.27 (Relational–evidential distinction)**.** *Evidence that a relation exists, persists, or changes should be distinguished from the relation itself and from representations that merely encode or summarize it. The stronger the inferential step from trace to relational claim, the more explicit the inquiry should be about the manifestation relation, plausible alternatives, and the dimensions of the target that remain unobserved.*

Claim 5.27 gives GRE a way to handle heterogeneous records without collapsing them into a single evidential hierarchy. A transcript may provide strong evidence for an utterance, weaker evidence for the speaker's durable intention, and still weaker evidence for the long-term structure of a relation. A transfer record may strongly support that a transaction occurred, while providing only partial evidence about coercion, trust, dependence, or the distribution of alternatives surrounding that transaction. The same trace can therefore carry different evidential weight for different targets.

This target-relativity should not be confused with arbitrary interpretation. The relevant relation between trace and target can itself be investigated. Evidence becomes stronger when the trace-generation process is well understood, competing explanations are constrained, observations are independently corroborated, and the inference remains stable under reasonable alternative codings or models. Evidence becomes weaker when the trace can be generated by many materially different con-

figurations, when preservation is selective, or when the observation system systematically excludes parts of the relation under study.

The relation–evidence distinction also matters for historical inquiry. Present researchers often encounter past relations only through surviving traces. Survival adds an additional manifestation relation: what was produced, what was recorded, what was preserved, what was destroyed, what became legible, and what later institutions chose to index or digitize. Historical evidence therefore bears the history of both the target relation and the evidential infrastructure through which present access becomes possible.

5.4.2 Direct Traces

A direct trace is relatively proximal to the relation or event targeted by the inquiry. Proximity can be temporal, procedural, institutional, material, or causal. Examples include a contemporaneous transaction record for a transfer, an authenticated message for a communication event, a legal filing for a formally registered status, a sensor record for a physical interaction, or an observed sequence of actions within a specified setting. The term *direct* is therefore relational and scoped. It does not mean unmediated access to reality.

Definition 5.28 (Direct trace)**.** A *direct trace* is a trace generated through a relatively short and specified manifestational path from the target relation or relational event to the evidential object, such that the principal transformations between target and trace are sufficiently known for the inquiry's purpose.

The definition makes directness a property of the evidential path rather than of a privileged class of objects. A signed contract may be direct evidence that specified parties entered a recorded agreement under a particular legal procedure. The same contract is not direct evidence that the parties experienced equal bargaining power. An interaction log may be direct evidence that two accounts exchanged messages while remaining weak evidence about friendship, authority, dependence, or trust. Directness therefore does not automatically confer broad scope.

Direct traces can be especially useful for establishing occurrence, timing, sequence, and formally recorded participation. They are less automatically informative about unrecorded motivations, counterfactual options, tacit norms, or distributed conditions. GRE should therefore resist a documentary bias in which formally captured relations appear more real simply because their traces are easier to stabilize and inspect. Institutional systems often produce abundant direct traces for what they are designed to recognize and sparse traces for relations outside their categories. The history of statistical and administrative classification illustrates how standardized records can increase comparability while simultaneously organizing what becomes visible (Porter 1995; Desrosières 1998).

Direct traces can also be strategically generated. A declaration, report, score, or official record may be created precisely because actors anticipate later evaluation. The trace then remains direct with respect to the recorded act while its evidential relation to broader conduct requires additional scrutiny. A compliance certificate can directly establish that a certificate was issued; its value as evidence of substantive compliance depends on the inspection regime, incentives, and possibility of strategic

adaptation. Directness thus reduces some inferential distance without eliminating the need for a manifestation-relation analysis.

5.4.3 Indirect Traces

Many economically significant relations leave no single proximal record. Their existence is reconstructed from downstream effects, repeated patterns, correlated changes, institutional responses, or combinations of traces produced through several mediating steps. Such traces are indirect relative to the target relation. Indirectness does not make them inferior by definition. In some inquiries, a distributed pattern across multiple indirect traces can provide stronger evidence than a formally direct record that captures only one declared aspect of the relation.

Definition 5.29 (Indirect trace)**.** An *indirect trace* is a trace connected to an epistemic target through one or more intervening relations, transformations, consequences, or preservation processes whose contribution must be reconstructed for the trace to support the target claim.

Examples include changes in prices used to infer supply constraints, migration patterns used to investigate changing opportunity structures, repeated exclusion outcomes used to investigate an institutional barrier, or downstream changes in behavior used to investigate a trust relation. In each case, the trace may be compatible with several candidate explanations. The epistemic burden therefore shifts toward discriminating among plausible generative paths.

Indirect traces are particularly important for relations that are distributed, tacit, stigmatized, historically remote, or institutionally unrecorded. A relation of dependence may be inferred from repeated asymmetries of exit, access, and response even when no actor explicitly records the relation as dependence. A field-like constraint may be reconstructed from patterned local outcomes that cannot be attributed to a single dyadic command. A historical relation may become visible only through later consequences because contemporaneous record-making omitted the affected actors. These cases show why GRE cannot limit evidence to explicit self-description or formal documentation.

At the same time, indirect traces invite over-attribution when analysts move too quickly from pattern to relation. Several relational structures can generate similar downstream manifestations, as Section 5.2 established. The disciplined response is triangulation across traces generated through partially independent pathways. Documentary evidence, behavior, testimony, longitudinal change, institutional records, and intervention results can constrain one another when their errors and selection processes are not identical. Contextual empiricism is relevant here because what counts as evidentially probative depends partly on background assumptions that themselves require critical examination (Longino 1990).

Remark 5.30 (Combination of weak traces)*.* Several individually weak traces can jointly support a stronger relational claim when their dependence structure is understood and when the traces constrain overlapping alternatives through sufficiently different manifestation pathways. Simple numerical accumulation of mutually dependent traces does not provide the same warrant.

Remark 5.30 prevents a common mistake in large evidential systems. Thousands of records generated from the same classification rule may contain less independent information than a small set of traces produced through distinct mechanisms. Evidential quantity and evidential diversity are therefore analytically different.

5.4.4 Observable Relations

Some relations can be observed in a relatively direct operational sense. A transfer can be witnessed, a conversation can be heard, an exchange can be recorded, a contractual status can be queried, or a physical connection can be inspected. GRE nevertheless treats observability as relation-specific and regime-specific rather than as a universal boundary between known and unknown objects. Observation itself occurs through a manifestational configuration involving an observer, instrument, category, temporal window, and criterion of recognition.

Definition 5.31 (Operationally observable relation)**.** A relation is *operationally observable* for an inquiry when the relation or a constitutive relational event becomes available within the inquiry's observation regime with sufficiently specified criteria of recognition and sufficiently limited inferential distance for the target claim.

This definition allows an exchange event to be observable while the durable economic relation within which it occurs remains partly inferred. Observing repeated transfers does not by itself settle whether the relation is reciprocal, exploitative, charitable, coerced, strategic, or embedded in a longer obligation. Similarly, observing two persons collaborate can establish interaction while leaving the distribution of authority, dependence, recognition, and future obligation underdetermined.

Operational observability can also be created institutionally. Administrative systems render some relations queryable by assigning identifiers, categories, and records. Network platforms can make interaction histories inspectable. Sensors and digital infrastructures can transform previously ephemeral events into persistent traces. Such changes expand evidential access while also altering the relation between observation and conduct. Once actors know that a relation is observed, the observation regime can become part of the relational system. The epistemology of performative observation will therefore require later attention in Sections 116–118.

A further distinction is useful between observing a relational event and observing a relationally real object. A single communication event can be observed, while a stable trust relation requires evidence of persistence, organization, and causal efficacy across a relevant interval. The GR criterion for relational reality therefore places a higher evidential burden on durable relational claims than on the occurrence of isolated relational events.

5.4.5 Inferred Relations

Most relations studied by GRE are at least partly inferred. Inference becomes necessary whenever the target exceeds any single observation: persistent authority, institutional dependence, social trust, exclusion, access asymmetry, generative capacity, field position, and many forms of economic power are reconstructed from multiple manifestations and traces. The inferred character of these relations does not

weaken them ontologically. It describes the epistemic route through which they become known.

Definition 5.32 (Inferred relation)**.** An *inferred relation* is a relational target whose existence, organization, persistence, or causal role is supported through an explicit inferential synthesis of traces, manifestations, observations, models, or interventions rather than through a single sufficiently proximal observation.

Inference can take qualitative, historical, statistical, computational, formal, or mixed forms. A historian may reconstruct an institutional dependence from correspondence, legal records, and resource flows. An ethnographer may infer a tacit hierarchy from repeated interactional patterns and participants' accounts. A network model may infer ties from event data. A causal analysis may infer a relational effect from variation under a specified design. GRE does not assign automatic priority to one form. The relevant standard is whether the inferential method is appropriate to the target and whether its assumptions and residual alternatives are made visible.

Inferred relations should therefore carry an account of identification. An inquiry should state which traces would be expected under the proposed relation, which serious alternatives remain compatible with the evidence, and which additional observations could discriminate among them. This requirement follows directly from the inverse problem. The relation becomes better identified when competing configurations are progressively constrained, even if unique reconstruction remains unavailable.

The distinction between inferred relation and speculative relation is consequently evidential rather than rhetorical. An inferred relation has articulated support and known inferential conditions. A speculative relation may be worth considering as a hypothesis but lacks comparable constraint. GRE benefits from preserving both categories because early-stage inquiry often needs hypotheses that can guide trace collection without treating those hypotheses as established relational reality.

5.4.6 Latent Relations

Some relations are causally operative without being manifest in the observation channel currently used by an inquiry. GRE describes such relations as latent relative to that epistemic arrangement. Latency is therefore an epistemic condition of access, not a statement that the relation lacks relational reality. A relation can persist, constrain action, and shape subsequent generation while remaining unavailable to a particular observer, instrument, category, or temporal window.

Definition 5.33 (Latent relation)**.** A *latent relation* is a relation that may satisfy the relevant conditions of relational reality while remaining unmanifest or insufficiently discriminated within a specified observation regime, even though indirect traces or later manifestations may permit its reconstruction.

The qualification "within a specified observation regime" is essential. A relation latent to one observer can be manifest to another. Informal care relations may be absent from market statistics while plainly visible in household practice. A dependency may be invisible in an organizational chart while apparent in patterns of consultation and approval. A computational relation may be inaccessible in a user interface while

recorded in backend logs. Latency therefore often reflects the partiality of epistemic access rather than the intrinsic invisibility of the relation.

Latent relations are especially important when manifestational systems privilege what is readily quantified. Standardized categories can improve coordination and comparison while leaving relations outside those categories weakly represented (Porter 1995; Desrosières 1998). GRE should therefore treat the absence of a variable, category, or explicit edge from a dataset as a property of the representational system until additional evidence supports a stronger conclusion about the underlying relation.

The notion also helps distinguish pre-manifestational relational reality from mere analyst invention. A relation can be latent before it is consciously recognized if it already persists and exerts causal efficacy within the system. Its later discovery changes epistemic access, and perhaps subsequent relations once the discovery becomes operative, without implying that the relation began to exist only when it was named.

5.4.7 Hidden Relations

Hidden relations form a narrower epistemic problem. A relation is hidden when the observation regime fails to reveal it because relevant traces are inaccessible, suppressed, displaced, masked, or systematically routed outside the observer's evidential field. Strategic concealment is one important mechanism, but hiddenness can also arise from institutional segmentation, technical opacity, confidentiality, unequal access, or the topology of a distributed system. Section 118 will examine observer position and strategic concealment in greater detail; the present section defines the evidential distinction.

Definition 5.34 (Hidden relation)**.** A *hidden relation* is a relation for which evidential access is materially obstructed within a specified inquiry because relevant traces are unavailable, obscured, selectively preserved, strategically concealed, or generated outside the observer's accessible manifestational domain.

Hiddenness differs from latency primarily in the structure of access. Latency emphasizes insufficient manifestation within an observation regime; hiddenness emphasizes obstruction or exclusion from the evidential field. The categories can overlap. A relation may be latent because its effects are subtle and hidden because actors also conceal the traces most likely to reveal it. GRE should therefore use the distinction analytically rather than treat it as a rigid ontology of relations.

Hidden relations create asymmetric epistemic burdens. Actors inside a relation may possess knowledge unavailable to external investigators; institutions may control records required for verification; affected subjects may experience consequences without access to the infrastructures that produce them; and observers with technical privileges may see relational structures that ordinary participants cannot inspect. These asymmetries later become questions of epistemic justice and machine-mediated knowledge, but they begin here as properties of evidential access.

A hidden relation should not be inferred solely from the fact that evidence is missing. The hypothesis of concealment itself requires traces: discontinuities, inconsisten-

cies, restricted access, unexplained selection, testimony, leaked records, differential visibility, or other observations that make obstruction more plausible than simple nonexistence or measurement failure. This requirement guards against converting every unexplained absence into evidence of an invisible structure.

5.4.8 Absence of Evidence and Evidence of Absence

Negative evidence requires a particularly explicit manifestation model. The nonappearance of a trace can support a claim that a relation is absent only when the inquiry has reason to expect that the relation, if present, would probably have generated an observable and preserved trace within the relevant observation regime. Without that expectation, missing evidence remains weakly informative.

Definition 5.35 (Negative evidential warrant)**.** *Negative evidential warrant* is the support that nonappearance of an expected trace provides for the absence, weakness, interruption, or transformation of a target relation when the trace-generation, detection, coverage, and preservation conditions are sufficiently specified.

The definition makes four conditions especially important. First, *trace generation*: would the target relation normally produce the relevant manifestation? Second, *detection*: would the observation system register it if produced? Third, *coverage*: was the relevant temporal, spatial, institutional, or population domain actually observed? Fourth, *preservation*: could the trace have been lost, deleted, censored, or transformed before inspection? Evidence of absence becomes stronger as these conditions become better understood and as the expected trace becomes more reliable under the hypothesized relation.

This distinction is crucial in economic and institutional research. The absence of a complaint is weak evidence that no harm occurred when complaint mechanisms are inaccessible or risky. The absence of a transaction record is weak evidence that no transfer occurred when informal exchange is common. The absence of a network edge is weak evidence of no relation when the network is reconstructed from a partial communication channel. By contrast, the persistent absence of an expected entry in a highly complete registry under a stable mandatory reporting regime can provide stronger negative evidence for a formally registered relation.

Claim 5.36 (Condition for evidential absence)**.** *Absence of evidence becomes evidence of absence to the extent that the inquiry can justify a sufficiently reliable expectation that the target relation, if present at the relevant strength and scope, would have generated a detectable and preserved trace within the observation regime.*

Claim 5.36 also clarifies why evidential silence can be historically and politically structured. Classification systems, archives, administrative routines, and research infrastructures determine which relations reliably produce traces. Hacking's account of historical ontology and the histories of statistical classification examined by Desrosières provide examples of how categories and recording practices can change the objects that become visible to inquiry (Hacking 2002; Desrosières 1998). Silence in an archive or dataset therefore requires knowledge of the record-making relation before it can support a substantive inference.

The same principle applies to repeated nonobservation. More observations in-

crease evidential strength only when they meaningfully increase the probability of detection under the target hypothesis. Repeatedly inspecting the same narrow channel does little to rule out a relation expressed elsewhere. Expanding observer positions, temporal coverage, trace types, and independent manifestation pathways can be more informative than multiplying observations within a single constrained regime.

The relation–trace–evidence distinction therefore supplies a basic grammar for the remainder of Chapter 5. Relations belong to the reality under inquiry; traces are heterogeneous manifestations or remainders generated through relational and historical processes; evidence arises when traces are connected to specified claims through warranted inferential relations. Direct and indirect traces differ by the structure of their manifestational paths rather than by an absolute hierarchy of reliability. Observable, inferred, latent, and hidden relations describe different conditions of epistemic access rather than different degrees of ontological reality. Negative evidence becomes informative only when trace generation and observation are sufficiently understood. These distinctions prepare the next section's treatment of symbolization and representation, where traces are transformed into linguistic, legal, administrative, statistical, and computational forms that can both preserve and reorganize relational knowledge.

5.5 Symbolization and Representation

Section 5.4 distinguished relations from the traces through which they become epistemically accessible and from the evidential roles later assigned to those traces. The present section examines a further transformation: traces, observations, and relational configurations are frequently rendered into symbolic forms that can be stored, communicated, compared, aggregated, interpreted, and acted upon across settings. Its role is to clarify how symbolization and representation participate in relational knowledge without being treated as transparent duplication of the realities they concern. The section proceeds through eight components: manifestation and symbolization, linguistic representation, administrative representation, legal representation, statistical representation, computational representation, symbolized relations, and representation error. The method is comparative. Each representational form is analyzed in terms of what it selects, preserves, compresses, transforms, and makes newly available for inference.

Symbolization matters for GRE because relational inquiry rarely proceeds through unprocessed manifestations alone. A spoken description, a category in a registry, a legal status, a statistical indicator, a graph edge, a model parameter, or a machine-readable embedding can make a relation portable across time, space, institutions, and observers. Such portability expands epistemic reach. It also introduces additional conditions of interpretation. The same relational reality can be symbolized differently under different languages, administrative systems, legal regimes, statistical conventions, and computational architectures. Conversely, similar symbols can refer to relations that differ substantially in their histories, mechanisms, or causal organization. Symbolization therefore becomes part of the epistemic pathway through which relational reality is reconstructed.

Cassirer's philosophy of symbolic forms provides one important lineage for treating symbolic articulation as constitutive of intelligibility rather than as a secondary label placed upon already finished experience, while Bourdieu's analysis of language emphasizes that symbolic forms operate within social relations of authority and differential recognition (Cassirer 1955; Bourdieu 1991). GRE draws on these insights without committing itself to a comprehensive philosophy of symbolic form. The narrower claim developed here is methodological: symbolic systems organize access to relational reality by establishing distinctions, equivalences, references, and conventions through which manifestations become interpretable and transportable.

Definition 5.37 (Symbolization)**.** *Symbolization* is the relational process through which a manifestation, trace, object, relation, process, event, or distinction is rendered in a symbolic form that can be recognized, communicated, stored, compared, transformed, or used within an epistemic or institutional practice.

Definition 5.37 keeps symbolization broader than language. A symbol may be a word, category, code, legal designation, numerical variable, visual mark, network edge, database field, model state, or computational token. What unifies these cases is the establishment of a rule-governed relation through which some differences are preserved and others are suppressed, grouped, or transformed.

Definition 5.38 (Representation)**.** A *representation* is a symbolic, material, formal, linguistic, administrative, legal, statistical, computational, or other constructed configuration used to stand for, describe, model, encode, or make inferentially accessible selected aspects of an epistemic target.

Representation therefore has a target-relative structure. A representation can be highly adequate for one inferential purpose while remaining uninformative for another. Giere's account of scientific representation is useful here because it treats models as purposive representations of selected aspects of reality rather than as literal duplicates of their targets (Giere 2004). GRE generalizes this restraint beyond scientific models. Every representational practice selects a relation between a target, a representational form, and a purpose under which similarity, relevance, fidelity, or usefulness is judged.

5.5.1 Manifestation and Symbolization

Manifestation and symbolization occupy different stages and roles within epistemic access. A manifestation is the way in which some aspect of reality becomes available within a relational configuration of perception, instrumentation, practice, institution, or other mediation. Symbolization renders some aspect of that manifestation into a form that can circulate within a symbolic practice. The two can occur nearly simultaneously, especially in highly institutionalized settings, yet the distinction remains analytically useful.

A price appearing on a trading interface is already heavily symbolized at the point of manifestation. A person's bodily discomfort can become manifest before it is linguistically articulated. An institutional status can be symbolically recorded at the same moment that it becomes administratively manifest. These examples show that manifestation and symbolization can overlap while still answering different questions. Manifestation concerns availability; symbolization concerns the rule-governed

form through which what is available is rendered communicable, recordable, or manipulable.

The distinction also clarifies why pre-symbolic or weakly symbolized relational realities remain possible. A pattern of dependence, trust, vulnerability, attraction, exclusion, or coordinated expectation can become relationally real before participants possess a stable vocabulary for it. Later symbolization can increase epistemic accessibility by supplying names, categories, comparisons, and records. Symbolization can also reorganize the field of attention by making some relations easier to notice and others less legible.

Claim 5.39 (Symbolic mediation of epistemic access)**.** *Symbolization can expand, stabilize, and reorganize epistemic access to relational reality by rendering selected manifestations portable across observers, settings, and times. The resulting symbolic accessibility remains dependent on the selection rules and interpretive conventions through which the representation is produced and used.*

Claim 5.39 explains why symbolic systems are both epistemically enabling and selective. A stable vocabulary can support comparison across cases that would otherwise remain locally intelligible. A coding standard can aggregate records across institutions. A legal category can coordinate recognition across courts and agencies. At the same time, each gain in portability is achieved through a representational decision about which distinctions will count as relevant.

5.5.2 Linguistic Representation

Linguistic representation provides one of the most flexible media for relational knowledge. Language can name entities, specify relations, narrate trajectories, mark modality, attribute causes, preserve testimony, and express uncertainty. It can also embed distinctions that become difficult to see once they are stabilized in ordinary usage. Terms such as *worker*, *owner*, *household*, *market*, *dependency*, *care*, or *trust* can function simultaneously as descriptive conveniences and as historically inherited classifications.

For GRE, linguistic representation should therefore be analyzed at two levels. The first concerns semantic content: what relation or object a linguistic expression is intended to describe. The second concerns the social conditions under which the expression becomes authoritative, ordinary, contestable, or unavailable. Bourdieu's account of linguistic markets is useful here because it emphasizes that linguistic efficacy depends partly on social position, institutional authorization, and the conditions of reception (Bourdieu 1991). A description can thus fail to become publicly consequential even when it captures an important aspect of relational reality, while an institutionally authorized description can become widely reproduced despite serious epistemic limitations.

Linguistic representation is especially important for relations whose traces are dispersed across experience rather than concentrated in formal records. Testimony about dependence, exclusion, coercion, care, trust, or tacit norms often requires narrative articulation before the relevant relational pattern becomes available to others. Such articulation can condense a long trajectory into a linguistic form that permits comparison and inquiry. The evidential value of the account still depends on context,

corroboration, target specification, and the possibility of alternative interpretations.

Language also supports second-order representation. A subject can describe the categories through which an institution describes them, contest those categories, or propose a new vocabulary for a relation previously rendered obscure. Epistemic change can therefore involve changes in the representational language itself. This does not imply that reality changes whenever vocabulary changes. It means that available distinctions influence which relational hypotheses can be formulated, communicated, and tested.

5.5.3 Administrative Representation

Administrative representation converts persons, organizations, events, transactions, locations, resources, and relations into standardized categories suitable for coordination across institutional settings. Registries, forms, identifiers, taxonomies, eligibility rules, case files, accounting fields, and reporting systems create representational infrastructures through which large organizations can act upon realities that no single administrator encounters directly.

The epistemic advantage is substantial. Standardization allows cases to be compared, aggregated, retrieved, and transported across organizational boundaries. The same process can reduce heterogeneous relations to a limited set of recognized attributes. Desrosières' history of statistical reasoning and Porter's study of quantitative objectivity both show how conventions of classification and standardized procedures support impersonal and transportable judgment (Desrosières 1998; Porter 1995). Hacking's historical ontology further emphasizes that categories can acquire histories and participate in reorganizing the fields they describe (Hacking 2002).

Administrative representation therefore generates a specific epistemic asymmetry. Relations that fit the administrative schema can become highly visible, while relations that fall outside the schema can remain weakly represented even when they are causally important. A household may be represented by an address and membership field while care dependencies remain unrecorded. Employment may be represented by contract status while effective control is distributed through subcontracting, platforms, algorithms, and informal expectations. A benefit system may record eligibility categories while omitting relational barriers that shape practical access.

Definition 5.40 (Administrative legibility)**.** *Administrative legibility* is the degree to which an object, relation, event, or condition can be represented within the categories, identifiers, procedures, and record structures through which an administrative system observes and acts.

Administrative legibility is epistemically useful because it supports coordination and comparison. It is also selective because legibility is defined relative to a particular representational infrastructure. GRE therefore treats administrative absence with caution: an unrecorded relation may reflect nonexistence, weak trace generation, exclusion from the schema, incomplete reporting, strategic concealment, or a mismatch between lived relations and recognized categories.

5.5.4 Legal Representation

Legal representation renders relations through categories of status, right, duty, authority, liability, ownership, membership, capacity, obligation, and procedure. Legal systems thereby produce highly structured representations of relational positions. These representations can summarize complex histories into recognized forms: a person is registered as an owner, a corporation as a juridical entity, an agreement as a contract, a relation as employment, or an act as a legally relevant transfer.

Hart's account of primary and secondary rules highlights how legal systems depend on socially organized practices for identifying, changing, and applying valid rules, while Searle's account of institutional facts emphasizes how recognized status functions can support rights, duties, powers, and other institutional consequences (Hart 2012; Searle 1995). GRE can use these accounts to study legal representation while preserving a distinction among the represented relation, the legal category, and the wider relational reality in which the category operates.

Legal representation can be epistemically precise within its own domain. A registry can provide strong evidence of formally recognized ownership. A judgment can establish the legal disposition of a dispute. A statute can specify an authorized category. The same representation may provide only partial access to bargaining power, practical dependence, social recognition, informal obligation, or the full generative consequences of the relation. Legal status and relational structure therefore overlap without being interchangeable.

This distinction becomes particularly important when several legal forms can support similar relational effects or when the same legal form operates differently across material and institutional conditions. GRE should ask which dimensions of a relation a legal category preserves, which it abstracts from, and how much inferential weight the category can bear outside the legal question for which it was designed.

5.5.5 Statistical Representation

Statistical representation renders heterogeneous observations into variables, counts, distributions, indices, correlations, rates, and other numerical forms. This transformation can reveal patterns that remain invisible at the level of individual cases. It can also establish equivalences among cases that differ along dimensions omitted from the representation. Statistical knowledge therefore depends on both measurement and classification.

Desrosières emphasizes that statistical categories rely on conventions that make heterogeneous cases comparable, while Porter shows how standardized quantification can support forms of objectivity that travel across institutional settings (Desrosières 1998; Porter 1995). These insights are particularly important for GRE because relational phenomena are often transformed into variables whose apparent simplicity conceals substantial representational work. A variable labeled *employment*, *income*, *trust*, *household*, *network degree*, or *access* may summarize a complex family of relational judgments.

Statistical representation can operate at several distances from the target. Some variables are direct encodings of standardized records. Others are constructed

indices combining multiple indicators. Still others are latent quantities estimated through models. The evidential burden changes across these cases. A relation inferred from a latent variable requires justification of both the measurement model and the substantive interpretation that connects the statistical construct to the relational target.

Claim 5.41 (Statistical representation and relational compression)**.** *Statistical representation can expand relational knowledge by revealing aggregate patterns and structured variation while simultaneously compressing heterogeneity through classification, measurement, and aggregation. The epistemic adequacy of a statistical representation therefore depends partly on whether the dimensions suppressed by that compression are material to the relational claim under inquiry.*

Claim 5.41 provides a practical criterion for GRE. Compression is not itself an error. Every representation omits detail. The relevant question is whether the omitted structure changes the inference. A national average may be useful for one question and deeply misleading for another when important relational differences are concentrated across regions, classes, institutions, or networks.

5.5.6 Computational Representation

Computational representation extends symbolic transformation into machine-processable structures. Databases encode entities and attributes; graphs encode nodes and relations; simulations encode rules and state transitions; machine-learning systems encode statistical regularities in parameters or latent spaces; agent-based models encode actors, environments, interaction rules, and update processes. These representations enable forms of analysis that exceed unaided human inspection in scale, speed, and combinatorial complexity.

Scientific modeling provides a useful epistemic precedent. Giere treats models as purpose-relative representations of selected aspects of reality, while Winsberg shows how computer simulation mediates among theory, model construction, approximation, computation, and evidence (Giere 2004; Winsberg 2010). GRE extends the same caution to computational representations of economic and social relations. A graph, simulation, classifier, embedding, or prediction model should be interpreted through the choices that generated its objects, variables, relations, loss functions, update rules, and evaluation criteria.

Computational representation can create particularly strong appearances of precision because symbolic categories are translated into exact machine-readable states. Exact encoding, however, does not guarantee exact correspondence with the target. A network edge can be precisely stored while remaining an imperfect representation of friendship, authority, dependence, or information flow. A classifier can assign a precise probability while relying on target categories whose social or institutional meaning is unstable. A simulation can execute deterministic rules whose relation to the modeled system remains uncertain.

Algorithmic systems also blur the boundary between epistemic representation and institutional operation. A computational representation can be used to allocate tasks, rank subjects, determine access, flag risk, or structure incentives. Kellogg, Valentine, and Christin show how algorithms in organizations can participate in directing, eval-

uating, and controlling work (Kellogg et al. 2020). The present section records this possibility while reserving the fuller recursive and performative analysis for Section 117. For epistemology, the immediate point is that an operational representation may later affect the data from which its adequacy is evaluated.

5.5.7 Symbolized Relations

A relation becomes symbolized when some aspect of its structure is rendered into a symbolic form that can be identified and manipulated within an epistemic practice. Symbolization can preserve the identity of relata, relation type, direction, intensity, duration, sequence, legal status, uncertainty, or other properties. Different representations preserve different subsets of these features.

A network graph can preserve adjacency while omitting the qualitative meaning of a tie. A contract can preserve specified obligations while omitting the history of bargaining. A statistical matrix can preserve covariance while omitting local narrative context. A linguistic account can preserve experienced meaning while leaving scale and comparability uncertain. None of these forms is intrinsically superior. Their adequacy depends on the target and the question.

Definition 5.42 (Symbolized relation)**.** A *symbolized relation* is a representation in which one or more aspects of a target relation are encoded into a symbolic structure according to an explicit or implicit representational rule.

Definition 5.42 allows GRE to separate the relational target from the representational object used to study it. The distinction is especially important when a symbolized relation acquires institutional durability. A database edge, legal status, score, category, or label can be preserved long after the relation that originally motivated it has changed. Epistemic inquiry must therefore ask whether the representation continues to track the target, records only a past state, or has become part of a new relational configuration.

Symbolized relations can also be multiply realizable. The same underlying relation may be represented through testimony, legal documents, administrative records, statistical variables, graph structures, and computational states. Agreement across heterogeneous representations can strengthen a claim when the representations rely on sufficiently independent manifestation pathways. Apparent agreement among representations derived from the same underlying record system provides weaker triangulation because their errors may be correlated.

5.5.8 Representation Error

Representation error concerns the mismatch between what a representation preserves or implies and the epistemic target for which it is being used. The concept should remain broader than numerical measurement error. Linguistic categories can mischaracterize a relation; administrative schemas can omit relevant distinctions; legal forms can fail to track practical dependence; statistical indicators can compress consequential heterogeneity; computational models can encode inappropriate categories or unstable proxies.

Definition 5.43 (Representation error)**.** *Representation error* is a target-relative discrepancy introduced when a representation omits, distorts, conflates, misclassifies, mis-scales, or otherwise preserves inadequately a feature of the epistemic target that is material to the claim for which the representation is used.

This definition makes error dependent on both target and use. A representation can omit most details of a system and still be adequate for a narrow question. The same omission can become an error when the inquiry shifts. Representation error is therefore evaluated relative to material relevance rather than descriptive completeness.

Several forms deserve distinction. *Selection error* arises when the representation excludes relations or cases important to the target. *classification error* arises when cases are assigned to categories that fail to preserve relevant differences. *aggregation error* arises when combining observations suppresses structure material to the inference. *semantic error* arises when a symbol is interpreted as referring to a different relation from the one it reliably tracks. *temporal error* arises when a representation is treated as current after the underlying relation has changed. *structural error* arises when the representational form itself presupposes a relation type that differs from the target, for example when a distributed field is forced into pairwise edges or a temporally evolving relation is represented as a static attribute.

Claim 5.44 (Representation adequacy under relational inquiry)**.** *A representation is epistemically adequate for a relational claim to the extent that its selection, encoding, scale, temporal scope, and interpretive rules preserve the target-relevant structure sufficiently for the inference being made, with material sources of representational error identified and bounded where possible.*

Claim 5.44 complements the evidential distinctions of Section 5.4. Evidence can be abundant while representation remains poor. A large administrative dataset can provide many precise observations of categories that fail to capture the relation of interest. Conversely, a sparse qualitative representation can sometimes preserve a relational distinction that a large standardized dataset erases. Epistemic strength therefore depends on the relation among target, trace, representation, and inference rather than on volume or formal precision alone.

Representation error can also be systematic. Institutional categories may repeatedly underrepresent certain relations because the relevant distinctions are absent from the schema. Statistical systems may reproduce the same coding convention across decades. Computational systems may inherit labels and proxies from administrative infrastructures. Once such representations become widely reused, correlated errors can appear as cross-source confirmation. GRE should therefore examine the genealogy of representations as part of epistemic evaluation, especially when several apparently independent datasets or models depend on the same upstream categories.

The section's overall result is a layered account of symbolic mediation. Relational reality can generate manifestations and traces; symbolization renders selected aspects of those manifestations into portable forms; representations organize those symbols for linguistic, administrative, legal, statistical, or computational purposes; and representation error arises when the preserved structure is inadequate for the epistemic target. Symbolic forms can dramatically extend relational knowledge by en-

abling memory, comparison, aggregation, modeling, and communication across distance. Their epistemic force remains tied to the histories, conventions, institutions, and technical procedures through which they are produced. This layered account prepares Section 117, which examines what happens when representations move beyond epistemic mediation and enter the generative-relational system as operative classifications, rules, measurements, and algorithmic interventions.

5.6 Performative Representation

Section 5.5 treated representation principally as an epistemic mediation through which selected aspects of relational reality become portable, comparable, storable, and inferentially usable. The present section examines a further possibility: some representations enter the relational system in which they circulate and contribute causally to subsequent relations, opportunities, expectations, classifications, decisions, and institutional responses. Its role is to distinguish representational description from representational intervention while preserving the separation among epistemic adequacy, causal efficacy, relational stabilization, and normative evaluation. The section proceeds through seven components: representation and subsequent relation, classification effects, legal performativity, administrative performativity, statistical performativity, algorithmic performativity, and recursive representation. The method is relational and process-oriented. Each case is analyzed through the pathway by which a representation acquires uptake, becomes connected to action or institutional procedure, and alters conditions that can later become objects of representation in their own right.

The language of performativity has several intellectual lineages. Austin's analysis of performative utterances established a particularly influential case in which words can participate in the performance of actions under conventional and contextual conditions (Austin 1962). Historical and sociological work later broadened attention toward classifications, measurements, and models whose circulation can alter the practices and objects to which they refer. Hacking's historical ontology emphasizes the historical emergence of categories and objects within practices of classification and reasoning (Hacking 2002). Espeland and Sauder analyze reactivity to public measures, showing how rankings can alter expectations and organizational behavior (Espeland and Sauder 2007). MacKenzie documents cases in which financial models became incorporated into market practices and thereby participated in reshaping the markets they represented (MacKenzie 2006). GRE draws on these lineages while giving the term a narrower relational specification.

Definition 5.45 (Performative representation)**.** A *performative representation* is a representation that, through uptake within a social, institutional, legal, technical, or other relational process, contributes causally to the subsequent configuration, persistence, transformation, or generation of relations relevant to its domain of use.

Definition 5.45 makes performativity conditional. Representations vary in their capacity to affect subsequent relations. A privately written description that remains unread can be epistemically rich while having little practical effect on its target domain. A coarse administrative category connected to eligibility rules can have substantial

causal consequences despite limited descriptive resolution. The relevant question is therefore whether a credible pathway connects the representation to subsequent relational change.

Several conditions commonly strengthen such a pathway. A representation may acquire recognized authority, become embedded in organizational routines, trigger a legal or administrative rule, guide allocation, coordinate expectations among multiple actors, alter incentives, or become repeatedly reproduced in later decisions. Persistence and reach also matter. A classification used once in a local setting can produce a narrow effect, whereas a category embedded across interoperable databases can structure relations across institutions and time. These conditions concern performative efficacy rather than epistemic quality. The distinction becomes central to the analysis that follows.

Claim 5.46 (Separation of representational adequacy and performative efficacy)**.** *The epistemic adequacy of a representation and its performative efficacy are distinct properties. A representation can exert substantial causal influence while preserving the target poorly, and a highly adequate representation can remain causally weak when it lacks uptake or operational connection.*

Claim 5.46 extends the discussion of representation error in Section 5.5. An inaccurate score can still affect access to resources when institutions act upon it. A careful scholarly reconstruction can remain practically inert when no relevant institution, participant, or decision process uses it. Causal efficacy therefore supplies neither a truth criterion nor a normative endorsement. Conversely, epistemic adequacy supplies no guarantee of practical consequence.

5.6.1 Representation and Subsequent Relation

A representation becomes performatively relevant when it enters a pathway through which subsequent relations depend partly on its presence, content, or institutional interpretation. The phrase *subsequent relation* refers here to a relation whose configuration is temporally downstream from the representation and whose formation, modification, persistence, or dissolution is causally influenced by the representation's uptake. The representation can concern the same relation, a neighboring relation, or a higher-order structure that reorganizes several relations at once.

Consider a representation of creditworthiness. The representation may summarize traces of income, repayment, debt, or institutional history. Once lenders use the representation in allocation decisions, the score can influence access to credit, the terms of borrowing, subsequent repayment opportunities, and future records. The representation then occupies two roles. It remains an epistemic object intended to say something about a target, while also becoming a causal input into a changing relational configuration among borrowers, lenders, intermediaries, and institutions. The later configuration can generate traces that are subsequently used to evaluate or update the original representational system.

The same structure can occur without centralized authority. A public reputation category can coordinate expectations among many actors. A widely circulated label can alter whom others approach, avoid, trust, or monitor. A market model can influence trading strategies. A scientific classification can redirect data collection and in-

stitutional attention. The relevant mechanism differs across cases, yet the relational structure is comparable: representation enters practice, practice changes relational conditions, and those changed conditions can later manifest through new traces.

This process also clarifies the relation between performative representation and relational reality. The preceding ontological chapter defined relational reality through emergence, sufficient stability over some spacetime region, and causal efficacy within a generative-relational system. A representation that becomes institutionally stabilized and causally consequential can therefore itself acquire relational reality within the relevant domain. Its relational reality concerns the representation's effective presence in the system. The truth or adequacy of what it represents remains a separate epistemic question.

A useful analysis of performativity should therefore identify at least three objects: the *target relation* that the representation purports to describe; the *operational relation* through which the representation enters action, decision, or coordination; and the *subsequent relation* whose configuration is altered through that operation. These objects can coincide only partially. A legal status may represent one relation while changing several adjacent rights and obligations. A statistical ranking may represent performance while altering recruitment, funding, attention, and internal organizational priorities. A computational score may estimate one target while becoming an input into an allocation process with wider relational consequences.

Proposition 5.47 (Operational mediation of performative effects)**.** *A claim of performative representation is strengthened when the analysis identifies a traceable operational mediation connecting the representation to subsequent relational change, including the actors, rules, infrastructures, expectations, or decision procedures through which the representation acquires causal relevance.*

Proposition 5.47 guards against treating temporal succession as sufficient evidence of performativity. A representation can precede a relational change without contributing materially to it. Epistemic warrant requires evidence concerning the transmission pathway, competing causes, timing, scope, and persistence of the effect. The epistemology of performativity is therefore an attribution problem as well as a representational one. Later sections on evidence, generative relations, and attribution develop this problem more systematically.

5.6.2 Classification Effects

Classification is one of the most common routes through which representation becomes performative. A classification groups cases according to distinctions that make them administratively, legally, statistically, socially, or computationally tractable. Once a category is connected to recognition, expectation, allocation, sanction, entitlement, or organizational procedure, category membership can contribute to the relations available to the classified case.

Hacking's historical ontology is relevant because it directs attention to the historical formation of categories and objects within practices of naming, classification, inquiry, and intervention (Hacking 2002). GRE places particular emphasis on the relational consequences of this process. A classification can make a dispersed pattern publicly recognizable, support coordination around a previously weakly articulated

relation, or provide a vocabulary through which subjects can interpret experience. It can also compress heterogeneity, stabilize a contested boundary, or attach institutional consequences to differences that were previously less consequential.

Classification effects can operate through several pathways. First, institutions can route cases differently after classification. Second, other actors can alter expectations toward a classified person, organization, object, or event. Third, subjects can adapt behavior in anticipation of classification. Fourth, the classification can alter data collection, because institutions begin recording variables that matter to the category. Fifth, repeated use can stabilize the category itself, making it appear increasingly natural or inevitable even when its boundary arose historically from specific institutional purposes.

The economic significance of classification is especially clear when category membership affects conversion possibilities. A person classified as eligible can gain access to an entitlement, service, market, or institutional pathway. An organization classified under a particular legal or administrative type can face different reporting duties or financing possibilities. An object classified as a commodity, protected resource, waste product, cultural object, or regulated good can enter different circuits of valuation and exchange. Kopytoff's analysis of commoditization illustrates how object status can vary across social contexts and histories rather than functioning as an invariant property of the object itself (Kopytoff 1986). GRE treats such changes as transformations in the relational organization through which value and exchange become possible.

Classification effects remain heterogeneous. A category can have strong formal consequences and weak practical uptake. Another can have little formal standing while strongly coordinating expectations. A category can also become performative through anticipation before an official decision is made, for example when actors reorganize behavior around an expected classification threshold. The causal unit is therefore the broader classificatory arrangement, including rules of assignment, visibility, authority, anticipated consequences, channels of contestation, and the temporal persistence of records.

The possibility of classification effects intensifies the epistemic stakes of representation error. Misclassification can alter the target environment and thereby generate traces consistent with the category that produced the intervention. An initially weak representation can thus acquire apparent empirical support after institutions reorganize behavior around it. This possibility does not make all classifications self-confirming. It identifies a specific recursive pathway that relational inquiry should test where classification and intervention are tightly connected.

5.6.3 Legal Performativity

Legal representation supplies a comparatively explicit form of performativity because legal systems connect recognized symbolic acts, categories, and documents to rules governing rights, duties, powers, liabilities, statuses, procedures, and institutional competencies. Austin's account of performative utterances is directly relevant to cases in which conventional acts accomplish legally recognized changes under appropriate conditions (Austin 1962). Hart's analysis of primary and secondary

rules provides a complementary perspective on how legal systems organize conduct and establish rules through which legal validity, alteration, and adjudication are recognized (Hart 2012).

For GRE, the important point concerns the generation or transformation of relations through legally operative representation. A contract can specify obligations that become institutionally recognizable. Incorporation can establish an organizational form with consequences for asset ownership, liability, governance, and third-party relations. Property registration can reorganize claims among holders, users, creditors, successors, and public authorities. Organizational law can structure asset partitioning and relations between firms, owners, managers, and creditors (Hansmann and Kraakman 2000). In each case, a symbolic form participates in producing a relational configuration because institutions recognize the form and connect it to durable rules of action and adjudication.

Legal performativity depends on more than textual existence. A document outside a recognized procedure can fail to alter legal relations. A valid rule can have uneven practical consequences when enforcement, awareness, institutional capacity, or social uptake varies. The performative effect therefore travels through a relational infrastructure composed of authorized procedures, offices, records, enforcement capacities, professional practices, expectations, and conventions of recognition.

This distinction also clarifies the relation between legal reality and wider relational reality. A legal status can be causally effective even when everyday practice only partially conforms to it. Conversely, a stable practical relation can exist without corresponding legal recognition. GRE should therefore distinguish legal representation, legally constituted relations, practically enacted relations, and the wider relational field in which both are situated. Their correspondence is an empirical and historical matter.

Legal representation can further transform epistemic conditions. Once a relation receives a legal form, it often becomes easier to record, archive, contest, compare, and transmit across institutions. Legal performativity can therefore generate new traces at the same time that it restructures rights and obligations. This dual role is important for later inquiry: the evidential record available to the researcher can be partly produced by the legal arrangements whose consequences are being studied.

5.6.4 Administrative Performativity

Administrative systems convert heterogeneous situations into categories, records, statuses, files, priorities, thresholds, and procedural states that can be processed at organizational scale. Section 5.5.3 examined these forms primarily as representations. Their performative dimension emerges when administrative records are connected to allocation, access, sequencing, monitoring, recognition, or institutional response.

An administrative category can determine whether a case enters a queue, receives a benefit, triggers an inspection, qualifies for an exception, or becomes visible to a particular office. A record can also coordinate actions across institutions when interoperable systems reuse the same status or identifier. Administrative representation then becomes an infrastructure for relational coordination. It shapes which actors encounter one another, which procedures become available, how quickly an interac-

tion proceeds, and what documentation must be supplied for further recognition.

Institutional analysis has long emphasized that formal rules and organizational structures shape incentives and patterns of interaction (North 1990). GRE adds a representational question: the operation of a rule frequently depends on how a case has first been rendered administratively legible. The category is therefore part of the pathway through which the institution acts. A mismatch between lived relations and administrative representation can have material consequences even when the formal rule is applied consistently to the recorded category.

Administrative performativity can accumulate over time because records persist. A category assigned at one moment can influence subsequent decisions long after the underlying relation has changed. Later institutions may inherit the recorded status without observing the original context. This creates temporal asymmetry between relational transformation and administrative updating. Historical inquiry should therefore distinguish the time of the represented relation, the time of recording, the time of institutional use, and the time at which consequences become visible.

Large-scale data infrastructures extend this process by enabling records to circulate across organizational boundaries. The World Bank's treatment of integrated data systems illustrates the growing institutional importance of administrative and other data sources for public decision processes (World Bank 2021). From a GRE perspective, integration increases both epistemic reach and performative reach. A category used across many institutional settings can coordinate services and reduce repeated informational costs; the same portability can also propagate a representational error through multiple downstream decisions.

Administrative performativity is therefore inseparable from questions of correction and contestability. A system that acts on records requires mechanisms through which outdated, contextually inappropriate, or erroneous representations can be revised. The epistemic significance of such mechanisms is substantial: they help prevent a representational state from becoming self-reinforcing solely because later institutions repeatedly treat the existing record as evidence of its own correctness.

5.6.5 Statistical Performativity

Statistical representation becomes performative when indicators, rankings, benchmarks, forecasts, classifications, or numerical models are incorporated into behavior, evaluation, coordination, or resource allocation. The history of quantitative objectivity shows how standardized numerical procedures can acquire authority partly because they enable impersonal comparison across cases and institutions (Porter 1995). Desrosières likewise emphasizes the historical construction of statistical categories, conventions, and comparability (Desrosières 1998). These representational infrastructures can later become objects around which institutions organize action.

The performative pathway is particularly visible when measurement becomes evaluation. A numerical indicator used only for descriptive analysis can have limited effect on the target. Once the same indicator enters a funding rule, ranking system, performance review, public comparison, or organizational target, actors gain reasons to attend to the metric. Espeland and Sauder's study of law-school rankings demonstrates this form of reactivity: public measures can alter expectations

and organizational behavior, with commensuration and self-reinforcing expectations contributing to the process (Espeland and Sauder 2007). The measure thereby becomes part of the environment within which the measured organizations act.

Statistical performativity can alter both behavior and category meaning. Actors may direct effort toward measured dimensions, redesign internal procedures to improve recorded performance, invest in data practices that affect future measurement, or reorganize activities around threshold effects. Such responses can improve the target of measurement when the indicator tracks a valued objective sufficiently well. They can also increase divergence between the measured variable and the wider target when optimization concentrates on what the metric captures.

MacKenzie's study of financial economics provides a related case at the level of models rather than simple indicators. Financial models became incorporated into market practices and contributed to changes in the markets to which those models referred (MacKenzie 2006). For GRE, this example is important because it shows that representation can participate in the generation of conditions under which its own assumptions become more or less descriptively successful. Model evaluation in such settings requires historical attention to deployment as well as comparison with an independently evolving target.

The epistemic challenge is especially sharp when a statistical representation changes the data-generating relations that later supply evidence about its adequacy. A ranking can change applicant behavior, institutional investment, and reporting practices. A forecast can alter expectations that influence subsequent transactions. A performance target can change which activities are prioritized and recorded. Later observations then describe a world partly reorganized through earlier measurement. Statistical evaluation should therefore ask whether observed stability reflects a stable target, adaptation to the measure, changes in recording practice, or some combination of these processes.

Claim 5.48 (Reactivity of operationalized measures)**.** *The probability and scope of statistical performativity increase when a measure becomes visible to affected actors and is coupled to consequential decisions, comparative evaluation, resource allocation, reputational effects, or repeated organizational routines.*

Claim 5.48 is deliberately conditional. Quantification alone does not establish reactivity. The causal mechanism depends on how the measure enters a relational field and what capacities actors possess to respond to it. This preserves the distinction between statistical representation and statistical intervention.

5.6.6 Algorithmic Performativity

Algorithmic systems intensify several mechanisms already present in legal, administrative, and statistical performativity. A computational representation can be generated rapidly, updated repeatedly, individualized at fine granularity, and connected directly to operational decisions. Scores, rankings, recommendations, classifications, forecasts, and generated outputs can therefore enter relational processes with short delays between representation and consequence.

Algorithmic performativity begins when computational outputs affect subsequent

action. A ranking can determine visibility; a recommendation can redirect attention; a risk score can trigger review; a scheduling system can reorganize temporal relations among workers, tasks, and managers; a classifier can determine which cases receive further human examination. Kellogg, Valentine, and Christin document how algorithmic systems in workplaces can participate in directing, evaluating, and disciplining work through computational mechanisms of control (Kellogg et al. 2020). The broader epistemic lesson is that algorithmic outputs can simultaneously represent a domain and intervene within it.

Several features make this form distinctive in degree even when its relational logic resembles earlier institutional technologies. First, computational systems can operate at high frequency and large scale. Second, their outputs can be personalized, producing different relational environments for different subjects. Third, automated systems can connect representation to action with little deliberative delay. Fourth, models can be updated using data partly generated after previous versions were deployed. Fifth, complex model architectures can make the operative path difficult for affected actors and sometimes difficult for institutional operators to reconstruct fully.

These features create recursive epistemic problems. A model predicts behavior; institutional action follows the prediction; subjects respond to the resulting environment; their response generates new data; and later models learn from data produced under the earlier intervention. The resulting dataset records a mixture of target behavior and system-induced behavior. Relational inquiry should therefore distinguish pre-deployment patterns, intervention pathways, behavioral responses, institutional adaptation, and later representational updates where evidence permits.

Algorithmic performativity also expands the importance of counterfactual evaluation. Observed outcomes after deployment cannot by themselves establish what would have occurred without the representational intervention. A low observed default rate among people granted credit, for example, does not reveal the outcomes of people who were denied access on the basis of a score. Similar selection problems arise in policing, employment, insurance, moderation, education, and other allocation contexts. The epistemic issue concerns missing relational trajectories created by the decision process itself.

The distinction in Claim 5.46 becomes especially important here. An algorithm can be operationally powerful because institutions rely on it extensively, while its target validity remains uncertain or uneven across contexts. Conversely, a well-validated model can have limited performative impact when humans routinely override its outputs or when the modeled decision has weak consequences. Evaluation therefore requires separate evidence for predictive or representational adequacy, institutional uptake, causal effects of deployment, and normative acceptability.

5.6.7 Recursive Representation

The preceding cases converge on a general epistemic structure: representation can enter the system it represents, contribute to subsequent relational change, and thereby alter the conditions from which later representations are produced. GRE calls this structure *recursive representation*. The term does not imply that the same representation repeats unchanged. Recursion can involve successive legal cate-

gories, updated administrative records, revised indicators, changing model versions, strategic responses, or institutional reinterpretations.

Definition 5.49 (Recursive representation)**.** *Recursive representation* is a process in which a representation contributes causally to subsequent relational conditions, and those altered conditions later become part of the evidential or practical basis for further representation.

Definition 5.49 adds time to the representational architecture developed in Section 5.5. The epistemic relation between representation and target can change after deployment because the target itself may develop partly through responses to previous representations. Evaluation at a later moment therefore cannot always assume that the represented system evolved independently of the representational practices used to know and govern it.

Recursive representation can produce several patterns. One is *stabilizing recursion*, in which a representation coordinates expectations and practices in ways that make the represented category or regularity more durable. Another is *destabilizing recursion*, in which actors respond strategically and reduce the representation's later predictive or classificatory usefulness. A third is *transformative recursion*, in which the representation redirects practices sufficiently that the original target changes form and requires a revised vocabulary or model. These patterns are analytical possibilities rather than exhaustive types.

The epistemic investigation of recursion therefore requires a genealogy of representation. Researchers may need to reconstruct when a representation was introduced, which institutions adopted it, how it was operationalized, which actors encountered its consequences, what opportunities for adaptation or contestation existed, how records were subsequently generated, and whether later measures reused the same categories. This historical reconstruction can prevent later observations from being treated as independent confirmation when they are partly products of earlier representational interventions.

Recursive representation also clarifies why knowledge infrastructures can become components of the realities they study. Statistical offices, registries, legal records, classification standards, ranking systems, and algorithmic platforms can initially emerge to observe, coordinate, or describe. Once their outputs influence action repeatedly, the infrastructure becomes part of the relational environment. Its categories can acquire persistence, causal efficacy, and institutional reach. The resulting relational reality may then include both the represented processes and the representational machinery through which those processes are governed and known.

This conclusion preserves ontological restraint. The causal incorporation of a representation establishes a claim about its relational efficacy within a specified system and interval. It does not establish the representation's ultimate ontological status, descriptive completeness, epistemic truth, or normative legitimacy. These dimensions require their own arguments and evidence. The distinction is particularly important for GRE because economic institutions routinely operate through prices, classifications, contracts, accounts, metrics, models, forecasts, and computational systems whose representational and causal roles are intertwined.

Section 5.6 therefore extends the epistemology of GRE from mediated access to

recursive mediation. Representations can preserve and distort relational knowledge, and some can also become causal participants in later relational generation. Their epistemic assessment consequently requires attention to the target they represent, the operational pathways through which they act, the relations they subsequently transform, and the traces produced after intervention. This result prepares Section 118, which turns to observation and partial access. Once representations can participate in producing the relations later observed, the position, scope, and limits of observation become even more consequential for relational knowledge.

5.7 Observation and Partial Access

Sections 5.4–5.6 established three progressively richer conditions of epistemic mediation: relations leave traces that acquire evidential roles, manifestations can be symbolized and represented through selective schemes, and some representations can enter practice and alter subsequent relational conditions. The present section examines a further constraint that cuts across all three processes: observation is ordinarily partial. Its role is to specify how access to relational reality varies with observer position, institutional capacity, distributed observation, hiddenness, concealment, and time. The objective is neither to reduce knowledge to perspective nor to treat partial access as generalized skepticism. It is to make the conditions of observation explicit enough that claims can be calibrated to what an observation regime could plausibly register. The section proceeds through seven components: partial observation, observer position, unequal epistemic access, distributed observation, hidden relations, strategic concealment, and temporal limits. The method is target-relative and relational. Observation is analyzed through the relation among an epistemic target, an observer or observing system, the channels through which traces become accessible, and the conditions that shape what remains outside those channels.

Scientific perspectivism provides one useful precedent for this orientation. Giere argues that scientific observation and representation are perspectival while remaining open to disciplined evaluation against selected aspects of the world (Giere 2006). Longino's contextual empiricism adds that evidential reasoning is socially organized and can be strengthened through critical interaction among differently situated inquirers (Longino 1990). GRE draws a narrower conclusion from these lineages: the position and capacities of an observer belong to the evidential conditions of a relational claim, yet perspectival mediation does not dissolve the distinction between better and worse warranted claims.

Definition 5.50 (Observational access)**.** *Observational access* is the target-relative capacity of an observer or observing system to register, retrieve, preserve, or otherwise obtain traces that can bear evidentially on a specified relational claim within a given interval and observational regime.

Definition 5.50 treats access as structured rather than binary. An observer may possess direct access to some traces, mediated access to others, and little access to further traces that remain outside the observation regime. Access can also change through instrumentation, institutional permission, record preservation, legal authority, cooperation from participants, technical interoperability, or historical reconstruction.

The epistemic question is therefore not simply whether a relation was observed. It concerns which aspects of the relation could become observable to which observer, through what channels, and under what conditions.

5.7.1 Partial Observation

Partial observation occurs when the accessible evidential field captures only a subset, projection, interval, manifestation, or trace structure relevant to the relational target. The partiality can arise because the target relation extends beyond the observer's spatial reach, persists longer than the period of observation, contains components that do not manifest through available instruments, or participates in neighboring relations that remain unrecorded. Partiality can also be produced institutionally when a registry, survey, platform, archive, or administrative procedure records selected categories while leaving other dimensions unregistered.

The term should be distinguished from simple error. An observation can be accurate with respect to what it registers while remaining incomplete with respect to the target relation. A transaction ledger may accurately record transfers while revealing little about the expectations, obligations, informal sanctions, or prior relations that gave the transfers their meaning. A labor dataset may accurately record wages and hours while only partially registering care responsibilities, informal work, bargaining relations, workplace authority, or dependencies outside the employing organization. A legal file may faithfully preserve formal acts while leaving much of the surrounding social relation outside the record. The problem is therefore one of evidential reach before it becomes one of incorrect measurement.

Partial observation is also distinct from underdetermination, although the two can interact. Partial access concerns the evidential field available to the observer. Underdetermination concerns the possibility that the available evidence remains compatible with multiple relational reconstructions. Expanding observation can reduce underdetermination when newly accessible traces discriminate among alternatives. It can also reveal additional complexity and thereby enlarge the set of plausible reconstructions. More observation therefore does not mechanically produce uniqueness, yet the structure of partial access remains indispensable for evaluating what conclusions the evidence can sustain.

Claim 5.51 (Target-relative partiality)**.** *An observation is partial only relative to an epistemic target and a specified claim. The same evidential field can provide extensive access for one target while providing limited access for another.*

Claim 5.51 prevents completeness from becoming an undefined ideal. A price series may be sufficient for a narrowly specified claim about recorded price variation and insufficient for a claim about the generative history of market power. A network trace may reveal interaction frequency while providing weaker access to the meanings, obligations, or asymmetries carried by those interactions. Observational adequacy should therefore be evaluated against the target relation and inference actually at stake.

Partial observation also has a recursive dimension after Section 5.6. Observation regimes can alter behavior, and those behavioral responses can change what later becomes observable. Once participants know which indicators are measured, which ac-

tions create records, or which traces trigger institutional responses, they may adapt to the observation regime. The evidential field then reflects both the target process and responses to being observed. Partiality is consequently capable of changing through the very practices designed to reduce it.

5.7.2 Observer Position

Observer position identifies the relational location from which traces become accessible and interpretable. Position can include physical location, organizational role, legal standing, technical permission, social membership, temporal location, disciplinary training, and participation in the relation being studied. These dimensions should not be collapsed into a single standpoint. They describe distinct conditions that can shape access to different portions of the evidential field.

An employee, a manager, a regulator, a customer, and an external researcher can encounter the same organization through different trace structures. The employee may observe day-to-day coordination and informal authority while lacking access to strategic records. The manager may possess aggregate reports while seeing less of informal adaptation. The regulator may obtain standardized disclosures without continuous access to internal practice. A customer may observe outcomes and interfaces while remaining outside the organization's production process. An external researcher may combine records across institutions while lacking the situated knowledge held by participants. These positions can generate complementary evidence and distinct blind spots.

Observer position also affects the interpretation of traces. A technically identical record can acquire different evidential significance when observers possess different contextual knowledge about how the record was generated. An entry in an administrative database may look like a direct indicator to an external analyst while practitioners know that it is routinely produced through local workarounds, discretionary coding, or delayed reporting. Conversely, participants deeply embedded in a practice can normalize regularities that become more visible through comparison across settings. Positional proximity and distance can therefore each generate epistemic capacities and limitations.

Giere's perspectivism is helpful here because it permits situated representation without making all perspectives epistemically interchangeable (Giere 2006). GRE likewise treats observer position as a condition to be reported and evaluated, rather than as an automatic source of privilege or disqualification. A positional claim gains warrant when the observer's location is relevant to the target, the access channel is specified, and the evidential contribution can be compared with other available traces.

Definition 5.52 (Observer-position profile)**.** An *observer-position profile* is a structured description of the locations, permissions, capacities, dependencies, and temporal conditions that shape an observer's access to evidence relevant to a specified relational target.

The profile in Definition 5.52 is an analytical device rather than a requirement for exhaustive self-description. Its purpose is to reveal the dimensions of position that materially affect an inference. For a platform study, technical access and data-retention policy may be decisive. For research on care relations, household

participation and temporal proximity may matter more. For historical reconstruction, archival survival and later access rules can dominate. The relevant positional dimensions should therefore be selected in relation to the claim rather than listed mechanically.

5.7.3 Unequal Epistemic Access

Observation is often distributed unequally. Actors can differ in access to records, instrumentation, language, expertise, computational resources, legal discovery, institutional archives, confidential communications, and opportunities to question participants. They can also differ in whether their own observations are preserved, recognized, and treated as credible by institutions. Unequal epistemic access therefore concerns both possession of traces and participation in the processes through which traces become accepted evidence.

These inequalities can follow existing relational asymmetries. An institution may possess detailed records about individuals who possess little reciprocal visibility into the institution's decision procedures. A platform can observe user behavior at fine granularity while users encounter only selected outputs of the platform's internal models. Employers may aggregate workplace data unavailable to workers; financial intermediaries may combine records unavailable to applicants; states can possess administrative information distributed across agencies while residents experience the resulting classifications without equivalent access to the underlying infrastructures. The epistemic relation is then asymmetric even before the resulting knowledge is used for action.

Unequal access can also arise within research communities. Expensive instruments, proprietary datasets, security classifications, language barriers, disciplinary specialization, and institutional affiliations can determine which investigators can inspect which evidence. Longino's account of socially organized criticism is relevant because the epistemic benefits of plural criticism depend partly on whether differently situated participants can actually enter the critical process and receive uptake (Longino 1990). Where access to evidence and channels of criticism are concentrated, apparent consensus can reflect a narrow observational field as well as strong evidential convergence.

Fricker's analysis of epistemic injustice provides a more specifically normative lineage concerning credibility, testimony, and interpretive participation (Fricker 2007). The present section uses that work cautiously. Unequal access is broader than epistemic injustice: differences in access can arise from specialization, confidentiality, temporal position, or technical constraints without already establishing an injustice. Conversely, some access inequalities can be produced or intensified through power and exclusion. Section 118 records the epistemic structure; the systematic normative treatment of epistemic justice is reserved for Section 129.

Claim 5.53 (Asymmetry of observational visibility)**.** *Relational systems can generate asymmetric observational visibility in which one participant or institution can inspect, aggregate, or preserve traces concerning another while reciprocal access remains substantially weaker.*

Claim 5.53 is important for GRE because observational asymmetry can become eco-

nomically consequential even before a later analysis of power or justice. Differential visibility can affect bargaining, prediction, screening, monitoring, coordination, and the ability to contest a representation. It can also shape the evidential archive available to future inquiry. Researchers should therefore record whose traces become legible to whom and whose interpretive resources enter the evidential process.

5.7.4 Distributed Observation

Partial access does not imply that observation must remain confined to the perspective of a single observer. Relational knowledge can be assembled through distributed observation: multiple persons, instruments, institutions, records, and computational systems can contribute different portions of the evidential field. The epistemic problem then shifts from the limits of one observer to the conditions under which heterogeneous observations can be combined without erasing their provenance or falsely treating them as independent.

Hutchins's study of navigation provides an influential precedent for analyzing cognitive accomplishment across persons, artifacts, procedures, and socially organized practice (Hutchins 1995). GRE does not identify distributed observation with distributed cognition. The narrower borrowing is structural: an epistemic accomplishment can depend on a system of differentiated observational roles whose contributions are coordinated through material and institutional arrangements.

Distributed observation can expand access in several ways. Different observers can occupy complementary positions. Instruments can register phenomena outside ordinary human perception. Administrative systems can preserve traces over long intervals. Historical archives can connect temporally separated observers. Computational systems can search volumes of records beyond unaided human capacity. Affected communities can contribute contextual knowledge missing from standardized datasets. Cross-disciplinary research can combine distinct techniques for eliciting, measuring, interpreting, and reconstructing evidence.

The combination process introduces its own risks. Observations can share a common source and therefore provide less independent corroboration than their number suggests. Several databases may reproduce the same upstream record. Multiple witnesses may rely on a shared narrative. Several models may be trained on overlapping datasets. Institutional reports may inherit a common classification scheme. Apparent triangulation can therefore be generated by replication of the same observational dependency.

Distributed observations can also be difficult to translate. Different observers may use categories that overlap only partially, operate at different temporal resolutions, or register different levels of a relational system. Integration then requires an explicit account of correspondence among the observational schemes. The goal is not necessarily to collapse them into a single dataset. In some cases, preserving several partially compatible representations can retain information that forced harmonization would destroy.

Proposition 5.54 (Provenance in distributed observation)**.** *The evidential value of distributed observation increases when the provenance, dependence structure, observational position, and transformation history of the contributing traces remain recov-*

erable during integration.

Proposition 5.54 connects distributed observation to the book's broader concern with future re-epistemization. Provenance allows later researchers to distinguish independent corroboration from repeated transmission, reconstruct disagreements, revise mappings among categories, and incorporate evidence that earlier syntheses excluded. Distributed observation is therefore strongest when integration preserves the conditions under which each contribution became observable.

5.7.5 Hidden Relations

Section 5.4 introduced hidden relations as relations whose relevant traces remain outside an observation regime because they are inaccessible, suppressed, displaced, masked, or routed beyond the observer's evidential field. The present subsection develops hiddenness from the standpoint of partial access. A relation can be hidden from one observer and accessible to another, hidden during one interval and later reconstructed, or visible through consequences while its internal organization remains inaccessible. Hiddenness is therefore relational to an observer-position profile and an observation regime.

This target-relative account avoids treating hiddenness as an intrinsic metaphysical property. A private agreement can be hidden from the public while fully known to its participants. An informal coordination practice can be hidden from an administrative database while directly experienced by workers. A computational dependency can be hidden from users while inspectable by engineers. A historical relation can be hidden during its operation and become partly accessible after archives open. The status of hiddenness can change without the underlying historical event changing.

Hidden relations often reveal themselves indirectly. A pattern of outcomes can be difficult to explain through visible relations alone. Repeated discrepancies among official categories, reported experience, and observed consequences can motivate inference toward an unobserved mechanism. Such inference requires restraint. The presence of unexplained residuals does not identify a unique hidden relation. It provides a reason to widen the compatibility set, seek discriminating traces, examine missing channels, and compare alternative reconstructions.

The distinction among latent, hidden, and merely unrecorded relations should also remain intact. A latent relation is analytically inferred from manifestations without requiring that actors intentionally obscure it. A hidden relation is inaccessible relative to an observation regime, regardless of whether the inaccessibility is deliberate. An unrecorded relation may have been openly visible at the time while leaving weak surviving traces. These conditions can overlap, yet they generate different evidential problems and call for different forms of reconstruction.

Hiddenness can also be institutionally produced without a deliberate decision to conceal. Organizational fragmentation can place mutually relevant records in separate units. Data protection can intentionally restrict access for legitimate reasons. Technical systems can store information in incompatible formats. Informal practice can remain outside reporting categories. Specialized language can make evidence practically inaccessible to outsiders. Treating all hiddenness as deception would therefore obscure the heterogeneous mechanisms through which relational

knowledge becomes unavailable.

5.7.6 Strategic Concealment

Strategic concealment is a narrower case in which an actor, organization, or coordinated group intentionally changes the visibility, accessibility, timing, or interpretability of traces in order to shape what another observer can know. The strategy can involve withholding information, compartmentalizing access, producing selective disclosure, delaying records, routing activity through less visible channels, manipulating categories, or generating misleading traces. The epistemic target is consequently affected by an adversarial or strategic relation between observer and observed.

Simmel's early sociology of secrecy treated differentiated access to knowledge as a constitutive feature of social relations rather than a marginal anomaly (Simmel 1906). GRE extends this insight into an epistemic specification: secrecy and concealment alter the observation relation itself. A researcher, regulator, contractual counterparty, competitor, or affected community may receive an evidential field partly shaped by the target actor's expectations about observation.

Strategic concealment complicates ordinary assumptions about missing data. Absence can result from nonexistence, failed detection, lack of preservation, restricted access, or successful concealment. The evidential meaning of non-observation therefore depends partly on whether the observation regime is robust against strategic behavior. Where actors benefit from remaining unseen, evidence of absence requires stronger knowledge of detection pathways and stronger reasons to believe that relevant traces could not easily have been displaced or suppressed.

Concealment can also be selective rather than comprehensive. An actor may disclose enough information to satisfy a formal requirement while obscuring the relation most relevant to the observer's target. A firm can provide aggregate figures that preserve confidentiality while also limiting inspection of internal distribution. A platform can publish policy descriptions while withholding model details. A political or commercial organization can release favorable records and leave unfavorable episodes difficult to reconstruct. These cases differ normatively and legally, yet they share an epistemic structure in which the observed evidential field has been strategically curated.

The response to strategic concealment should remain evidential rather than presumptive. Suspicion alone does not establish a hidden relation. Researchers can compare independent sources, inspect inconsistencies, analyze incentives for disclosure and concealment, study record-generation procedures, seek traces generated outside the control of the focal actor, and report remaining uncertainty. An adversarial observation setting raises the burden of reconstruction while preserving the requirement that claims remain supported by evidence.

Claim 5.55 (Strategic observability)**.** *When observed actors can anticipate an observation regime and possess meaningful capacity to alter the traces available to that regime, observability becomes partly strategic and should be modeled as a relational condition of evidence production.*

Claim 5.55 extends Section 5.6's account of performativity. Observation need not

merely record a pre-existing evidential field; the expectation of observation can influence which traces are generated, preserved, displayed, displaced, or concealed. The epistemology of GRE therefore requires attention to the interaction between observational design and strategic response.

5.7.7 Temporal Limits of Observation

Observation is temporally situated. An observer encounters a relation during an interval, through traces that have their own durations, delays, retention periods, and rates of decay. Some relations are slow and persistent relative to observation; others are episodic, rapidly changing, or visible only during transition. Temporal position therefore affects which aspects of a relational process can be observed and which must be reconstructed from surviving traces.

Several temporal limits are analytically distinct. First, an observation window can be shorter than the formation or transformation of the target relation. Short windows may then misclassify transient conditions as stable structures or stable structures as isolated events. Second, manifestations can lag behind relational change. An institutional reform can alter practice before aggregate indicators respond, while a financial or administrative record can continue reflecting earlier conditions after the relation has changed. Third, traces can decay or disappear. Informal communication, tacit coordination, and ephemeral digital interactions can leave uneven historical records. Fourth, later observation can benefit from archives and hindsight while losing access to meanings, expectations, and uncertainties that were available to contemporaneous participants.

Temporal access also interacts with recursive representation. A later observer may study a system after earlier classifications, measurements, and interventions have already reshaped it. Present traces then contain historical layers. Some features record earlier relations; some reflect adaptation to prior observation; some result from later reinterpretation or data migration. Reconstructing relational history therefore requires attention to when a trace was produced, when it was recorded, when it became accessible, and whether its meaning changed across those intervals.

The temporal limit of observation should not be answered by privileging either contemporaneous or retrospective knowledge in general. Contemporary observers may possess practical and contextual access unavailable later while lacking knowledge of long-run consequences. Later observers may compare broader trajectories and recover previously inaccessible archives while interpreting the past through categories that emerged afterward. Each temporal position produces characteristic capacities and blind spots.

Proposition 5.56 (Temporal indexing of observational warrant)**.** *A relational claim whose warrant depends materially on the timing, duration, preservation, or retrospective accessibility of evidence should state those temporal conditions as part of its observational scope.*

Proposition 5.56 is especially important for generative inquiry because causal and constitutive processes often unfold across multiple timescales. Evidence gathered at one moment can be adequate for a local state description while remaining weak for a claim about formation, persistence, transformation, or dissolution. Later sections

on relational identity, generative effects, and historical trajectories will develop these temporal problems further.

Section 5.7 therefore places observation inside the relational epistemology rather than outside it. Observation provides access through positions, institutions, instruments, records, and temporal windows whose capacities are uneven and sometimes strategically contested. Partiality can be reduced through distributed observation, provenance-preserving integration, and the widening of access channels, yet it cannot be assessed apart from a specified target and claim. The resulting epistemic discipline is constructive: researchers can identify what their observation regime reaches, where access becomes asymmetric or hidden, how strategic actors may shape visibility, and which temporal limits constrain inference. Section 119 extends this analysis from observer access to the selection of boundaries and scales through which relational systems become objects of knowledge.

5.8 Boundary and Scale in Relational Knowledge

Section 5.7 located observation within a structured relation among epistemic targets, observer positions, access channels, and temporal conditions. The present section addresses a logically subsequent problem: relational inquiry must also specify where an epistemic object begins and ends, and at what scale its organization is being described. Its role is to make boundary and scale selection explicit parts of epistemic warrant. The objective is to distinguish analytical delimitation from claims about the organization of relational reality, while showing how the two can inform one another. The section proceeds through boundary selection, internal and external relations, relational neighborhoods, scale dependence, cross-scale relations, open and permeable boundaries, and boundary uncertainty. The method is comparative and sensitivity-oriented. A relational claim is evaluated not only against available evidence, but also against the boundary and scale conditions under which the evidence has been assembled and the claim has been formulated.

The issue is especially important for GRE because economic objects are rarely isolated by a single natural perimeter. A firm can be analyzed through legal incorporation, ownership, contractual relations, production networks, workplace organization, financing, technological dependencies, ecological inputs, or household effects. A market can be delimited by product categories, geography, institutions, infrastructures, substitution patterns, or regulatory jurisdiction. A household can appear as a consumption unit, a care relation, a property arrangement, a site of labor reproduction, or a node in wider kinship and transfer networks. Each delimitation can be analytically useful, yet each reveals some relations and places others outside the immediate frame.

Systems and network traditions provide several precedents for taking this problem seriously without requiring a single universal ontology of systems. Simon's analysis of complex organization emphasizes hierarchical and near-decomposable structures whose useful description depends on the level at which subsystems and their interactions are examined (Simon 1962). Wellman's structural network perspective similarly directs attention toward patterned relations, clusters, boundaries, and positions

rather than treating social units as self-contained aggregates (Wellman 1983). Multiscale approaches make the dependence on scale even more explicit: Bar-Yam shows that organization and coordinated variation can differ across scales, so a description adequate at one scale can omit structure that becomes salient at another (Bar-Yam 2004). GRE draws from these lineages a limited epistemic conclusion. Boundary and scale are conditions of representation and inference whose adequacy must be assessed relative to the relational target, rather than assumed in advance.

Definition 5.57 (Epistemic boundary)**.** An *epistemic boundary* is a stated rule of inclusion and exclusion that delimits the entities, relations, events, traces, intervals, or environments treated as immediately constitutive of a specified object of inquiry.

Definition 5.57 concerns inquiry rather than ultimate ontology. An epistemic boundary can follow a legally instituted border, an organizational membership rule, a spatial perimeter, a temporal interval, a network criterion, or a researcher-defined analytical cutoff. Some such boundaries correspond closely to durable relational structures; others are provisional devices used to make inquiry tractable. Their epistemic status therefore depends on how they are justified and how sensitive the resulting claims are to alternative delimitations.

5.8.1 Boundary Selection

Boundary selection is the act of specifying which relations and conditions belong to the immediate object of inquiry and which are treated as part of its environment, background, or adjacent systems. Selection is unavoidable whenever the relational field exceeds what can be observed or represented in a single analysis. The epistemic problem is consequently less whether a boundary has been imposed than whether the chosen boundary is appropriate to the claim and whether its consequences for inference remain visible.

A boundary can be selected through several kinds of criteria. Institutional boundaries can follow formal membership, jurisdiction, ownership, or contractual responsibility. Spatial boundaries can follow physical proximity, administrative territory, ecological region, or infrastructural reach. Temporal boundaries can delimit episodes, policy periods, organizational lifecycles, or generational intervals. Relational boundaries can include actors connected through specified types or strengths of relation. Functional boundaries can follow participation in a production process, financial circuit, care arrangement, or knowledge system. These criteria can overlap without coinciding.

Boundary selection therefore already contains a theory of relevance. When an analysis defines a firm by corporate ownership, it gives one kind of relation priority. When it defines the same productive activity through supply-chain dependence, labor coordination, or financial exposure, different relations become constitutive of the object. The issue is not that one description is automatically more real. Each boundary supports different epistemic targets. Problems arise when conclusions obtained under one delimitation are generalized as though the omitted relations were irrelevant to the target claim.

This point is familiar in social–ecological inquiry. Ostrom's framework for social–ecological systems distinguishes connected resource systems, resource units, gover-

nance systems, users, interactions, and outcomes, thereby making the analyzed system depend on a configuration of linked components rather than a single institutional or ecological border (Ostrom 2009). GRE uses this precedent to emphasize diagnostic boundary construction: the research boundary should be chosen so that relations capable of materially affecting the target claim remain inspectable where feasible.

Claim 5.58 (Boundary-relative warrant)**.** *The warrant of a relational claim is partly conditional on the boundary within which evidence is assembled and relations are reconstructed when materially relevant relations cross, constitute, or alter that boundary.*

Claim 5.58 does not imply that every analysis must expand indefinitely. A narrowly bounded study can be rigorous when its target is correspondingly narrow and its exclusions are justified. The claim instead requires alignment between the reach of the conclusion and the reach of the inquiry. A workplace study can make strong claims about a specified organizational process while remaining cautious about effects that depend on household, regulatory, ecological, or transnational relations outside its evidential boundary.

Boundary selection can also be recursive. Once a boundary becomes institutionalized through law, accounting, statistics, or administration, it can affect the relations subsequently observed within it. A legal definition of an enterprise, a statistical labor-market region, or an administrative service area can organize reporting, eligibility, responsibility, and resource allocation. The analytical boundary then interacts with the performative mechanisms developed in Section 5.6. Epistemic inquiry should therefore distinguish a boundary selected for analysis from a boundary that has itself become relationally efficacious.

5.8.2 Internal and External Relations

Once an epistemic boundary is selected, relations can be described as internal or external relative to that boundary. An internal relation connects elements included within the immediate object of inquiry. An external relation connects an included element to an element, condition, or process treated as lying outside that object. These terms are boundary-relative classifications. They do not establish that an external relation is causally weak, ontologically secondary, or economically peripheral.

The distinction is important because many consequential processes are boundary-crossing. A firm's internal production arrangements can depend on external credit, regulation, energy infrastructures, intellectual-property regimes, platform access, household labor reproduction, and suppliers. A household's internal allocation can depend on wage relations, public services, property markets, kinship transfers, and legal status. A local market can be reorganized by financing, logistics, information, or regulatory decisions made elsewhere. Treating these relations as external for one analytical purpose can be entirely legitimate while still requiring them to be reintroduced when the target concerns formation, persistence, vulnerability, or transformation of the bounded object.

The internal–external distinction can also change with analytical purpose. An employment contract may be external to a study of household interaction and internal to a study of labor-market organization. A national regulation may be external to a firm-level process model and internal to an institutional analysis of the sector. The same

relation can therefore occupy different classificatory positions without contradiction when the epistemic target changes.

Simon's account of near-decomposability is useful for specifying when such boundaries can support tractable analysis (Simon 1962). A subsystem can sometimes be studied with relative autonomy when interactions within it are sufficiently stronger or faster than interactions with its environment over the relevant interval. GRE adopts this as a methodological possibility rather than a universal structural law. Near-decomposability is something to establish for the case at hand. Where boundary-crossing relations are strong, rapid, or constitutive, an analysis that treats them as background will have correspondingly narrower warrant.

Proposition 5.59 (Conditional analytical closure)**.** *A bounded relational object can be treated as provisionally closed for a specified claim when omitted boundary-crossing relations are unlikely to alter the inference materially over the relevant interval and scale, or when their effects are explicitly represented as external conditions.*

Proposition 5.59 gives closure an epistemic rather than ontological meaning. Closure is a controlled simplification. Its adequacy can be tested by widening the boundary, introducing external conditions, comparing cases with different environments, or examining whether residual patterns systematically track omitted relations. This treatment permits focused inquiry while retaining sensitivity to relational openness.

The distinction also disciplines causal language. If a bounded model explains an outcome through internal relations while a major external condition remains unexamined, the explanation should be stated at the level supported by the boundary. The model may identify an internal mechanism without establishing that the mechanism is sufficient across environments. Conversely, evidence that a process depends strongly on external relations can itself be a substantive result about the relational architecture of the object.

5.8.3 Relational Neighborhoods

Many relational inquiries do not require a complete system boundary at the outset. They begin from a focal entity, relation, event, or problem and reconstruct a *relational neighborhood*: the set of nearby relations judged relevant under a specified criterion of connection. Neighborhood reasoning is particularly useful when institutional borders are porous, when the target is locally situated within a much larger network, or when the relevant environment cannot be identified through spatial proximity alone.

A relational neighborhood can be defined through direct ties, repeated interaction, shared institutions, dependency, information flow, legal obligation, resource transfer, common infrastructure, or other target-relevant criteria. The meaning of "near" is therefore relational. Two geographically distant actors can belong to a close financial or informational neighborhood, while adjacent actors can remain weakly connected for the target relation. GRE consequently avoids assuming a common metric space for heterogeneous relations. Neighborhoods can be topological, institutional, temporal, semantic, contractual, or functional without being reducible to a single numerical distance.

Network analysis provides a useful precedent because it directs attention toward

patterned ties and positions rather than beginning from categorical aggregates (Wellman 1983). Yet a relational neighborhood in GRE can include conditions that are difficult to represent as pairwise links: legal regimes, infrastructures, shared classifications, historical dependencies, environmental constraints, or distributed fields. The neighborhood concept is therefore broader than a graph-theoretic ego network, although network measures can be appropriate in cases where the relevant relation admits that representation.

Neighborhood construction should also preserve the reason each relation is included. A researcher studying access to housing may include household income, landlord practices, credit screening, zoning, transport, employment location, family transfers, and public assistance because each bears differently on the target. Treating all of these as generic "connections" would lose evidential structure. The neighborhood should instead record relation type, direction where relevant, temporal status, evidential basis, and the pathway through which the relation can affect the claim.

Definition 5.60 (Relational neighborhood)**.** A *relational neighborhood* is a target-relative set of relations and conditions included around a focal epistemic object because their connection is judged materially relevant to describing, explaining, or reconstructing that object under a stated criterion.

Definition 5.60 keeps neighborhood construction open to revision. Initial inquiry may reveal relations whose importance was not known in advance. The neighborhood can then expand, contract, or change composition. This is especially important for exploratory research, historical reconstruction, and generative inquiry, where the relations responsible for an observed manifestation may initially be uncertain.

Neighborhoods can also overlap. A worker can simultaneously participate in workplace, household, credit, care, migration, professional, and platform neighborhoods. A firm can occupy production, finance, legal, innovation, and regional-development neighborhoods. Overlap can become epistemically important when a relation appearing weak in one neighborhood becomes consequential through another. This observation prepares the later treatment of higher-order relations and relational fields in this chapter.

5.8.4 Scale Dependence

Scale specifies the level of aggregation, spatial extent, temporal resolution, organizational depth, or relational granularity at which an object is observed and represented. A change of scale can alter which regularities become visible, which variations are averaged, which actors remain distinguishable, and which relations appear stable. Scale is therefore an epistemic condition of relational description rather than a neutral change in presentation.

Different kinds of scale should remain distinguishable. Spatial scale concerns extent and resolution in space. Temporal scale concerns observation interval and temporal granularity. Organizational scale concerns nested units such as teams, firms, sectors, jurisdictions, or transnational arrangements. Relational scale concerns the granularity at which interactions are represented, ranging from individual ties to clusters, networks, institutions, or distributed conditions. Statistical aggregation can combine these dimensions but should not be treated as equivalent to them.

Bar-Yam's multiscale analysis is relevant because it explicitly relates coordinated variation to the scale at which system behavior is described (Bar-Yam 2004). Simon's account of complex architecture similarly emphasizes nested levels and the analytical importance of identifying subsystems (Simon 1962). GRE uses these resources to support a modest principle: a relational pattern established at one scale does not automatically retain the same form, explanatory role, or evidential meaning at another.

For example, aggregate wage stability can coexist with substantial worker-level turnover and redistribution. A national increase in output can coexist with regional contraction. A firm-level productivity gain can coincide with greater unpaid work elsewhere in the relational system. A stable annual indicator can conceal rapid short-term volatility. A network that appears integrated at sector level can contain fragmented local clusters. None of these examples implies that the aggregate description is false. They show that aggregation changes the object represented and therefore changes the scope of the claim.

Claim 5.61 (Scale-indexed relational claims)**.** *When a relational regularity, dependency, or generative effect varies materially with spatial, temporal, organizational, or relational granularity, its epistemic statement should identify the scale at which the evidence supports the claim.*

Claim 5.61 is intended to limit unmarked scale transfer. A pattern observed among individuals should not be attributed to organizations without further evidence, and an aggregate regularity should not be assigned to constituent actors simply because they participate in the aggregate. Similar caution applies temporally: a short-run association may differ from a long-run trajectory because adaptation, institutional change, and delayed effects enter at different intervals.

Scale selection also affects evidential availability. Fine-grained data can reveal heterogeneous responses while creating privacy, sparsity, or interpretability problems. Aggregate data can reveal long-run structure while suppressing local variation. Historical archives can support institutional-scale reconstruction while leaving individual interaction weakly observed. High-frequency computational traces can provide detailed temporal access while covering only activities mediated by the relevant platform or instrument. There is consequently no universally privileged scale of observation. The relevant scale follows from the target, mechanism, and claim.

5.8.5 Cross-Scale Relations

Scale dependence becomes more demanding when processes at different scales interact. Cross-scale relations connect phenomena represented at different levels of aggregation, temporal duration, organizational depth, or relational granularity. Their epistemic importance lies in preventing scale-specific descriptions from being mistaken for self-contained explanations.

Cross-scale relations can operate in several directions. Local interactions can accumulate, coordinate, or diffuse into patterns visible at broader scales. Broader institutions can condition local possibilities through law, infrastructure, standards, prices, categories, or resource distributions. Slow processes can alter the environment within which faster processes unfold, while repeated fast interactions can gradually transform slower institutional arrangements. These descriptions should

be treated as candidate relational mechanisms whose presence requires evidence, rather than as a generic doctrine of upward or downward causation.

Complex-systems research provides useful examples of multilevel organization without resolving the epistemology for GRE. Levin's treatment of ecosystems as complex adaptive systems emphasizes localized interactions, historical dependence, self-organization, and multiple levels of dynamics (S. A. Levin 1998). Ostrom's social–ecological framework likewise studies connected components across ecological and institutional levels (Ostrom 2009). GRE draws on these works to emphasize that a scale can be analytically coherent while remaining dependent on processes represented elsewhere.

Cross-scale inference requires bridge evidence. If a household-level practice is proposed to contribute to a regional pattern, the analysis should identify the aggregation or transmission pathway. If a regulatory regime is proposed to alter individual behavior, evidence should connect the institutional rule to local incentives, constraints, interpretations, or enforcement. If a long-run structural change is proposed to emerge from repeated short-run interactions, the persistence and accumulation mechanisms should be specified. Merely observing compatible patterns at two scales provides weaker warrant than tracing the relations connecting them.

Proposition 5.62 (Cross-scale bridge requirement)**.** *A claim that attributes a relational or generative connection across scales gains warrant from evidence concerning the pathway that links the scale-specific processes, rather than from correspondence between scale-level patterns alone.*

Proposition 5.62 will become especially important in the later sections on generative relations and attribution of generative effects, where the chapter turns from relational knowledge toward knowledge of generation. For the present section, the point is epistemic: cross-scale interpretation requires an account of mediation between levels, including the possibility that intermediate relations modify, filter, amplify, or dissipate effects.

Cross-scale relations can also generate apparent contradictions that disappear once scale is specified. An institution can be stable at one organizational level while undergoing rapid change in local practices. A policy can increase aggregate access while intensifying exclusion in a subgroup. A network can become more connected globally while some neighborhoods become more isolated. GRE should preserve these differences rather than forcing them into a single scalar verdict. Divergence across scales can itself reveal the relational organization of the process.

5.8.6 Open and Permeable Boundaries

Many economic and social objects have boundaries that organize relations without fully containing them. GRE describes such boundaries as open or permeable when actors, resources, information, obligations, representations, risks, or generative effects can cross the analytical or institutional perimeter in ways relevant to the target. Permeability is therefore compatible with boundary significance. A boundary can structure access and responsibility while remaining traversed by important relations.

The distinction is useful for avoiding two opposite simplifications. One treats a for-

mally defined unit as though relations outside it were merely contextual. The other treats openness as though any delimitation were arbitrary. In practice, legal entities, jurisdictions, households, organizations, markets, and infrastructures often possess consequential boundaries precisely because crossing them is regulated, costly, asymmetric, or selective. The epistemic task is to identify what the boundary organizes and what kinds of relation pass through it.

Permeability can be typed. Resource permeability concerns flows of money, material, labor, energy, or goods. Informational permeability concerns communication, data, knowledge, and signaling. Institutional permeability concerns overlapping jurisdictions, shared standards, delegated authority, or external governance. Social permeability concerns mobility, membership, kinship, professional affiliation, or collective participation. Generative permeability concerns the transmission of capacities, constraints, opportunities, and downstream effects across a boundary. These forms can vary independently.

Open boundaries also matter for attribution. An outcome observed within a bounded unit can partly arise through incoming relations, and actions originating within the unit can generate effects elsewhere. A balance sheet, administrative dataset, or organizational performance indicator may record the internal manifestation while leaving the external transfer weakly represented. For GRE, this is particularly important when later chapters examine value conversion, return, extraction, externalization, and the distribution of generative conditions. The epistemology developed here precedes those normative and substantive analyses by asking whether the relevant boundary-crossing relations are visible at all.

Definition 5.63 (Boundary permeability)**.** *Boundary permeability* is the target-relative extent and manner in which relations, flows, constraints, representations, or effects traverse a specified boundary during the interval relevant to an epistemic claim.

Definition 5.63 does not require permeability to be measured by a single scalar quantity. In some inquiries it can be quantified through flows or network ties. In others it is better represented through legal pathways, institutional interfaces, qualitative process tracing, or historical reconstruction. The analytical representation should follow the type of boundary-crossing relation rather than forcing heterogeneous forms into premature commensurability.

Boundary permeability can itself change historically. Trade rules, migration regimes, data infrastructures, financial integration, technological standards, organizational restructuring, war, environmental disruption, or institutional reform can alter what crosses a boundary and under what conditions. The evidential meaning of a boundary should therefore be indexed to time. A perimeter that once supported relative analytical closure can become substantially more permeable, and a previously open interface can become restricted.

5.8.7 Boundary Uncertainty

Boundary uncertainty arises when the evidence and research purpose remain compatible with more than one plausible delimitation of the epistemic object, or when the significance of boundary-crossing relations remains incompletely known. It dif-

fers from ordinary observational uncertainty. An observer can possess extensive evidence while still face uncertainty about where the object should be delimited for the target claim.

Several sources of boundary uncertainty recur in relational inquiry. Institutional categories can overlap or conflict. Informal relations can extend beyond formal membership. Networks can lack a sharp cutoff. Historical processes can change the relevant perimeter during the period studied. Different relation types can imply different neighborhoods. A target can also be nested within several larger systems, each of which introduces potentially relevant conditions. These cases make boundary selection an object of inquiry rather than a preliminary housekeeping decision.

Boundary uncertainty should be represented rather than hidden behind a single convenient specification. One strategy is comparative delimitation: reconstruct the claim under several plausible boundaries and inspect which conclusions remain stable. Another is progressive expansion: begin from a focal neighborhood and widen the boundary until additional relations cease to change the target inference materially within the practical limits of the study. A third is layered representation: retain several overlapping boundaries corresponding to legal, organizational, spatial, financial, ecological, or social structures. A fourth is explicit residualization: identify relations known to cross the boundary while recording the limits of evidence concerning their effects.

Definition 5.64 (Boundary-sensitivity analysis)**.** *Boundary-sensitivity analysis* is the systematic comparison of a relational claim across two or more defensible boundary specifications in order to identify which components of the inference are robust, which are boundary-dependent, and which require additional evidence.

Boundary-sensitivity analysis in Definition 5.64 is a general epistemic practice rather than a single quantitative technique. It can be implemented statistically, computationally, historically, ethnographically, legally, or through mixed methods. Its value lies in exposing the dependence of a conclusion on delimitation choices that might otherwise remain implicit.

Boundary uncertainty also interacts with scale uncertainty. A researcher can be unsure both about where to draw the perimeter and about the granularity at which the relevant relations should be represented. Expanding the boundary can reveal a broader-scale structure; increasing resolution can reveal local heterogeneity; changing temporal extent can reveal formation or decay that was invisible in a shorter interval. These operations can alter one another. The appropriate response is therefore iterative: boundary and scale specifications should be revised together as evidence about the relational architecture develops.

The resulting epistemic stance is neither boundary skepticism nor boundary realism in a simple sense. Some boundaries are strongly instituted and causally consequential; others are provisional analytical constructions; many combine both features. Their status should be established from evidence about how relations are organized, how the boundary is produced and maintained, which processes cross it, and how conclusions change under alternative specifications. Ontological suspension remains intact because this procedure does not require a final claim about ultimate system boundaries.

Section 5.8 therefore extends the account of partial access by showing that observation always occurs within a delimited and scaled epistemic object. Boundary selection determines which relations enter immediate analysis; internal and external status remains relative to that selection; relational neighborhoods provide flexible local reconstructions; scale changes what patterns become visible; cross-scale claims require bridge evidence; open boundaries direct attention toward traversing relations; and boundary uncertainty calls for sensitivity analysis. These principles prepare Section 120, which turns from the delimitation of relational objects to their identity and persistence through time. Once boundaries and scales are made explicit, the chapter can ask more precisely under what conditions a changing relation should still be treated as the same relation, and when formation, transformation, or dissolution warrants a change of identity claim.

5.9 Identity and Persistence of Relations

Section 5.8 established that relational claims depend on explicit boundaries and scales. The present section addresses the temporal counterpart of that problem: once a relation has been delimited for inquiry, under what conditions may observations at different times be treated as observations of the same relation? Its role is to provide an epistemic account of relational identity and persistence that can accommodate formation, stabilization, transformation, and dissolution without reducing identity to surface similarity or requiring exact continuity of every constituent feature. The objective is to make persistence claims auditable by specifying which properties are treated as identity-bearing, which variations remain compatible with continuity, and which changes warrant a revised relational classification. The section proceeds through identity, persistence through change, formation, stabilization, transformation, dissolution, and historical continuity and discontinuity. The method is criterion-based and historically comparative. Identity is treated as a claim whose warrant depends on the target, scale, temporal interval, and evidential continuity relevant to the inquiry.

The problem is pervasive in economic and institutional analysis. An employment relation can persist while wages, supervisors, tasks, schedules, and contractual terms change. A credit relation can continue through refinancing, restructuring, partial repayment, and changes in collateral. A household relation can persist through changes in residence, income, caregiving arrangements, and membership. An organization can remain legally continuous while its personnel, technologies, ownership, and internal authority are substantially reorganized. Conversely, the continuation of a name, identifier, legal shell, or statistical category can conceal a transformation so extensive that treating the later configuration as epistemically identical to the earlier one becomes misleading for the target claim.

Relational sociology offers an important precedent for treating social objects through unfolding relations rather than through fixed substances. Emirbayer emphasizes processual and dynamic relations as an alternative to substance-centered explanations (Emirbayer 1997). White similarly develops identities and social formations through networks, control efforts, and emergent relational organization (White 2008). Temporal-network analysis makes a related point in formal terms: the

timing and duration of ties matter to what can be inferred from a network, because an aggregate network can conceal whether relations actually coexisted or followed one another (Holme and Saramäki 2012). GRE adopts a narrower epistemic conclusion from these traditions. A claim that a relation persists across time requires a defensible continuity criterion and evidence that the criterion remains satisfied over the interval at issue.

Definition 5.65 (Relational identity criterion)**.** A *relational identity criterion* is an explicit set of target-relative conditions under which relational configurations observed at different times are treated as instances or phases of the same relation for a specified inquiry.

Definition 5.65 makes identity operationally accountable without reducing it to a single universal property. Depending on the target, continuity may be carried by participating relata, institutional recognition, recurring obligations, organized patterns of interaction, causal dependencies, governance rules, shared history, functional roles, or processes that reproduce the relation. Several such features can jointly support identity, and their evidential importance can change with scale. The same historical sequence can therefore support continuity for one target and discontinuity for another without contradiction, provided that the respective identity criteria are stated.

5.9.1 Identity of a Relation

The identity of a relation concerns whether two temporally separated relational configurations should be treated as belonging to one continuing relational history. This is distinct from the identity of the entities participating in the relation. The participants can remain the same while the relation changes, and the relation can sometimes persist while some participants change. A firm can retain a contractual relation with a supplier after personnel turnover. An office can retain an authority relation after the officeholder changes. A household can preserve some relational organization through changes in membership. Conversely, two actors can remain physically or legally identical while trust, obligation, authority, dependence, or exchange between them is transformed.

Identity therefore requires specifying what is being tracked. For a legal inquiry, continuity of a recognized contract or corporate person may carry substantial weight. For an organizational inquiry, recurring authority and coordination patterns may matter more. For a historical inquiry, the continuity of a practice, inherited rule, or institutional lineage may be central. For a study of dependence, the relevant identity may lie in a continuing asymmetry of access or obligation even when the formal instrument through which it is realized changes. The identity criterion should follow the epistemic target rather than ordinary-language naming alone.

The ambiguity of identity language has long been recognized in the social sciences. Brubaker and Cooper show that the term “identity” can combine analytically different phenomena such as categorization, self-understanding, commonality, connectedness, and groupness (Brubaker and Cooper 2000). GRE applies the same discipline to relations. Claims of relational identity should be decomposed into the dimensions of continuity actually being asserted. A statement that “the same employment relation

continued" can refer to legal continuity, organizational role continuity, economic dependence, recurring interaction, or a combination of these. The evidential burden changes accordingly.

Claim 5.66 (Criterion-indexed relational identity)**.** *A relational identity claim is warranted only relative to a stated or recoverable identity criterion whose continuity is supported by evidence over the interval and scale relevant to the claim.*

Claim 5.66 prevents persistence from being inferred from labels alone. A continuing category can be evidence of institutional recognition, but it does not establish continuity of every relation carried under that category. Likewise, changes in terminology do not establish that the underlying relational organization has disappeared. Names, identifiers, and classifications belong to the evidential field and can themselves become causally important, yet their continuity and the continuity of the relation remain analytically distinguishable.

Identity criteria can also be plural. A relation can satisfy one criterion while failing another. A corporation can remain legally identical while its ownership and productive organization change; a long-standing exchange relation can remain economically continuous while its contractual form changes; a political or administrative relation can preserve formal authority while practical compliance weakens. The appropriate response is often a differentiated description rather than a forced binary decision. Researchers can report legal continuity together with organizational transformation, or interactional continuity together with a change in the distribution of power.

5.9.2 Persistence through Change

Persistence concerns the maintenance of sufficient relational continuity across change. It therefore differs from immobility. Relations can persist through variation in intensity, participants, media, rules, manifestations, and surrounding conditions when the identity-bearing organization relevant to the inquiry remains sufficiently continuous. Chapter 4 developed this idea ontologically through dynamic persistence. The present section translates it into an epistemic requirement: evidence of persistence should show how continuity is carried through the observed changes.

Several continuity carriers are common. Recurrent interaction can reproduce expectations and obligations. Legal or administrative recognition can maintain roles across changes in personnel. Records and memory can preserve commitments across interruptions. Infrastructure can sustain access and dependency despite changes in surface practice. Organizational routines can reproduce coordination through turnover. Financial balances, debts, credentials, property claims, or reputational histories can connect earlier and later states. None of these carriers is universally decisive, but each can provide evidence for a particular persistence claim.

Persistence can also be intermittent. Relations may tolerate gaps without losing identity when the system preserves expectations or mechanisms of resumption. A seasonal employment relation can recur after months of inactivity. A dormant credit line can remain a continuing relation despite periods without transactions. A diplomatic, kinship, or professional relation can persist through sparse interaction because status, memory, entitlement, or recognized possibility remains operative. Temporal-network representations are useful here because they distinguish the

existence of ties over time from their collapse into one static aggregate (Holme and Saramäki 2012). GRE extends that insight beyond pairwise ties by asking what is preserved during inactive intervals and what evidentially supports the claim of continued relational availability.

Definition 5.67 (Persistence profile)**.** A *persistence profile* is a structured account of the mechanisms, records, practices, recognitions, dependencies, and temporal recurrences through which a specified relation maintains identity-bearing continuity across an interval of change.

The persistence profile in Definition 5.67 helps distinguish several forms of continuity that can otherwise be conflated. A relation can persist because actors actively reproduce it, because an institution maintains it, because material or technical infrastructure carries it, because historical commitments remain enforceable, or because several of these mechanisms reinforce one another. A profile can also reveal fragility. If continuity depends on one record, one intermediary, or one recurring practice, the relation may be more vulnerable to interruption than its current stability suggests.

Persistence is also scale-sensitive. A supply relation can appear continuous at an annual scale while exhibiting repeated breakdowns at a weekly scale. A labor relation can persist institutionally while everyday supervisory relations change rapidly. A monetary institution can remain historically continuous while its technical settlement processes are replaced. The persistence claim should therefore specify the temporal and relational resolution at which continuity is being asserted. This follows directly from the scale discipline developed in Section 5.8.

5.9.3 Relation Formation

Relation formation concerns the transition from the absence of a specified relation, or from a looser precursor configuration, to a relational organization that satisfies the inquiry's entry criterion. The epistemic challenge lies in identifying when enough evidence exists to treat a relation as having formed. Formation rarely occurs through a single universal threshold. It can arise through a contract, repeated interaction, mutual recognition, technical connection, accumulated dependence, institutional designation, shared practice, or gradual convergence of several conditions.

A legal relation can have a relatively sharp formal beginning, such as the execution of an agreement or conferral of a status. An interpersonal relation may emerge gradually through repeated interaction and expectation. A market relation can form through recurring exchange and the development of mutual responsiveness. A dependency relation can arise incrementally as alternatives disappear or switching costs accumulate. A platform relation can begin with registration, yet economically consequential dependence may develop only after data, reputation, customers, or complementary investments accumulate. The beginning of the formal relation and the beginning of the substantively relevant relation can therefore differ.

Formation should consequently be analyzed through entry conditions tied to the target. An investigator interested in legal obligation may date formation to a recognized act. An investigator interested in practical dependence may require evidence that one party's feasible options or capacities have become materially conditioned by the other. An investigator interested in trust may require a pattern of expectation and

reliance extending beyond a single encounter. These criteria can identify different formation times while referring to one historical sequence.

Definition 5.68 (Relational entry condition)**.** A *relational entry condition* is the target-relative evidential threshold at which a developing configuration is treated as having formed the relation specified by the inquiry.

Definition 5.68 supports historical precision because it separates the earliest precursor from the point at which the relation becomes analytically operative. A negotiation can precede a contract; repeated encounters can precede trust; technical adoption can precede infrastructural dependence; shared classification can precede institutionalized membership. Formation can therefore be reconstructed as a process even when the inquiry uses a specific threshold for dating the relation.

Relational formation can also depend on recursive recognition. Participants may alter their conduct once they understand themselves to be in a relation. Institutions can classify a relationship and thereby create obligations or expectations that further stabilize it. This connects formation to the performative representation developed in Section 5.6. Recognition is neither necessary for every relational reality nor merely descriptive when it enters subsequent conduct. The evidential task is to establish which role recognition played in the specific formation process.

5.9.4 Stabilization

Stabilization concerns the processes through which a newly formed or previously variable relation acquires sufficient regularity, durability, and causal reliability to support stronger persistence claims. Stabilization can occur through repetition, institutionalization, mutual adaptation, infrastructure, law, routines, expectations, sanctions, learning, investments, classification, or accumulated history. It should be treated as a matter of degree and mechanism rather than as a universal stage through which every relation must pass.

Giddens's account of structuration provides one precedent for understanding how social practices can recursively reproduce rules and resources through continued enactment (Giddens 1984). GRE uses this insight cautiously. Reproduction can stabilize a relation when repeated practices make later continuation easier, more expected, more enforceable, or more materially embedded. The existence of repetition alone, however, does not establish the mechanism. Stability can also be maintained by legal coercion, technical lock-in, unequal dependence, organizational routine, shared meaning, or deliberate maintenance.

Stabilization should therefore be evidenced through the carriers that make continuation probable or resilient. Repeated successful coordination can increase confidence that a relation will recur. Complementary investments can raise the costs of exit. Records can preserve obligations across personnel turnover. Standardization can reduce ambiguity in interaction. Institutional recognition can make enforcement available. Shared narratives and categories can provide interpretive continuity. Infrastructure can make some interactions routine while making alternatives costly. Each mechanism leaves different traces and carries different implications for later transformation.

Claim 5.69 (Stabilization through reproduced conditions)**.** *Evidence for relational stabilization is strengthened when the conditions that support continuation are themselves shown to be reproduced, maintained, or renewed across time rather than inferred solely from repeated outcomes.*

Claim 5.69 distinguishes stabilization from mere recurrence. Two actors can transact repeatedly because external circumstances repeatedly bring them together without producing a durable relation between them. Conversely, a stable relation can persist through temporary inactivity when institutions, expectations, or obligations maintain the conditions for resumption. The relevant evidence therefore concerns both observed continuity and the mechanisms that sustain it.

Stabilization is normatively indeterminate. Trust, cooperation, care, exploitation, exclusion, hierarchy, monopoly, debt dependence, and discriminatory practice can all become stable. The epistemic task in the present chapter is to establish whether and how stabilization occurs. Evaluation of the desirability or justice of that stabilized relation requires separate normative analysis. Preserving this distinction is especially important because durable relations can become easier to observe precisely because institutions record and reproduce them, while unstable or marginalized relations may remain less legible.

5.9.5 Transformation

Transformation arises when change affects the identity-bearing organization of a relation sufficiently to require either a qualified continuity claim or a revised relational classification. The analytical difficulty lies between two errors. One error treats every change as evidence of a new relation. The other treats a continuing label or participant set as proof that the relation remains substantially unchanged. A defensible transformation claim compares the earlier and later configurations against the identity criterion, persistence profile, and scale of the inquiry.

Transformation can concern the relata, the structure connecting them, the distribution of capacities and obligations, the governing rules, the mechanisms of reproduction, the medium of interaction, or the relation's position within a wider field. Some changes modify only parameters within an established relation. Others alter the conditions through which the relation operates. A loan can be repriced while remaining the same debt relation; a restructuring can change priority, collateral, counterparties, or enforcement conditions enough to alter the relevant relational architecture. Employment can continue through a new schedule, while a transition from direct employment to platform-mediated contracting can alter authority, risk allocation, visibility, and access to protections.

Historical sociology provides useful resources for identifying consequential transformation. Sewell's analysis of historical events emphasizes that events can transform structures by reorganizing schemas, resources, and subsequent action (Sewell 1996). Pierson's account of path dependence emphasizes how timing, sequence, and self-reinforcing processes can make earlier developments consequential for later possibilities (Pierson 2000). GRE draws an epistemic implication from these approaches: transformation should be reconstructed through changes in the organization and reproduction of the relation, with attention to how earlier configurations condition the

later one.

Definition 5.70 (Relational transformation threshold)**.** A *relational transformation threshold* is the target-relative point at which accumulated or event-driven change alters one or more identity-bearing dimensions sufficiently that an unqualified persistence claim would obscure a materially relevant difference.

The threshold in Definition 5.70 need not be numerically sharp. Historical and qualitative inquiry can identify transformation through converging evidence that the relation now operates through different rules, capacities, dependencies, or reproduction mechanisms. Quantitative inquiry can specify thresholds where measurable structure changes. Legal or administrative inquiry can identify formal reconstitution. The appropriate threshold follows the target and evidence rather than a universal metric.

Transformation can preserve lineage. A relation may be historically continuous in the sense that the later configuration descends from and is causally shaped by the earlier one while differing enough to warrant a new subtype, phase, or category. This is particularly important for institutions. A monetary regime, organization, profession, or governance arrangement can transform repeatedly while preserving records, assets, memberships, obligations, or inherited constraints. Lineage and identity should therefore be reported separately when they diverge.

5.9.6 Dissolution

Dissolution concerns the point at which a relation ceases to satisfy the identity and persistence conditions relevant to the inquiry. Dissolution can be abrupt, gradual, formal, practical, partial, or contested. A contract can terminate on a legally specified date. A trust relation can erode through repeated breaches. A market connection can disappear as transactions and expectations cease. An organizational role can remain formally recorded while losing practical authority. A dependency can weaken as alternatives become available. These cases show that termination of one manifestation of a relation and dissolution of the relation itself can occur at different times.

The epistemic burden of dissolution resembles the problem of evidence of absence developed in Section 5.4. Non-observation after time t does not by itself establish that a relation has ended. Activity can become latent, hidden, intermittent, or inaccessible to the observation regime. A stronger dissolution claim requires evidence that the mechanisms, obligations, expectations, channels, or institutional conditions carrying the relation have ceased, become ineffective, or been replaced in ways that make continuation implausible under the stated criterion.

Formal termination can nevertheless be highly probative when the target relation is institutionally constituted by formal status. Dissolution of a corporation, revocation of a license, cancellation of a contract, or abolition of an office can change rights and obligations immediately. Even then, historical effects can remain. Debts, records, reputations, infrastructures, property distributions, learned routines, and legal precedents can survive the relation that generated them. The end of relational persistence therefore differs from the disappearance of all consequences.

Proposition 5.71 (Residual efficacy after dissolution)**.** *The dissolution of a relation*

does not imply the disappearance of effects generated during its persistence; later relational configurations can remain conditioned by residues of a relation whose own identity criteria are no longer satisfied.

Proposition 5.71 matters for historical explanation. Former institutions can continue to shape distributions, infrastructures, expectations, records, categories, and strategic positions. A relation can therefore cease to exist as a continuing relation while remaining causally relevant through its historical products. This distinction prevents retrospective disappearance: a dissolved relation can have been relationally real and economically consequential during the interval in which it persisted.

Dissolution can also be uneven across scales. A formal organization may dissolve while local networks formed within it continue. A legal relationship may end while social obligations persist. A production network may fragment while technical standards remain shared. An exchange relation may end between two firms while industry-level dependencies continue. Researchers should therefore specify which relational object has dissolved and which inherited relations remain operative.

5.9.7 Historical Continuity and Discontinuity

Historical continuity and discontinuity bring the preceding distinctions together. A longitudinal relational account should be able to state where a relation forms, what stabilizes it, which changes remain compatible with persistence, when transformation becomes analytically consequential, and under what conditions dissolution is inferred. These judgments depend on the identity criterion and scale of inquiry, yet they remain constrained by evidence. Historical reconstruction therefore requires more than chronological ordering. It requires a defensible account of what is continuing across the ordered observations.

Continuity can take several forms. There can be continuity of participants, legal recognition, institutional lineage, infrastructure, practice, causal dependence, memory, or generative conditions. Discontinuity can likewise affect some dimensions while leaving others intact. A revolution can transform formal authority while preserving administrative routines. A merger can terminate corporate identities while preserving production systems and employment relations. A technological transition can replace the medium of exchange while preserving creditor–debtor relations. An institutional reform can preserve names and offices while changing the distribution of decision authority. Historical interpretation should therefore identify the dimensions in which continuity and discontinuity occur.

This multidimensional approach also improves periodization. Historical periods are often constructed around events, reforms, crises, regime changes, or technological transitions. Such boundaries can be useful when they correspond to changes in the relations relevant to the inquiry. They become misleading when the period boundary is treated as if every relation changed simultaneously. Different relational processes can have different turning points, rates of change, and persistence mechanisms. A single chronology may therefore contain overlapping continuities and discontinuities.

Definition 5.72 (Relational continuity judgment)**.** A *relational continuity judgment* is an evidence-based assessment that specifies which identity-bearing dimensions of a

relation persist, transform, or dissolve across a stated historical interval and analytical scale.

Definition 5.72 replaces an undifferentiated same-or-different judgment with an auditable historical account. The judgment can conclude that a relation persists substantially, persists with transformation, divides into several relations, merges with another configuration, becomes dormant, or dissolves while leaving residual effects. These possibilities are analytically distinct and can be supported by different evidence.

Historical continuity can also be path-dependent. Earlier stabilization can alter later transition costs, available categories, institutional expectations, and distributions of capability. Pierson's treatment of increasing returns and path dependence highlights how sequences can become self-reinforcing under specified mechanisms (Pierson 2000). For GRE, this means that persistence is sometimes explained partly by the history of the relation itself. Continued existence can result from accumulated investments, learned coordination, legal precedent, reputational capital, sunk costs, institutional complementarities, or the narrowing of alternatives. A persistence claim should nevertheless distinguish such mechanisms from mere duration. Longevity is evidence of survival; explanation requires evidence about what reproduced the relation.

Discontinuity likewise requires historical specificity. Sewell's event-centered account shows how concentrated episodes can transform structures and later trajectories (Sewell 1996). Other transformations accumulate gradually without a single decisive event. The evidence should therefore be open to both event-driven and cumulative change. A discontinuity claim gains strength when earlier persistence mechanisms cease to operate, when new mechanisms become constitutive, or when the relation's causal capacities and obligations change enough that the previous identity criterion loses adequacy.

Section 5.9 therefore establishes relational identity as a temporally and epistemically disciplined claim. Identity depends on explicit criteria; persistence requires evidence of continuity carriers and reproduction mechanisms; formation requires target-relative entry conditions; stabilization concerns the reproduction of conditions supporting continuation; transformation marks materially relevant change in identity-bearing dimensions; dissolution concerns the failure of persistence conditions while allowing historical residues to remain effective; and historical continuity judgments specify which dimensions persist and which change. This framework prepares the following section's move from single relations through time to knowledge of relations among relations. Once the identity and persistence of individual relational objects can be stated with greater precision, higher-order relational configurations can be reconstructed without assuming that their constituent relations are timeless or internally homogeneous.

5.10 Higher-Order Relational Knowledge

Section 5.9 established criteria for judging the identity, persistence, transformation, and dissolution of individual relations through time. The present section extends

the epistemic problem from relations considered one at a time to configurations in which relations themselves become mutually dependent, collectively organized, nested, typed across several layers, or jointly constituted through interactions involving more than two relata. Its role is to specify what GRE may reasonably claim when the relevant object of knowledge is a relational configuration whose organization cannot be recovered by inspecting isolated dyads alone. The objective is to distinguish several forms of higher-order relational knowledge and to state the evidential requirements appropriate to each form. The section proceeds through relations among relations, collective relations, nested relations, higher-order relations, multilayer relations, hyperrelational configurations, and the limits of higher-order reconstruction. The method is reconstructive and representation-sensitive: higher-order claims are treated as inferential constructions constrained by observed traces, relational identities, boundary and scale choices, and the semantics of the representation through which the configuration becomes epistemically accessible.

Higher-order inquiry is economically important because many consequential arrangements are composed of several relations whose effects depend partly on one another. A household's credit relation may depend on employment income; employment may depend on an organizational authority structure; the organization may depend on financing, supply, and regulatory relations; and each of these may be conditioned by infrastructures that connect many actors at once. Studying each relation separately can identify important local mechanisms while leaving the architecture through which they become mutually reinforcing, substitutable, conflicting, or jointly vulnerable insufficiently reconstructed. Relational sociology and network analysis provide established resources for moving beyond atomized attributes toward patterned relations (Emirbayer 1997; Wellman 1983). GRE extends that epistemic orientation by asking what additional warrant is required when the object of inquiry is itself composed of several identified relations or relation types.

The resulting problem is partly representational. A configuration can be encoded as a set of pairwise ties, a membership structure, a multilayer network, a higher-order interaction, or another relational representation. These encodings illuminate different features and suppress others. A richer representation can therefore increase analytical capacity while also increasing assumptions, data requirements, and opportunities for misclassification. Higher-order knowledge should consequently be judged by correspondence between the target claim, the chosen relational representation, and the evidence available for reconstructing the relevant dependencies.

Definition 5.73 (Higher-order relational knowledge)**.** *Higher-order relational knowledge* is warranted knowledge about configurations in which the epistemic target concerns relations among relations, organized collectivities, nested relational structures, multiple relation types, or interactions whose relevant organization is not exhausted by independently described pairwise relations.

Definition 5.73 is intentionally broad. It does not imply that every economic phenomenon requires a higher-order representation. Pairwise relations remain appropriate when the target can be adequately reconstructed at that level. The definition instead identifies cases in which the evidential object includes organization among relations. The burden of inquiry then shifts from establishing that several relations exist to establishing how they are connected, coordinated, conditioned, or jointly con-

stituted.

5.10.1 Relations among Relations

Relations among relations arise when the existence, operation, strength, interpretation, or consequences of one relation depend materially on another relation. This dependence can be institutional, causal, informational, normative, temporal, or infrastructural. A collateral relation can condition a credit relation; an employment relation can condition eligibility for insurance; a legal relation can authorize an administrative relation; a supply relation can be activated only when a financing relation is maintained. The epistemic target is therefore a dependency between relational objects rather than a new attribute of one participant.

Knowledge of such dependencies requires the constituent relations to be identified with sufficient clarity before their interdependence is inferred. Section 5.9 matters directly here. If the identity or temporal continuity of one relation remains uncertain, a claim about its dependence on another relation inherits that uncertainty. The problem also inherits the boundary and scale conditions developed in Section 5.8: two relations may appear independent within a narrow boundary while sharing an external institutional condition at a wider scale.

A relation among relations should not be inferred merely because two relations share a participant. A worker may have an employment relation and a tenancy relation without the two being materially dependent. Conversely, a dependency can exist even when the relations do not share the same immediate relata. A lender's financing relation with a firm may alter the firm's employment relations with workers through covenant conditions, liquidity constraints, or restructuring decisions. Evidence for a relation among relations therefore concerns a mechanism or patterned dependency connecting relational processes, rather than simple co-occurrence.

Claim 5.74 (Non-aggregation of relational dependence)**.** *The observation of several relations within the same boundary does not by itself warrant a claim about relations among those relations. Higher-order dependence requires evidence that specifies how variation, persistence, activation, interpretation, or consequences in one relational object are connected to another.*

Claim 5.74 places an evidential threshold between relational inventory and relational architecture. Such evidence may come from institutional rules, temporal sequencing, intervention, comparative cases, organizational records, contractual conditions, recurring covariation supported by mechanism, or testimony from participants positioned within the relevant processes. Several forms of evidence can converge. The appropriate combination depends on whether the higher-order claim concerns causal dependence, legal dependence, functional coordination, symbolic coupling, or another specified relation between relations.

The distinction is especially important when relations can substitute for or compensate for one another. A household may respond to reduced wage income through borrowing, intra-household transfers, public benefits, asset sales, or informal support. A firm may replace one supplier, financing source, or distribution channel with another. In such cases, knowledge of the relations individually does not yet explain the resilience or fragility of the larger arrangement. The higher-order target con-

cerns the pattern of substitutability, complementarity, or mutual constraint among relations.

5.10.2 Collective Relations

Collective relations concern relations in which at least one relatum is an organized collectivity whose relational capacities cannot be reconstructed adequately by treating it as a mere list of individual members. Firms, households, associations, agencies, cooperatives, classes of officeholders, and other collectivities can act or be treated as relational participants through rules that organize membership, authority, representation, obligation, and continuity. The epistemic problem is to determine when a collective attribution is warranted and what features of the collectivity carry the relation.

The duality between persons and groups provides a useful precedent for this problem. Breiger shows that membership structures connect interpersonal and intergroup organization rather than reducing one level straightforwardly to the other (Breiger 1974). White's relational sociology similarly treats identities and social formations as emerging through patterned relations and control processes rather than as pre-given substances (White 2008). GRE adopts a narrower epistemic lesson: a collective relation should be reconstructed through evidence about the organization that enables the collectivity to enter, sustain, interpret, or modify the relation.

For example, a corporation may owe a debt even though the individuals working within it change. The relation is carried through legal personality, accounting systems, governance rules, authorized representatives, and organizational continuity. A household may participate in a mortgage relation through jointly organized income, ownership, legal responsibility, or caregiving arrangements. A labor union may bargain with an employer through procedures that authorize representatives to act on behalf of members. In each case, the relation involves individuals, yet the collective relational capacity depends on an organization of those individuals that must itself be evidenced.

Definition 5.75 (Collective relational attribution)**.** A *collective relational attribution* is an epistemic judgment that a specified collectivity may be treated as a relatum because identifiable organizational, legal, procedural, representational, or practical mechanisms enable the collectivity to enter and sustain the relation relevant to the inquiry.

Definition 5.75 guards against two opposite simplifications. The first treats collective entities as self-evident actors whose internal organization is irrelevant. The second reduces every collective relation to a sum of individual ties and thereby loses the mechanisms through which the collectivity persists, represents itself, and exercises relational capacities. A warranted account can move between these levels while specifying which evidence supports the collective attribution.

Collective relations also require attention to internal disagreement. A collective can enter a relation without all members sharing the same preferences, knowledge, or benefits. Organizational authorization, voting, hierarchy, delegation, legal representation, custom, or coercion may generate the effective collective action. The existence of the collective relation therefore does not establish internal consensus. GRE

should keep the external relation and the internal relations that constitute collective agency analytically separable, even when they are mutually consequential.

5.10.3 Nested Relations

Nested relations occur when a relation is organized within, enabled by, constrained by, or constitutive of a wider relation or relational arrangement. The nesting can be organizational, institutional, legal, spatial, temporal, or functional. A supervisory relation can be nested within an employment relation; an employment relation can be nested within an organizational arrangement; the organization can be nested within a supply regime, regulatory order, or ownership structure. Nesting therefore concerns relational containment or dependency across analytically distinguishable levels rather than mere physical inclusion.

The epistemic value of nesting lies in showing that local relations often inherit conditions from wider arrangements while retaining locally specific mechanisms. A supervisor's authority over an employee can depend on an employment contract and organizational office, yet the concrete exercise of authority can vary substantially by team, task, workplace, and historical moment. A transaction conducted within a platform can inherit platform rules, ranking systems, payment infrastructures, and dispute procedures while remaining a distinct exchange between participants. Knowledge at one level may therefore condition interpretation at another without determining every local outcome.

Nesting should be specified rather than assumed from organizational diagrams or administrative labels. Formal hierarchy provides one source of evidence, but practical relations can cross or circumvent formal nesting. Informal advice networks can connect units that are administratively separate. Contractors can be economically integrated into production while remaining legally external. Family, employment, ownership, and debt relations can overlap without forming a single neat hierarchy. The relevant question is which wider relation changes the conditions under which the nested relation exists or operates.

A useful reconstruction identifies at least three elements: the nested relational object, the wider relational object, and the mechanism connecting them. The mechanism can involve authorization, resource dependence, rule inheritance, infrastructural access, monitoring, sanction, identity, or another specified pathway. This structure helps prevent scale labels such as "micro," "meso," and "macro" from doing explanatory work by themselves. Nesting is established through the relation between levels, not simply by assigning them names.

Nested relations can also be recursive. A local relation can contribute to reproducing the wider arrangement that conditions it. Employment relations reproduce organizations through labor and coordination; organizations contribute to industries and institutional orders; those wider orders influence the terms under which employment is organized. Such recursion does not erase level distinctions. It makes the epistemic task more demanding because evidence must track both downward conditioning and upward contribution without presuming that one direction exhausts the relation.

5.10.4 Higher-Order Relations

The term *higher-order relation* can be used more narrowly than higher-order relational knowledge. It refers here to a relation whose relata include one or more relations or relational configurations. The objects connected by the higher-order relation are therefore themselves relationally constituted. Examples include a legal rule that subordinates one contractual relation to another, a governance arrangement that coordinates several organizational relations, or a dependency in which the continuation of one relational configuration conditions another.

Definition 5.76 (Higher-order relation)**.** A *higher-order relation* is a target-relative relation in which at least one relatum is itself an identified relation or relational configuration, and for which evidence supports the claimed connection among those relational objects.

Definition 5.76 distinguishes higher-order relations from ordinary pairwise ties between persons or organizations. The distinction concerns the level at which the epistemic target is specified. A bank can have a contractual relation with a firm; that is a first-order relation at the chosen level. A covenant linking continuation of that financing relation to specified debt ratios, ownership conditions, or other financing relations can create a higher-order dependency among relational arrangements. Similarly, a collective-bargaining framework can regulate relations between workers and employers while itself depending on legal recognition and organizational representation.

Higher-order claims can reveal architecture that disappears when all relational objects are flattened into one network of undifferentiated edges. White, Boorman, and Breiger's blockmodel work illustrates how multiple networks can be used to identify roles and positions from patterned relational structure rather than from isolated attributes (White et al. 1976). The broader epistemic lesson is that relational organization can be expressed through recurring configurations among ties and positions. GRE should nevertheless distinguish a formally detected pattern from the stronger claim that the pattern corresponds to a substantively meaningful higher-order relation. Interpretation requires domain knowledge and evidence about the mechanisms represented by the formal structure.

Higher-order relations can also carry asymmetries that are invisible at the first-order level. Two contractual relations may each appear bilateral while one is institutionally subordinate to the other. Several apparently independent exchange relations may be coordinated through a common platform rule. Separate organizational relations may be jointly conditioned by ownership or financing arrangements. The higher-order reconstruction becomes warranted when the evidence shows that the relations' terms, continuation, or consequences are linked through such an organizing mechanism.

5.10.5 Multilayer Relations

Multilayer relational analysis becomes useful when a system contains several distinguishable types of relations, contexts, or connectivity structures whose interaction matters to the target claim. Kivelä and colleagues synthesize a formal literature on

multilayer networks that includes multiplex relations, interconnected networks, and other settings in which nodes and links are organized across several layers (Kivelä et al. 2014). For GRE, the epistemic importance of this literature lies in making relation type and interlayer connection explicit rather than collapsing heterogeneous ties into a single undifferentiated network.

An economic configuration can contain ownership, employment, credit, supply, information, kinship, legal, and administrative relations among overlapping sets of actors. These relations can differ in direction, duration, institutional form, observability, and causal capacity. Aggregating them into one edge set can create false equivalence. Keeping every layer fully separate can produce the opposite problem by obscuring interdependence. Multilayer reconstruction therefore requires both layer-specific semantics and evidence about connections across layers.

Definition 5.77 (Multilayer relational reconstruction)**.** A *multilayer relational reconstruction* is an evidentially supported representation in which distinct relation types or relational contexts are modeled separately and the mappings or dependencies connecting those layers are specified according to the epistemic target.

The definition emphasizes semantics because a layer is an analytical representation, not an ontological domain established merely by being drawn separately. One layer may represent legal ties, another financial exposures, and another information flows. Their separation is justified when the distinctions matter to the target and are supported by the evidence. Interlayer connections then require their own interpretation. Shared actors can connect layers, but cross-layer dependence may also arise through rules, infrastructures, or institutions that connect otherwise different sets of relata.

Multilayer analysis can improve epistemic precision in several ways. It can identify actors whose prominence differs by relation type; distinguish redundancy within one layer from dependence across layers; reveal whether apparent resilience in one network depends on fragility in another; and examine whether a relation that seems peripheral in one domain becomes central because it connects layers. These possibilities are particularly relevant to GRE because value, resources, authority, information, and capabilities may circulate through different relational channels whose conversion interfaces matter economically.

The advantages also create new risks. Layer definitions can reify administrative categories, impose sharp distinctions on relations that are historically entangled, or multiply degrees of freedom beyond what the evidence supports. A multilayer model can appear richly realistic while remaining poorly identified. The number of layers should therefore follow the analytical need and evidential capacity rather than a presumption that more layers necessarily yield better knowledge.

5.10.6 Hyperrelational Configurations

Some interactions involve several relata jointly in ways that lose important information when decomposed into independent dyads. Contemporary higher-order network research formalizes this problem through hypergraphs, simplicial complexes, and related representations of interactions involving groups of three or more units (Battiston et al. 2020). GRE uses the broader term *hyperrelational configuration* for

epistemic targets in which the jointly constituted interaction matters to the economic relation being reconstructed.

A multilateral contract provides a simple illustration. If the obligations of three parties are defined jointly, replacing the arrangement with three bilateral contracts may misrepresent the conditions under which obligations arise. A consortium can allocate authority, contribution, and return through rules that operate at the level of the group. A clearing arrangement can connect several exposures through netting procedures whose consequences cannot be inferred by evaluating each gross bilateral exposure independently. A household decision can likewise involve joint obligations and dependencies that are altered when represented as separate pairwise ties.

Definition 5.78 (Hyperrelational configuration)**.** A *hyperrelational configuration* is a relational object in which three or more relata participate in a jointly constituted interaction and where decomposing that interaction into independent pairwise relations would omit information material to the target claim.

Definition 5.78 distinguishes hyperrelationality from higher-order relations in Definition 5.76. A higher-order relation relates at least one relational object to another object; a hyperrelational configuration concerns a joint interaction among several relata at the same specified analytical level. The two can coexist. A multilateral arrangement can itself become a relatum in a higher-order relation with a legal, financial, or administrative structure.

The epistemic threshold for hyperrelational reconstruction is correspondingly demanding. Evidence should establish that the joint participation is constitutive rather than merely simultaneous. Co-presence at an event or membership in the same organization does not by itself establish a hyperrelation. Relevant evidence can include joint rules, multilateral obligations, collective decision procedures, shared technological protocols, coordinated production processes, or outcomes that depend on the configuration of several participants together.

Pairwise decomposition can remain useful as an approximation when the omitted joint structure is weak relative to the target. The choice therefore remains target-relative. A bilateral exposure analysis can be appropriate for one question even when a multilateral representation is needed for another. GRE should treat the representational gain from hyperrelational modeling as an empirical and analytical question rather than as a general hierarchy in which higher-order formalisms automatically supersede simpler ones.

5.10.7 Limits of Higher-Order Reconstruction

Higher-order reconstruction increases what relational inquiry can represent, yet it also amplifies the epistemic limits developed throughout this chapter. Observation remains partial; relations can be hidden or strategically concealed; boundaries and scales remain consequential; relational identities can change through time; and representation can be performative. A higher-order model inherits these uncertainties from its constituent relations and adds uncertainty about how those relations are connected.

One limit is combinatorial. As the number of relation types, temporal states, nest-

ing levels, interlayer mappings, and multi-party interactions grows, the number of possible configurations expands rapidly. Richer representations can therefore outrun the capacity of available evidence to discriminate among plausible reconstructions. Computational tractability can alleviate some processing constraints, yet it does not create observations that were never available. A large model can enumerate possibilities while leaving the substantive configuration underdetermined.

A second limit concerns representation dependence. Pairwise networks, multilayer networks, hypergraphs, organizational charts, legal schemas, and qualitative relational maps each foreground different structures. Their outputs are therefore conditional on decisions about what counts as a relatum, what counts as a relation, which relation types remain distinct, how time is represented, and where boundaries are placed. Representation comparison becomes part of higher-order epistemic discipline. Robustness across several plausible encodings can strengthen confidence, while divergence can identify precisely where the conclusion depends on representational choice.

A third limit concerns inferential propagation. If evidence for one constituent relation is weak, higher-order claims relying on that relation should reflect the inherited uncertainty. Confidence should not increase simply because uncertain relations are assembled into an elaborate structure. The same principle applies to classification error. A misidentified legal relation, organizational boundary, or participant can alter several inferred dependencies at once. Provenance from Section 5.7 therefore becomes especially important when higher-order reconstructions integrate heterogeneous data sources.

Proposition 5.79 (Inherited uncertainty in higher-order reconstruction)**.** *When a higher-order relational claim depends on uncertain constituent relations or uncertain mappings among them, the warrant for the higher-order claim should remain conditional on those uncertainties and should identify which conclusions are sensitive to alternative admissible reconstructions.*

Proposition 5.79 does not require a single universal numerical uncertainty measure. Depending on the inquiry, uncertainty can be represented through alternative cases, confidence intervals, posterior distributions, sensitivity analyses, competing qualitative reconstructions, provenance grades, or explicit unresolved ambiguities. The common requirement is that complexity should not conceal fragility of inference.

A fourth limit concerns causal interpretation. Structural position, clustering, interlayer centrality, or membership in a higher-order motif can describe relational organization without by themselves establishing why an outcome occurred. Formal structure can generate hypotheses about mechanisms, exposure, coordination, or vulnerability. Causal claims require the additional evidential work appropriate to the mechanism and historical context. This restraint is especially important for GRE because later sections will distinguish relational knowledge from attribution of generative effects.

A fifth limit concerns ontological overreach. The success of a higher-order representation does not establish that economic reality is ultimately a network, hypergraph, multilayer system, or any other formal object. Under ontological suspension, these representations remain tools for disciplined access to relational organization.

Their value depends on explanatory, descriptive, predictive, comparative, or practical performance relative to specified targets and evidence.

Higher-order reconstruction therefore expands the epistemic vocabulary of GRE without establishing a universal representational hierarchy. Relations among relations identify dependencies among relational objects; collective relations concern organized collectivities with evidenced relational capacities; nested relations connect local and wider relational arrangements; higher-order relations take relations or relational configurations as relata; multilayer reconstruction preserves meaningful heterogeneity among relation types while specifying interlayer connections; and hyperrelational configurations capture jointly constituted interactions that materially exceed pairwise decomposition. Each construction requires evidence matched to its target and remains bounded by observation, history, scale, representation, and uncertainty.

Section 5.10 also marks a limit of configuration-based reconstruction. Even a richly specified set of pairwise, nested, multilayer, and hyperrelational relations can leave some distributed conditions insufficiently represented when effects depend on positions within a broader relational environment rather than on identifiable ties alone. The next section develops the epistemology of relational fields to examine that problem. Its task is to ask what kind of evidence can warrant claims about distributed relational conditions while preserving the same commitments to explicit boundaries, representation-sensitive inference, and ontological restraint established here.

5.11 Epistemology of Relational Fields

Section 5.11 extends the epistemology developed in Sections 5.7–5.10 from identifiable relations and higher-order configurations to distributed relational conditions. Its role is to clarify when the language of a *field* adds epistemic content beyond a dense collection of pairwise ties, a shared context, or an aggregate regularity. The section develops this problem in seven steps. It first distinguishes pairwise relations from distributed conditions, then specifies evidential requirements for field claims, reconstructive procedures, the relation between local position and distributed structure, overlapping fields, field boundaries, and limits of field attribution. The discussion treats field representations as target-relative analytical constructions under ontological suspension. Its method is therefore comparative and evidential: alternative representations are assessed by the differences they make to warranted description, explanation, and later generative attribution.

Field language already has several established meanings in the social sciences. Bourdieu and Wacquant formulate fields through relational positions, forms of capital, and structured struggles, while Martin analyzes field theory more generally through explanations in which regularities in action depend on positions relative to others (Bourdieu and Wacquant 1992; Martin 2003). Fligstein and McAdam develop strategic action fields as mesolevel social orders that can themselves be embedded in wider fields (Fligstein and McAdam 2012). GRE can learn from these traditions without identifying its own relational-field vocabulary with any one of them. The present task is narrower: to establish the epistemic conditions under which a distributed

relational environment becomes a warranted object of inquiry.

5.11.1 Pairwise Relations and Distributed Conditions

Pairwise relational analysis represents a system through identifiable relations between specified relata. This representation can be highly informative. Credit relations connect lenders and borrowers; employment relations connect workers and employers; supply relations connect firms; legal relations connect rights holders, duty bearers, offices, and institutions. Sections 5.4–5.10 have already developed the epistemic requirements for identifying such relations, locating them within boundaries and scales, tracing their persistence, and reconstructing higher-order configurations.

Some targets, however, depend materially on distributed conditions that are not adequately localized in any single pairwise relation. A firm's access to financing can depend on its position within a wider credit environment, prevailing classifications of risk, regulatory expectations, sectoral conventions, and the distribution of liquidity across institutions. A worker's bargaining possibilities can depend on labor-market tightness, occupational segmentation, legal recognition, organizational density, and expectations held by multiple actors who may never enter direct interaction with that worker. A price can be locally negotiated while the range of plausible negotiation is conditioned by distributed information, standards, infrastructures, institutional rules, and the positions occupied by other participants.

Network analysis already demonstrates why structural position can matter beyond individual attributes. Wellman's structural perspective emphasizes patterned relations, clusters, boundaries, dependency, and network position (Wellman 1983). Granovetter's analysis of embeddedness likewise shows that economic action is situated within ongoing structures of social relations (Granovetter 1985). A relational field extends the epistemic problem one step further when the target claim concerns a distributed condition whose effects depend on an actor's or relation's position within an organized environment and whose relevant organization cannot be exhausted by enumerating direct ties.

Definition 5.80 (Relational field)**.** A *relational field* is a target-relative reconstruction of a distributed relational condition in which the position, capacities, constraints, expectations, or possible transformations of relevant relata depend materially on an organized environment of relations, positions, rules, resources, classifications, or other relationally efficacious conditions whose joint significance exceeds the description of isolated pairwise ties.

Definition 5.80 makes three commitments. First, a field is target-relative. A configuration can be field-relevant for one question and adequately represented through local relations for another. Second, field attribution concerns distributed organization, not merely large size or high density. A network with many edges can remain fully tractable as a set of relations if the target depends primarily on those ties. Conversely, a relatively sparse configuration can exhibit field-like properties when positional differences, common institutional constraints, or distributed expectations materially condition local possibilities. Third, the definition remains compatible with ontological suspension. The field may be represented through physical, institutional, legal, symbolic, informational, organizational, or other coordinates without establish-

ing that one formal vocabulary captures the ultimate constitution of the economic world.

The distinction between a dense network and a relational field is therefore epistemic rather than cosmetic. Density describes one property of a network representation. A field claim adds the proposition that distributed organization is relevant to the target and that position within that organization changes what can occur locally. The additional burden of evidence follows from this stronger claim.

Distributed conditions can also operate through absence, scarcity, concentration, or patterned non-connection. A peripheral supplier can face limited alternatives because potential buyers are concentrated elsewhere in the field. A household can encounter credit constraints because institutions classify its location or income profile within a broader risk environment. A profession can reproduce opportunity differences through expectations and credential structures that are widely distributed across organizations. In these cases, the relevant condition is partly expressed through relations that are possible, foreclosed, weak, indirect, or institutionally mediated. Field reconstruction therefore concerns the organization of relational possibilities as well as observed ties.

5.11.2 Evidence for Fields

A field claim requires evidence that distributed organization contributes information that local relations or aggregate attributes leave unexplained. The evidential task is especially demanding because many patterns that appear field-like can also arise through compositional differences, common external causes, selection processes, institutional rules applied uniformly, or correlated responses to a shared event. Field language becomes analytically useful when the distributed relational organization can be identified with enough specificity to discriminate among these possibilities.

Several evidential forms can contribute to such warrant. Recurrent position-dependent differences provide one source. If actors occupying systematically different locations within a reconstructed relational environment encounter different constraints, opportunities, expectations, or response patterns, the evidence can support a field interpretation when relevant alternative explanations are addressed. Historical evidence provides another source by showing how positions, rules, resources, and classifications were assembled and reproduced. Organizational records, legal documents, transaction traces, network data, ethnography, interviews, administrative classifications, and computational reconstructions can each reveal parts of the distributed condition. The evidential strength comes from convergence among sources whose biases and access conditions differ, rather than from the quantity of traces alone.

Field evidence can also arise from patterned responses to changes that propagate through an environment. A regulatory revision may alter behavior differently across positions; a liquidity shock can have heterogeneous effects according to financing structures; a platform rule can reorganize opportunities across categories of participants; a new credential can shift the value of positions throughout an occupational domain. Such patterned variation can reveal distributed structure, although the stronger causal interpretation of propagation remains a later problem for the

chapter's subsequent treatment of generative relations and attribution.

Claim 5.81 (Evidential convergence for field attribution)**.** *Warrant for a relational-field claim is strengthened when heterogeneous evidence supports both the existence of a distributed relational organization and the target-relevant significance of positions or dependencies within that organization, while plausible aggregate and common-cause alternatives receive explicit examination.*

Claim 5.81 separates two evidential tasks. The first concerns reconstruction of the distributed organization itself. The second concerns the significance attributed to that organization for the target claim. A formally elegant map can satisfy the first task only partially and leave the second unresolved. Conversely, repeated local reports of constraint can establish an economically important phenomenon while leaving the wider field architecture underdetermined. Field epistemology becomes stronger when the two forms of evidence constrain one another.

The distinction between field effect and aggregate correlation is central. Suppose firms with a certain attribute exhibit similar outcomes. An aggregate account may explain the pattern through the attribute itself. A field account requires additional evidence that the outcome depends on relations, positions, distributed rules, or organized expectations surrounding those firms. Similarly, geographic clustering can reflect shared exposure to infrastructure or policy without establishing a relational field. Spatial proximity becomes field-relevant when the evidence shows that position within a distributed relational environment contributes to the pattern under investigation.

Field claims also benefit from negative and contrastive evidence. If a proposed field boundary predicts similar conditioning within a domain and weaker conditioning beyond it, observations that violate this pattern can reveal a misspecified boundary. If two positions treated as equivalent show systematically different possibilities, the positional reconstruction may require revision. If field language produces no observable or interpretive difference relative to a simpler representation, its epistemic contribution remains limited. A field concept earns analytical work by supporting distinctions that can be investigated.

5.11.3 Field Reconstruction

Field reconstruction is an inverse problem. Researchers encounter manifestations, traces, records, classifications, interactions, outcomes, and situated testimony, then infer a distributed organization that could have contributed to them. The non-invertibility developed in Section 5.2 therefore remains active. Several field reconstructions can be compatible with the same local observations, especially when relations are partially observed, boundaries are uncertain, or institutional categories already shape the traces from which the field is inferred.

A disciplined reconstruction begins with a specified target. The analyst identifies the phenomenon whose distributed conditioning is at issue, the relevant relata, candidate relations and institutional conditions, the temporal interval, and the boundary and scale assumptions inherited from Section 5.8. The reconstruction then asks which dimensions of position appear consequential for that target. These dimensions can include access to resources, legal status, organizational authority, dependence, in-

formation, reputation, credit, classification, spatial location, or other domain-specific conditions. Their selection should be justified by evidence and theory rather than imported from a preferred formal model.

Definition 5.82 (Field reconstruction)**.** A *field reconstruction* is an explicit, revisable representation of a target-relevant distributed relational environment that specifies the relevant relata, relations or conditioning structures, positional dimensions, boundaries, temporal scope, evidential sources, and uncertainties used to support claims about field organization.

Definition 5.82 places provenance at the center of the reconstruction. A field map assembled from administrative data can inherit institutional classifications. A map reconstructed from interviews can inherit unequal access, standpoint differences, strategic presentation, and memory limitations. Transaction data can privilege recorded exchanges over informal relations and unrealized possibilities. Computational network or embedding methods can detect patterned structure while depending strongly on data construction and representation choices. Section 5.5 therefore remains relevant: the reconstructed field is itself a representation whose relation to relational reality requires evaluation.

Field reconstruction can combine formal and interpretive methods. Blockmodeling, for example, identifies positions and roles from patterned relations across networks (White et al. 1976); field-theoretical traditions can emphasize structured positions, resources, struggles, and the logic of a domain (Bourdieu and Wacquant 1992; Martin 2003); strategic-action-field analysis can emphasize mesolevel orders and relations among fields (Fligstein and McAdam 2012). GRE can use these traditions as methodological resources while preserving distinctions among their objects and assumptions. Similar diagrams or terms across traditions do not establish theoretical identity.

Reconstruction should also compare plausible alternatives. One representation may organize a labor market primarily through firms and workers; another may foreground occupations, credentials, unions, legal categories, households, migration status, or platform infrastructures. Each can reveal relations hidden by the others. The appropriate comparison is target-relative: which representation preserves distinctions needed for the claim, which assumptions it introduces, which traces support it, and how sensitive the conclusion is to alternative admissible constructions.

Field reconstruction is therefore iterative. Local observations can suggest a wider distributed structure; the proposed field can then guide new observations; new evidence can alter positions, boundaries, relation types, or the field hypothesis itself. This recursion also creates the performative possibility developed in Section 5.6. Administrative, legal, statistical, or algorithmic field representations can be adopted by organizations and begin to alter the relational environment they describe. Provenance should consequently record when a representation remains primarily analytical and when it becomes part of the field's subsequent organization.

5.11.4 Local Position and Distributed Structure

Field epistemology links local observations to distributed structure through the concept of position. Position is not simply an intrinsic attribute attached to an actor. It

is a relational characterization of where an actor, organization, relation, or configuration stands with respect to relevant structures of dependence, access, authority, classification, distance, substitution, or other field dimensions. Martin's account of field theory highlights precisely this explanatory move: regularities are related to positions vis-a-vis others rather than reduced to isolated properties (Martin 2003).

Definition 5.83 (Field position)**.** A *field position* is a target-relative characterization of a relatum's location within a reconstructed distributed relational environment, defined by the dimensions of relation, dependence, access, resource distribution, classification, or institutional organization that are evidentially relevant to the inquiry.

The same local relation can therefore carry different implications at different field positions. A supplier contract can have one economic significance when alternative buyers are abundant and another when a dominant purchaser organizes access to the market. A debt contract can generate different vulnerabilities for borrowers occupying different income, collateral, legal, or refinancing positions. An employment relation can provide different bargaining possibilities depending on occupational demand, legal protections, union organization, household reserves, migration constraints, and available alternatives. Pairwise descriptions remain accurate at their own level while field position changes the conditions under which those relations operate.

Position also permits epistemic movement in the opposite direction. Local observations can become evidence for distributed structure when similar position-dependent patterns recur across cases. Testimony from participants located in several parts of a field can reveal differences in opportunity, expectation, or constraint. Transaction traces can show substitution patterns or dependencies. Institutional rules can explain why nominally similar actors occupy different practical positions. The inferential movement remains cautious because local evidence can support several field reconstructions. Distributed structure is inferred through patterned comparison, provenance, and alternative representations rather than read directly from a single local case.

Position should also be distinguished from rank. Some fields contain explicit hierarchies, yet positional structure can be multidimensional. An actor can have high legal authority and low informational access, strong reputation and weak liquidity, central connectivity and limited substitutability, or privileged classification in one institutional setting and constrained access in another. Compressing these dimensions into a single ranking can erase the particular mechanisms relevant to the target. Field reconstruction should preserve multidimensional positions whenever the evidence indicates that the dimensions operate differently.

A further complication arises because local action can modify distributed structure. Coordinated entry by firms, legal mobilization by workers, widespread adoption of a standard, changes in lending practice, or new classificatory technologies can alter the positions and dependencies that constituted the field. Position is therefore historically indexed. A field map should identify its temporal scope and remain open to structural change, consistent with the identity and persistence principles developed in Section 5.9.

5.11.5 Overlapping Fields

Economic actors frequently participate in several distributed relational environments at once. A university can occupy fields of higher education, research funding, labor, professional credentialing, real estate, public administration, and international mobility. A household can simultaneously participate in labor, housing, credit, care, education, welfare, kinship, and migration arrangements. A firm can occupy production, finance, regulation, technology, logistics, and professional domains whose boundaries and positional structures only partly coincide. Field overlap is therefore an ordinary epistemic problem rather than an exceptional complication.

Definition 5.84 (Field overlap)**.** *Field overlap* occurs when a relatum, relation, resource, classification, institution, or conditioning process participates materially in two or more distinguishable relational fields relevant to the inquiry, such that the fields' positions, rules, or trajectories can interact in the target phenomenon.

Overlap matters because an observation that appears anomalous within one field can become intelligible when another field is included. A firm may possess a peripheral position in a production network while occupying a privileged financial position. A worker may have scarce occupational skills while facing legal constraints on mobility. A household can appear income-secure while remaining vulnerable through housing, care, or debt relations. These examples do not require collapsing the fields into one larger undifferentiated structure. The epistemic gain comes from identifying where their conditions intersect.

Overlapping fields should also remain distinct from multilayer representation in Section 5.10. A multilayer model distinguishes types of relation or connectivity within a system. Field overlap concerns partially distinct distributed environments whose membership, boundaries, positional dimensions, and organizing processes can differ. A multilayer representation can be used to model overlapping fields, yet the formal representation and the substantive field claim remain separate epistemic objects.

Interactions among fields can take several forms. Conditions can reinforce one another when advantageous positions in finance facilitate entry into production or when professional recognition increases organizational authority. Conditions can conflict when a legally authorized practice encounters professional opposition or when financial incentives undermine another field's institutional norms. Resources, classifications, standards, and actors can travel across fields, although their meaning and efficacy can change during the transfer. Fligstein and McAdam's account of strategic action fields explicitly emphasizes embedding and inter-field relations, providing one established approach to such problems (Fligstein and McAdam 2012). GRE can use this as a comparative resource while retaining its own target-relative epistemic vocabulary.

Field overlap creates an attribution problem as well. An observed regularity may be incorrectly assigned to the most visible field when the operative conditioning is distributed across several. Research design should therefore track cross-field provenance where evidence suggests that positions or rules interact. Robustness can be tested by comparing reconstructions that separate, combine, or differently partition candidate fields. Divergent conclusions identify where field specification materially affects the epistemic result.

5.11.6 Field Boundaries

Field boundaries specify the domain within which distributed relational conditioning is reconstructed. The boundary problem developed generally in Section 5.8 becomes more demanding here because field claims frequently rely on interactions that cross organizational, legal, geographic, or classificatory borders. A field boundary therefore needs both an analytical rationale and evidence about the reach of the conditioning process relevant to the target.

Some boundaries are institutionally explicit. Licensing regimes, legal jurisdictions, organizational membership rules, trading venues, professional associations, platform access rules, or funding programs can create entry conditions and structured differences between participants and non-participants. Such boundaries can themselves possess relational reality when they persist and causally affect access, obligation, recognition, or opportunity. Other field boundaries are more permeable. Information, capital, standards, reputations, labor, and classifications can travel across nominal domains, making the effective relational field wider than the formal institution.

Definition 5.85 (Field-relevance boundary)**.** A *field-relevance boundary* is the provisional limit of a field reconstruction beyond which additional relata or relational conditions cease to make a material evidential difference to the specified target at the chosen scale and temporal interval, subject to revision when new evidence changes that assessment.

Definition 5.85 makes boundary selection an empirical and analytical judgment. The criterion concerns material relevance to the target, not mere formal membership. A supplier located outside a jurisdiction can remain field-relevant when its behavior changes local bargaining possibilities. A distant funding institution can shape research priorities through grant structures. An external regulatory standard can influence domestic production through certification requirements. Conversely, formal members can be peripheral to a particular target when their participation has little bearing on the distributed condition under investigation.

Boundary-sensitivity analysis is therefore especially important for fields. Researchers can compare nested or alternative boundaries and examine which positional claims, regularities, or inferred dependencies remain stable. If a result changes substantially when a plausible set of external actors or relations is included, the field claim should report that dependence. If several boundary specifications yield similar positional conclusions, confidence in the reconstruction can increase even though the boundary remains analytically constructed.

Temporal boundaries require comparable care. Fields can form, stabilize, transform, and dissolve. Institutional continuity can coexist with changes in position, resource distribution, or organizing rules. A reconstruction that pools several historical periods can therefore create an artificial field whose relations never coexisted in the represented form. The persistence criteria developed in Section 5.9 should be applied to the field itself: continuity claims need evidence about which organizing relations or mechanisms carry the distributed structure through time.

5.11.7 Limits of Field Attribution

Field language becomes epistemically weak when it functions as a residual label for whatever remains unexplained after local variables are considered. A field claim should add discriminating structure: it should identify a distributed organization, specify relevant positions or dependencies, delimit a provisional boundary, connect the reconstruction to evidence, and clarify what observations would favor alternative explanations. Without these elements, the term can remain metaphorically suggestive while contributing little to warranted knowledge.

A first limit concerns observational equivalence. Aggregate correlation, shared institutional exposure, network structure, common external causes, selection, and genuine field conditioning can produce similar manifestations. The inverse problem therefore persists at the level of fields. Evidence for a patterned outcome does not by itself identify which distributed mechanism produced it. Researchers should compare candidate reconstructions and identify which traces discriminate among them.

A second limit concerns scale. A pattern identified as field-level at one scale can decompose into several mechanisms at a finer scale or become one component of a wider field at a coarser scale. Scale dependence does not invalidate the field claim. It requires the claim to specify the level at which the distributed condition is reconstructed and the range over which the associated warrant is expected to travel.

A third limit concerns agency and heterogeneity. Field position conditions possibilities without mechanically determining action. Actors occupying similar positions can interpret, resist, exploit, or transform their conditions differently. Historical trajectories, identities, organizational capacities, resources, and cross-field affiliations can mediate responses. A field explanation therefore gains precision by identifying conditional tendencies or structured possibilities rather than converting position into deterministic prediction.

A fourth limit concerns formal representation. Network measures, spatial models, latent embeddings, correspondence analyses, agent-based models, and other computational tools can represent aspects of field structure. Their formal success remains distinct from substantive validation. The representation must preserve domain semantics, and its inferred positions or distances require evidential interpretation. Ontological suspension remains operative even when a field representation predicts effectively.

A fifth limit concerns causal and generative attribution. Establishing a field and locating positions within it does not yet establish that the field generated a particular capacity, relation, structure, constraint, or transformation. Field knowledge can identify the distributed conditions within which generative mechanisms operate, but the evidential burden for generative effect is stronger. The chapter's subsequent sections develop that distinction directly and address attribution among competing and distributed causes.

Proposition 5.86 (Minimum warrant for relational-field attribution)**.** *A relational-field attribution is epistemically warranted to the extent that the inquiry specifies a target-relevant distributed organization, provides evidence for meaningful positional or dependency structure, states the boundary and temporal scope of the reconstruction, examines plausible simpler or alternative explanations, and preserves uncertainty aris-*

ing from partial observation and representation choice.

Proposition 5.86 deliberately states a graded standard. Different inquiries can satisfy these requirements with different combinations of qualitative, historical, documentary, quantitative, network, spatial, legal, administrative, or computational evidence. The standard concerns explicitness and discriminating warrant rather than allegiance to a single method.

The epistemic value of field analysis can now be stated more precisely. Pairwise relations identify local connections; higher-order relational knowledge reconstructs configurations among relations; field analysis addresses distributed conditions in which position within an organized relational environment changes the interpretation of local relations, capacities, constraints, or possibilities. These representations can complement one another. Their usefulness depends on the target, evidence, boundary, scale, and historical interval of inquiry.

This distinction also establishes the transition to generativity. A field may be relationally real and epistemically well reconstructed while remaining only part of the background conditions for a later transformation. Conversely, a generative effect can depend on the interaction between a local relation and the field in which it operates. The next section therefore turns from the epistemology of distributed relational organization to the stronger problem of identifying *generative relations*: relations that participate in producing changes in capacities, relations, structures, constraints, possibilities, or the conditions of subsequent transformation.

5.12 Epistemology of Generative Relations

The preceding sections established how GRE can identify relations, reconstruct their persistence, move toward higher-order relational knowledge, and warrant claims about distributed relational fields. The present section introduces a stronger epistemic target: relations that participate in generating changes that become relevant to subsequent economic life. Its role is to specify what a generative claim means before the chapter turns to the more demanding problem of attributing generative effects among competing causes. The objective is therefore taxonomic and epistemic rather than fully causal. The discussion distinguishes generative effects from ordinary state change, then examines capacity generation, relation generation, structural generation, the generation of constraints and enabling conditions, the transformation of future possibilities, and changes in the conditions under which later transformation occurs. Throughout, the method is target-relative and temporally explicit: a claim of generation must identify what changes, for whom or for what configuration, over which interval, at which scale, and with what downstream relevance.

A relation can be relationally real without being generative with respect to the target under study. It can persist, structure interaction, and possess causal efficacy while leaving the relevant capacity, relation, structure, or option space materially unchanged during the interval of inquiry. Conversely, a relation can be generatively consequential even when its most important effects appear only after the initiating interaction has ended. GRE therefore treats generativity as a property of a relation-in-context relative to a specified effect, boundary, scale, and temporal horizon, rather

than as an intrinsic label attached permanently to a relation type.

Definition 5.87 (Generative relation)**.** A *generative relation* is a relation for which warranted inquiry supports the claim that participation in, exposure to, or operation through that relation contributes materially to the emergence, transformation, stabilization, suppression, or dissolution of a target capacity, relation, structure, constraint, possibility, or condition of subsequent transformation within a specified context and temporal horizon.

Definition 5.87 is deliberately relational and target-relative. Employment, credit, education, care, legal recognition, platform participation, research collaboration, or infrastructure access can be generative in one respect and comparatively inert in another. The definition also preserves directional openness. Generation can enlarge capacities and possibilities, but it can also stabilize dependence, produce constraints, suppress alternative relations, or narrow later option spaces. Epistemic identification of generativity therefore remains distinct from normative evaluation.

5.12.1 Relation and Generative Effect

Knowledge that a relation exists establishes an important part of the evidential basis for GRE, but existence alone does not establish what the relation generates. Two organizations can collaborate without the collaboration materially changing either organization's capabilities. A worker can hold a contract that structures payment and obligation without acquiring new skills or access through it. A legal status can be stable and causally relevant while producing little change in the target outcome during a particular interval. The epistemology of generative relations therefore begins by separating evidence for relational existence from evidence for a downstream generative effect.

A generative effect concerns a change that becomes part of the conditions of subsequent action, interaction, or transformation. Immediate outputs can be relevant evidence, yet they need not exhaust the effect. Training can produce an immediately observable certification while the more consequential effect lies in later competence or access. Collaboration can produce a publication while also generating shared routines, trust, instruments, or further collaborations. Infrastructure can provide current service while changing the set of activities that becomes feasible around it. The epistemic target is therefore temporally extended beyond the initiating relation and its first manifestation.

Granovetter's account of embedded economic action provides a useful precedent for treating ongoing relations as economically consequential rather than analytically incidental (Granovetter 1985). Powell, Koput, and Smith-Doerr similarly show that interorganizational collaboration can function as a locus of learning in biotechnology (Powell et al. 1996). These literatures do not by themselves establish the GRE category of a generative relation. They illustrate why the relation can be an explanatory object when later capacities and opportunities depend on relational participation.

Definition 5.88 (Generative effect)**.** A *generative effect* is a target-relevant change whose emergence or transformation is materially connected to a prior or ongoing relational process and whose significance extends to subsequent capacities, relations, structures, constraints, possibilities, or transformation conditions.

The phrase *materially connected* in Definition 5.88 states the epistemic burden without resolving the attribution problem in advance. Association, temporal succession, or narrative plausibility is insufficient on its own. The following section will examine the stronger evidential requirements involving mechanism, counterfactual dependence, multiple causation, distributed generation, delay, branching, and emergence. The present section specifies the objects among which such attribution must operate.

Generative effects can also be layered. A training relation can generate a capacity that later enables entry into a professional relation; the new relation can then alter organizational position; the changed position can affect later access to resources. Each step can be treated as a separate generative claim or as part of a longer generative trajectory. Epistemic clarity requires researchers to state which link is being claimed rather than treating an entire downstream history as the undifferentiated effect of one initiating relation.

5.12.2 State Change and Generative Change

A further distinction concerns change itself. Economic systems exhibit continual state change: prices move, balances fluctuate, persons relocate, inventories vary, organizations hire and release workers, and networks gain or lose connections. A change becomes generatively significant when it modifies the conditions from which later states can arise. The distinction is therefore temporal and structural rather than simply quantitative. A large change can be transient, while a small change can alter a pathway that later becomes consequential.

Consider a short-lived increase in income. If it changes current consumption and then leaves later capacities, relations, obligations, and access materially unchanged, the relevant claim may remain a state-change claim. If the same increase finances training, prevents the loss of housing, sustains a business through a liquidity shock, or permits entry into a relation that would otherwise have been inaccessible, its significance can become generative because subsequent conditions differ. The epistemic question concerns what persists or propagates from the change, not merely its magnitude at the moment of observation.

This distinction is compatible with established economic analyses of path dependence and increasing returns. Arthur's treatment of competing technologies shows how historically contingent events can become consequential when increasing-return mechanisms make later selection depend on earlier adoption (Arthur 1989). GRE uses such work as one lineage for thinking about how an apparently local change can become a condition of later development. It does not infer that every generative process is path dependent or governed by increasing returns.

Proposition 5.89 (Generative significance of change)**.** *Evidence of state change supports a claim of generative change only to the extent that the inquiry also identifies a warranted pathway through which the change alters subsequent capacities, relations, structures, constraints, possibilities, or conditions of transformation within the stated analytical boundary and temporal horizon.*

Proposition 5.89 prevents generativity from becoming a synonym for dynamism. It also separates generative analysis from a requirement that the generated consequence be permanent. A change can be generative over a finite interval if it modifies

subsequent conditions during that interval. Later reversal does not erase the historical effect; it changes the trajectory through which the effect should be reconstructed.

Generative change can occur through persistence, amplification, redirection, threshold crossing, or reconfiguration. These mechanisms have different evidential signatures. Persistence can be visible through durable capability or institutionalized routine. Amplification can appear through cumulative participation or increasing returns. Redirection can be inferred when later action follows a newly available pathway. Threshold crossing can be relevant when a previously unavailable relation becomes feasible. Reconfiguration can occur when the identities of components remain similar while their relational organization changes. The epistemic category should remain broad enough to accommodate these forms while requiring each empirical study to specify which form is supported.

5.12.3 Capacity Generation

Capacity generation concerns changes in what a subject, organization, collective, or relational configuration is able to do. It is one of the most direct ways in which a relation can alter later economic possibility. Capacities can be productive, epistemic, organizational, political, relational, adaptive, or infrastructural. Some can be attributed primarily to identifiable subjects; others remain distributed across teams, institutions, networks, or technical systems.

The capability approach provides an established conceptual resource because it distinguishes resources from substantive opportunities and directs attention to what persons are effectively able to do and to be (Sen 1999). GRE's epistemic problem is narrower and more processual: when does evidence support the claim that a relation participated in producing or transforming such an ability? A resource transfer and a capacity gain should not be treated as equivalent. The same nominal resource can produce different capacities when legal status, infrastructure, care obligations, prior knowledge, recognition, social support, or institutional access differ.

Capacity generation therefore requires at least a temporal comparison and a relational account of conversion. Evidence can include demonstrated performance, access to previously unavailable activities, durable competence, new organizational routines, successful coordination, changes in adaptive response, or the creation of shared infrastructure. Self-report can also be important, particularly for capacities that are not institutionally measured, although the evidential role of testimony must remain explicit. Where capacity is latent rather than exercised, inquiry should distinguish possession of an enabling condition from demonstrated use.

Some capacities are relational in their very operation. Trust, coordination, collective memory, professional recognition, bargaining power, and access through networks cannot be represented adequately as isolated possessions of one actor. Their generation may therefore require evidence at more than one level. A participant can acquire competence while a group simultaneously develops coordination capacity; an organization can learn through relations among units; a collaborative network can produce shared standards that later participants inherit. The higher-order epistemology developed in Section 5.10 becomes relevant whenever the generated capacity resides partly in a configuration rather than in a single relatum.

Capacity generation is also normatively open. A surveillance organization can acquire stronger monitoring capacity; a monopolistic platform can improve its ability to exclude rivals; a debt contract can increase purchasing capacity while also strengthening creditor leverage. GRE therefore records the generated capacity before evaluating its distribution or desirability. Later normative analysis can ask whose capacity increased, whose decreased, which dependencies were created, and how the generated capacity affects justice or power.

5.12.4 Relation Generation

Relations can generate further relations. A collaboration can produce trust that supports later collaboration; professional training can create mentorship and peer networks; infrastructure can connect previously separated actors; legal recognition can make contractual or organizational relations possible; a platform can create matching relations while simultaneously mediating their terms. Relation generation matters because the relational environment from which later economic action begins can itself be an outcome of earlier relations.

The epistemic burden is to distinguish a newly generated relation from a relation that was merely unobserved, latent, or already available. Temporal order provides part of the evidence but does not settle the issue. Researchers should examine whether the later relation became possible, probable, stabilized, or transformed through mechanisms associated with the earlier relation. Records of first contact, institutional eligibility, referral pathways, shared projects, communication histories, or changes in formal rights can be relevant traces. Where the later relation existed previously, the generative claim may concern strengthening, stabilization, or transformation rather than initial formation.

Interorganizational learning provides one empirical context in which relation generation can become visible. Collaboration can create knowledge and reputational effects that affect later alliance opportunities, while participation in a network can change access to additional partners (Powell et al. 1996). The epistemic lesson is not that networks automatically reproduce themselves. It is that later relational structure can be historically dependent on participation in earlier relational configurations.

Definition 5.90 (Relationally generated relation)**.** A *relationally generated relation* is a later relation whose formation, stabilization, weakening, or reconfiguration is supported by evidence linking that change materially to an earlier or ongoing relational process.

This definition also accommodates negative generation. A relation can generate exclusionary boundaries that suppress alternative ties. Exclusive contracts can make some supplier relations unavailable; professional closure can prevent entry relations; reputational mechanisms can discourage association; conflict can dissolve previously viable collaborations. The generative object is the transformation of the relational landscape, which can involve both formation and foreclosure.

Recursive representation from Section 5.6 provides an important special case. A representation can affect eligibility, ranking, recognition, or visibility and thereby generate later relations that produce new traces and representations. Relation generation is therefore one pathway through which epistemic infrastructures become

participants in the systems they describe.

5.12.5 Structural Generation

Structural generation concerns changes in relatively persistent patterns that organize multiple relations beyond a single dyad or episode. Examples include new organizational routines, durable divisions of authority, market architectures, standards, governance arrangements, infrastructures, classificatory regimes, or recurrent patterns of dependence. The concept therefore requires more than evidence that several individual relations changed at once. It requires evidence that the organization of relations acquired a degree of persistence and causal relevance at the scale specified by the inquiry.

Institutions provide a familiar reference point. North's account of institutions emphasizes rules and constraints that structure interaction and shape incentives (North 1990). GRE can treat institutional change as one form of structural generation when prior relations contribute to creating or transforming such organizing conditions. The category is wider than formal institutions, however. Informal routines, standards, technical architectures, and network structures can become sufficiently stable to condition later interaction even without codified rules.

Structural generation raises a scale problem. A relation can generate a local routine within one organization without transforming the wider institutional environment. Conversely, many local interactions can cumulatively contribute to a wider structural change. The claim should therefore specify the scale at which the generated structure is identified and the bridge evidence supporting movement across scales. Section 5.8 established this requirement generally; generative analysis makes it especially important because downstream structural claims can easily outrun the evidence available at the initiating scale.

Field reconstruction also becomes relevant. A newly generated structure can alter positions within a wider relational field without creating the field itself. A regulatory reform can change access to a profession; a platform rule can reorganize visibility among sellers; a standard can alter compatibility among firms. The epistemic claim can concern transformation of distributed position rather than replacement of the entire field. Researchers should therefore avoid treating every consequential structural modification as the birth of a wholly new system.

Structural generation can be identified through persistence, reproduction, and altered conditioning. A new rule or architecture becomes structurally consequential when later relations systematically encounter it as part of their environment. Evidence may include repeated administrative application, stable technical dependencies, recurrent organizational practices, patterned entry or exclusion, durable network reconfiguration, or sustained changes in the distribution of authority. The relevant test is whether the generated structure becomes an active condition of subsequent relations rather than remaining an isolated output.

5.12.6 Generation of Constraints and Conditions

Generativity includes the production of constraints as well as enabling conditions. A credit relation can create liquidity and repayment obligations. A technical standard can generate interoperability and exclude incompatible designs. A credential can create recognized access while making uncredentialed competence less legible. Infrastructure can lower some transaction costs while creating dependence on maintenance, ownership, or proprietary interfaces. These effects show why generativity cannot be equated with expansion, benefit, or freedom.

The epistemic task is to identify how a relation changes the conditions under which later action occurs. Constraints can concern legal permission, material resources, time, information, mobility, compatibility, obligation, visibility, bargaining position, or access to other relations. Enabling conditions can concern the same dimensions in the opposite direction, although a single change can enable one pathway while constraining another. The object of knowledge is therefore often a reorganization of conditional possibility rather than a simple increase or decrease in one variable.

North's institutional analysis is again relevant because institutions can both enable coordination and constrain behavior through structured rules and incentives (North 1990). Sen's emphasis on substantive opportunity likewise helps separate nominal resource possession from the social conditions under which resources become effective freedoms (Sen 1999). GRE uses these traditions to sharpen an epistemic question about generation: which prior relations produced the conditions that later actors encounter as permissions, resources, dependencies, obligations, or obstacles?

Constraints can themselves be generative. A standard can narrow permissible technical choices while enabling large-scale coordination within the remaining space. A budget ceiling can restrict current expenditure while inducing new organizational routines. A legal prohibition can suppress one practice and stimulate alternative organizational forms. Such cases make simple positive/negative coding inadequate. Inquiry should identify what is constrained, what becomes enabled, which actors experience each effect, and over what period.

The generation of conditions also includes maintenance. Some relations do not create a visibly novel capacity or institution; they reproduce the conditions under which an existing system can continue. Care relations sustain persons, maintenance work preserves infrastructure, administrative routines reproduce legal statuses, and ecological practices can maintain the material conditions of production. Epistemically, maintenance should not disappear merely because the observed state remains stable. Stability can itself be the generated consequence of ongoing relational work.

5.12.7 Transformation of Future Possibilities

Generative analysis reaches beyond realized outcomes to changes in the space of feasible or accessible futures. A relation can open, preserve, redirect, weight, or foreclose later possibilities without determining which possibility will be realized. Education can expand occupational and epistemic options; credit can make investment possible while narrowing later discretion through repayment; migration status can alter mobility and labor-market access; shared infrastructure can support activities

that were not specified when it was built. The epistemic object is a changed possibility structure, not a prediction of one future path.

This distinction is important because realized outcomes underdescribe generative significance. A research facility can expand the range of experiments that could be conducted even if only a fraction are eventually attempted. A legal right can create actionable options that remain unused. Redundant infrastructure can preserve alternatives that become valuable only under disruption. Conversely, an exclusive contract can remove feasible pathways even when the affected actor never attempts to use them. Evidence for transformed possibility therefore cannot rely exclusively on observed realized choices.

The capability literature again provides a useful precedent because it distinguishes achieved functionings from substantive opportunities (Sen 1999). For GRE, evidence of future possibility can include formal rights, eligibility, technical feasibility, available partners, resource access, documented opportunity sets, demonstrated substitutability, or credible pathways identified through historical and institutional reconstruction. Researchers should distinguish possibilities that are merely imaginable from those supported by a sufficiently specified relational and material pathway.

Definition 5.91 (Generative possibility transformation)**.** A *generative possibility transformation* is a warranted change in the set, accessibility, weighting, or durability of future pathways available to a specified subject or configuration that is materially connected to an earlier or ongoing relational process.

Possibility transformation is scale-relative and distribution-sensitive. The same institutional change can expand a firm's technological options while narrowing workers' mobility, or expand aggregate investment opportunities while concentrating access among already well-positioned actors. A system-level increase in the number of possible transactions does not establish that each participant's meaningful option space expanded. Epistemic claims should therefore state whose possibilities changed and at which scale.

Historical contingency remains central. Arthur's analysis of increasing returns illustrates one mechanism through which early events can reshape later technological possibilities and make some alternatives progressively harder to recover (Arthur 1989). Other domains can exhibit different mechanisms, including institutional learning, legal precedent, infrastructure dependence, ecological degradation, reputation, or cumulative capability. GRE therefore treats possibility transformation as a broad epistemic category whose mechanism must be established locally rather than assumed from path-dependence language alone.

5.12.8 Transformation of the Conditions of Transformation

The deepest generative claims concern changes in the conditions through which later change itself is produced. An intervention can alter outcomes while leaving the mechanisms of subsequent adjustment broadly intact. In other cases, it changes the institutional procedures, technical interfaces, learning capacities, classification systems, infrastructures, or selection environments through which later transformations occur. The epistemic target then moves from a generated state or option to a change in the generative conditions of future change.

Examples include platformization of a market, where matching and visibility become mediated by ranking and data infrastructures; legal reform that changes the categories through which later claims become recognizable; organizational learning that changes how future problems are solved; adoption of a common technical standard that reorganizes later innovation pathways; and machine-mediated decision systems that alter how subsequent classifications are produced. Espeland and Sauder's study of rankings demonstrates one concrete route through which public measures can reorganize organizational behavior and thereby recreate parts of the social environment they measure (Espeland and Sauder 2007). Such cases show why recursively performative representations can become relevant to generative epistemology.

A claim at this level should be stated carefully. Economic systems rarely possess a single fixed rule of change. The phrase *conditions of transformation* refers to the locally relevant mechanisms, procedures, infrastructures, capacities, and constraints through which change is generated in the studied domain. Different methods can represent these conditions differently. A legal analysis can reconstruct changing rights and procedures; organizational research can identify routines and learning; network analysis can track changing connection rules; computational work can model altered update mechanisms; historical inquiry can reconstruct how institutional sequences changed what later interventions could accomplish.

Definition 5.92 (Second-order generative change)**.** A *second-order generative change* is a transformation in the mechanisms, capacities, rules, infrastructures, or relational conditions through which subsequent generative changes are produced, selected, constrained, or propagated within the stated domain.

The term *second-order* in Definition 5.92 identifies an analytical level rather than a universal hierarchy. A change can be second-order relative to one target and ordinary structural change relative to another. The classification therefore depends on the research question and on evidence that later processes operate differently because the relevant transformation conditions have changed.

This level also sharpens the distinction between generativity and immediate effectiveness. An intervention can solve a present problem while weakening the capacities needed for later adaptation. Another can have modest immediate effects while building institutions, knowledge, trust, redundancy, or infrastructure that change how future problems are addressed. Generative epistemology therefore requires temporal horizons long enough to observe changes in the production of later change, while preserving uncertainty when those horizons exceed available evidence.

The eight subsections together establish a graded vocabulary for generative knowledge. Relations can generate immediate capacities, further relations, persistent structures, constraints and enabling conditions, altered possibility spaces, and changes in the conditions through which later transformation occurs. These objects can overlap, and one generative trajectory can move through several of them. Their analytical separation nevertheless matters because the evidential traces and temporal horizons differ. Evidence that a capacity was generated does not by itself establish structural transformation; evidence of structural change does not establish that the mechanisms of later change were transformed; evidence of expanded possibilities does not establish which possibilities will be realized.

The resulting epistemic discipline can be stated compactly. A generative claim should specify the initiating relation or relational configuration, the target change, the relevant boundary and scale, the temporal horizon, and the level of generative effect being asserted. It should also preserve the distinction between observed change and attributed generation. The present section has defined the possible objects of that attribution. The following section takes the next step by examining what evidence is required to warrant the claim that a particular relation, configuration, or field materially generated the effect in question.

5.13 Attribution of Generative Effects

Section 5.12 specified the objects of generative inquiry by distinguishing relational existence from claims about what a relation, configuration, or field helps to generate. The present section addresses the next epistemic problem: the attribution of those effects among competing, interacting, and temporally distributed conditions. Its role is to establish standards for moving from evidence that a generative change occurred to a warranted claim that some relation or relational configuration materially contributed to that change. The objective is neither to impose a single universal theory of causation nor to reduce generative inquiry to one identification technique. The section instead develops a plural evidential framework organized around association, mechanism, counterfactual dependence, multiple causation, distributed generation, delayed effects, branching pathways, and emergence. The method is comparative and target-relative. Each attribution claim should identify the effect, candidate contributors, relevant alternatives, boundary and scale, temporal horizon, and the evidential basis for assigning causal-generative responsibility.

Generative attribution is demanding because economic change is rarely produced by an isolated relation operating against a fixed background. Relations are embedded in infrastructures, institutions, fields, histories, material conditions, classifications, and other relations. The same observed effect can therefore be compatible with several causal accounts, while the same relation can contribute differently under different surrounding conditions. Mechanism-based explanation provides one established way to connect cause and effect by identifying the processes through which the connection is produced (Hedström and Ylikoski 2010). Counterfactual approaches provide another by asking how the target would vary under changes to a candidate cause or intervention (Woodward 2003; Gangl 2010). GRE draws on these traditions while preserving the additional problems created by relational dependence, historical sequence, heterogeneous scales, and distributed generation.

Definition 5.93 (Generative attribution)**.** A *generative attribution* is a warranted claim that a specified relation, relational configuration, or relational field materially contributed to the emergence, transformation, stabilization, suppression, or dissolution of a target generative effect within a stated boundary, scale, and temporal horizon.

Definition 5.93 leaves room for several forms of contribution. A relation can operate as a trigger, enabling condition, constraint, amplifier, mediator, channel, stabilizer, or component of a distributed configuration. The epistemic task is therefore

richer than assigning a binary label of cause or non-cause. Attribution should recover the form, scope, and degree of contribution that the available evidence can support.

5.13.1 Association and Generation

Association is often the first observable sign that a generative relation may be present. Participation in a training network can covary with later capability; access to finance can covary with organizational survival; legal recognition can covary with access to services; collaboration can covary with later innovation. Such patterns can direct inquiry toward plausible generative processes. Their evidential role is therefore important, especially when the relation under study is difficult to manipulate directly or when historical evidence is incomplete.

Association alone leaves several attribution problems unresolved. Selection into a relation can reflect pre-existing capacities. A shared institutional change can affect both the candidate relation and the later effect. The relation can be a manifestation of a deeper process rather than a contributor to the effect. Reverse influence can also occur when an emerging capability increases the probability of entering the relation subsequently treated as explanatory. These possibilities do not make association uninformative; they make its inferential role conditional on a broader reconstruction of temporal order, alternative explanations, and the processes linking the relation to the effect.

The distinction between association and generation should also remain sensitive to the object described in Section 5.12. A relation can be strongly associated with an outcome while weakly connected to the particular generative change under investigation. For example, membership in a professional network may correlate with income, while the relevant generative question concerns whether the network produces access to knowledge, legitimacy, referrals, or future collaborations. The attribution target should therefore be stated at the level at which the alleged generative contribution occurs.

Proposition 5.94 (Association as directional evidence)**.** *Evidence of association can support the direction of generative inquiry when temporal ordering, selection processes, plausible common conditions, and alternative relational explanations are examined explicitly. The strength of a generative attribution depends on the additional evidence that connects the association to a target-relevant contribution.*

Proposition 5.94 prevents two symmetrical errors. One error treats correlation as sufficient attribution. The other discards associative evidence whenever experimental identification is unavailable. GRE instead treats association as one evidential layer whose value depends on how it interacts with mechanism, counterfactual reasoning, temporal reconstruction, comparative cases, process tracing, quantitative identification, and other sources of warrant.

This layered view is especially important for historically situated relations. A relation may have existed only once, or under institutional conditions that cannot be reproduced. In such cases, attribution can still improve through triangulation across traces, comparison, sequence evidence, mechanism reconstruction, and carefully scoped counterfactual reasoning. The epistemic standard should reflect the attainable evidence while preserving uncertainty about rival accounts.

5.13.2 Mechanism

Mechanism evidence addresses how a candidate relation contributes to the target effect. A mechanism claim identifies a process or organized sequence through which relational participation changes capacities, incentives, expectations, resources, classifications, obligations, information, positions, constraints, or other conditions relevant to later states. Mechanism-based explanation has a long standing in the social sciences because it can connect observed regularities to the processes that generate them (Hedström and Ylikoski 2010). For GRE, mechanism evidence is particularly valuable when the generative effect concerns a transformation of relations or capabilities that cannot be understood adequately from end-state comparison alone.

A relation can support several mechanisms simultaneously. Credit can relax a liquidity constraint, alter bargaining power, create repayment obligations, and establish a history that affects later access. Legal recognition can change formal entitlement, administrative legibility, third-party expectations, and opportunities for collective organization. Collaboration can transmit knowledge, create trust, establish routines, and modify organizational reputation. A credible attribution therefore benefits from a mechanism profile rather than a single narrative link.

Definition 5.95 (Generative mechanism)**.** A *generative mechanism* is a reconstructable process through which a candidate relation or relational configuration contributes to a specified generative effect by altering one or more target-relevant conditions across time.

The requirement of reconstructability matters. A mechanism should be connected to traces, observations, interventions, institutional records, comparative sequences, behavioral evidence, or other forms of empirical support. A verbal sequence that merely redescribes the outcome offers limited additional warrant. Stronger mechanism evidence shows that intermediate changes occurred, that they were linked to the candidate relation, and that they plausibly carried part of the effect toward the target.

Mechanism evidence also has boundaries. Several mechanisms can produce observationally similar outcomes. A mechanism can operate without being sufficient for the effect. The same mechanism can generate different outcomes under different surrounding relations. Some components can remain latent or only indirectly observable. GRE therefore treats mechanism reconstruction as evidence for attribution rather than as automatic closure of the attribution problem.

The scale of mechanism should also match the scale of the claim. A macro-level institutional shift can depend on micro-level interactions, meso-level organizational routines, and field-level constraints. A complete account need not reproduce every lower-level event. It should, however, identify the cross-scale connections necessary for the claimed contribution. Section 5.8 established the need for bridge evidence when transporting relational claims across scales; generative attribution inherits the same requirement.

5.13.3 Counterfactual Dependence

Counterfactual reasoning asks how the target effect would differ under a relevant change to the candidate relation or its operation. Woodward's interventionist account treats such what-if-things-had-been-different questions as central to causal explanation and emphasizes invariant relations under interventions (Woodward 2003). In empirical social research, counterfactual frameworks likewise clarify causal identification by comparing observed outcomes with potential outcomes under alternative treatments or exposures (Gangl 2010). GRE adopts the epistemic discipline of this reasoning while extending the object of comparison from isolated treatments to relational and configurational conditions.

The relevant counterfactual is rarely a simple world in which one relation disappears while everything else remains fixed. Removing a relation can alter connected relations, classifications, expectations, resource flows, or institutional responses. A counterfactual concerning employment, credit, legal status, or network membership may therefore require a specification of what changes together with the focal relation and what is held approximately stable for analytical purposes. The credibility of the counterfactual depends on this relational specification.

Definition 5.96 (Relational counterfactual specification)**.** A *relational counterfactual specification* states the candidate relation or relational feature to be changed, the connected conditions permitted to vary with that change, the background conditions provisionally held stable, the target effect, and the temporal horizon over which the comparison is evaluated.

Definition 5.96 makes counterfactual reasoning compatible with the open and permeable systems analyzed in Sections 5.8–5.11. It also helps distinguish feasible alternatives from purely verbal ones. Historical and institutional constraints can make some counterfactuals comparatively informative and others remote from any plausible transformation pathway.

Counterfactual dependence can provide strong attributional evidence, yet absence of simple dependence does not always eliminate contribution. Redundant causes can each be sufficient under the observed conditions. An enabling relation may become visible only when another trigger occurs. Distributed systems can contain compensatory pathways that preserve the outcome after one component is removed. Generative attribution should therefore avoid treating a single binary counterfactual test as exhaustive.

Remark 5.97 (Counterfactual evidence and contribution)*.* Counterfactual evidence is strongest when the proposed intervention corresponds to a meaningful relational variation and when the resulting comparison preserves the dependencies necessary to interpret the target. Failure of one simple counterfactual test can reflect redundancy, substitution, compensation, or misspecified intervention boundaries rather than the absence of generative contribution.

5.13.4 Multiple Causation

Generative effects commonly arise from several contributors whose roles differ. One condition can enable a process, another can trigger it, a third can amplify it, and a

fourth can stabilize the resulting relation. Attribution in such cases should identify the contribution structure rather than search automatically for one privileged cause. This is especially important when institutional and economic outcomes depend on conjunctions of resources, permissions, capacities, infrastructures, and expectations.

Multiple causation can take several forms. Contributors can be jointly necessary within a local configuration. Several contributors can each be sufficient under the observed conditions. One contributor can substitute for another. A relation can increase the probability of an effect without determining it. A background condition can become causally salient only when another process changes. These forms have different implications for both explanation and intervention.

Definition 5.98 (Generative contribution profile)**.** A *generative contribution profile* records the evidenced role of a candidate relation within a multi-contributor process, including whether the relation functions primarily as an enabling condition, trigger, amplifier, mediator, constraint, substitute, stabilizer, or component of a jointly productive configuration.

The categories in Definition 5.98 are analytical roles rather than mutually exclusive ontological kinds. A single relation can occupy several roles over time. Credit can first enable investment, later constrain cash flow through repayment obligations, and eventually stabilize market access by building a recognized borrowing history. Contribution profiles therefore benefit from temporal indexing.

Multiple-cause analysis also changes the interpretation of negative evidence. If an effect persists after one relation is removed, the remaining pathways can indicate redundancy or substitution. If a relation produces little effect in one setting, a missing complement can explain the difference. Comparative inquiry should therefore examine configurations in which candidate contributors vary jointly and separately where the evidence permits.

For GRE, this configurational perspective is particularly compatible with the generative emphasis of Section 5.12. The aim is to understand how a target becomes possible, stabilized, redirected, or suppressed through interacting conditions. Attribution remains precise when the analysis specifies each candidate's supported role and avoids assigning the entire effect to the most visible contributor.

5.13.5 Distributed Generation

Some generative effects arise through distributed organization rather than through a compact set of readily isolable contributors. Knowledge production, market conventions, organizational routines, collective trust, infrastructural reliability, and field-level opportunities can depend on many interactions whose individual effects are modest while their combined organization is consequential. Section 5.11 established that field attribution requires evidence for distributed organization and positional significance. Generative attribution adds a further requirement: evidence that the distributed configuration contributes to the target transformation.

Complex adaptive systems provide useful precedents for understanding outcomes produced through localized interaction, historical dependence, and feedback across levels (S. A. Levin 1998; Arthur 1999). Adaptive-network research likewise examines

systems in which node states and network topology change through reciprocal feedback (Gross and Blasius 2008). GRE uses these literatures as analytical resources without assuming that economic relational fields obey one universal complexity model.

Distributed generation creates a localization problem. The effect can be attributable to the organization of the configuration even when no single relation reproduces the effect independently. Conversely, invoking "the system" can obscure concrete pathways if the distributed claim is left unspecified. Stronger attribution therefore identifies the organization that matters: connectivity, complementarity, feedback, positional differentiation, repeated interaction, shared infrastructure, or another target-relevant pattern.

Proposition 5.99 (Distributed generative attribution)**.** *A distributed generative attribution gains warrant when evidence supports both the existence of a relevant distributed organization and a pathway through which properties of that organization materially contribute to the target effect. Evidence concerning isolated components remains informative but need not exhaust the attribution when the effect depends on configurational properties.*

Proposition 5.99 preserves the distinction between distributed contribution and explanatory vagueness. It also permits mixed attributions. A focal actor or relation can have a distinctive role within a distributed process while the realized effect still depends on the surrounding field. Such cases should be represented through layered contribution profiles rather than forced into either purely individual or purely systemic explanation.

Distributed attribution also inherits the uncertainty of field reconstruction. Missing relations, changing boundaries, representation choices, and uneven observation can alter the inferred organization. The confidence attached to a distributed generative claim should therefore remain sensitive to the uncertainty established in Sections 5.7–5.11.

5.13.6 Delayed Effects

Generative effects can appear after substantial delay. A relation may first change a capacity, expectation, obligation, or infrastructure whose significance becomes visible only when later conditions activate it. Training undertaken years earlier can affect later occupational mobility; a legal classification can reshape future eligibility; an early technological choice can alter the costs of later switching; a trust relation can become consequential during a later crisis. Delay therefore weakens simple temporal proximity as a criterion of attribution.

Path-dependent analyses demonstrate how earlier events can acquire later significance when self-reinforcing processes make subsequent development sensitive to sequence (Arthur 1989; Pierson 2000). GRE extends this temporal sensitivity beyond lock-in. Delayed effects can also operate through stored capacity, institutional memory, accumulated obligations, latent options, slowly changing expectations, or deferred thresholds.

The main epistemic difficulty is separating delayed contribution from retrospective storytelling. As the time between candidate relation and observed effect

increases, the number of intervening conditions generally grows. Attribution should therefore identify the carriers through which the earlier relation remains relevant. These carriers can include skills, records, infrastructures, debts, organizational routines, legal statuses, durable classifications, network ties, or other persistent residues.

Definition 5.100 (Generative carrier)**.** A *generative carrier* is a persisting or transmitted condition through which the contribution of an earlier relation remains connected to a later target effect across a temporal interval.

Evidence for a carrier strengthens temporal attribution because it links the earlier relation to later conditions without assuming uninterrupted visible activity. The carrier itself can transform. A credential can become a reputation signal; a technical capability can become an organizational routine; a debt can become a constraint on later investment. The epistemic task is to reconstruct continuity of contribution through these transformations.

Temporal horizon also affects the sign and magnitude of attribution. A relation can generate a short-run capability while producing a longer-run constraint, or impose an immediate cost while creating later options. Generative attribution should therefore state the horizon over which the effect is assessed and, where relevant, separate short-, medium-, and long-run contribution profiles.

5.13.7 Branching Effects

A single relation can open several downstream pathways. Collaboration can generate knowledge, status, additional partners, conflict, dependence, and new organizational commitments. Access to infrastructure can enable several economic activities whose later trajectories diverge. A legal reform can alter rights, administrative practice, strategic behavior, and expectations simultaneously. Such branching makes it difficult to represent the generative effect as one linear chain.

Branching attribution begins by separating the opening of a pathway from the realization of a later outcome. A relation can make a trajectory feasible without determining which branch will later be taken. Subsequent decisions, shocks, complementary relations, and field conditions can select among the opened possibilities. Attributing the entire realized history to the initiating relation would therefore overstate its contribution.

Definition 5.101 (Generative branch)**.** A *generative branch* is a target-relevant downstream pathway made newly feasible, more probable, less probable, or structurally altered by a prior relational process, while later conditions continue to influence whether and how that pathway is realized.

Definition 5.101 connects attribution to the possibility transformations introduced in Section 5.12. The generative contribution can lie in changing the topology of feasible development rather than producing one fixed end state. Evidence for branching can therefore include newly available choices, altered transition probabilities, new organizational forms, emergent partnerships, institutional pathways, or the disappearance of previously available routes.

Branching also changes counterfactual reasoning. The relevant comparison may

concern the set of accessible trajectories rather than a single terminal outcome. A relation can be generatively important because it creates several possible futures even when the observed history ultimately follows only one. Conversely, a realized branch can depend heavily on later conditions that deserve separate attribution.

A useful practice is to decompose attribution across branch formation, branch selection, and branch stabilization. The initiating relation can be credited with opening or constraining pathways; later relations can be credited with selecting among them; still later processes can stabilize the chosen trajectory. This decomposition reduces retrospective compression of a long history into one causal statement.

5.13.8 Emergent Effects

Emergent effects are especially challenging because the target property can arise from interaction among many components without being attributable in the same form to any single component. Market conventions, collective expectations, organizational cultures, congestion, systemic fragility, and coordinated patterns of innovation can exhibit this structure. Complexity research offers well-established examples in which localized interactions generate system-level patterns whose dynamics depend on feedback, adaptation, and organization across levels (S. A. Levin 1998; Arthur 1999). These precedents support attention to emergent effects while leaving the empirical burden of each GRE application intact.

Emergence should not function as a substitute for causal reconstruction. A claim that an effect "emerged" can remain merely descriptive unless the inquiry identifies the interactions, constraints, feedbacks, thresholds, or organizational properties through which the higher-order pattern was produced. The epistemic advantage of an emergence claim lies in showing why the target cannot be attributed adequately to one component considered independently and why configurational organization matters to the realized effect.

Definition 5.102 (Emergent generative effect)**.** An *emergent generative effect* is a target-relevant change whose warranted explanation depends on organized interaction among multiple relations or components and whose explanatorily relevant properties are attributable to that interactional organization rather than to any single component considered independently.

Definition 5.102 remains compatible with ontological suspension. It is an epistemic and explanatory category. It does not require a metaphysical doctrine concerning irreducible levels of reality. The claim is narrower: for the specified target, boundary, and scale, the interactional organization carries explanatory content that is lost when components are analyzed independently.

Several kinds of evidence can support such attribution. Micro- or meso-level traces can show reciprocal adaptation or feedback. Comparative configurations can reveal that similar components produce different outcomes under different organizations. Simulation can test whether reconstructed interaction rules generate the qualitative pattern, while remaining a model-based source of evidence whose assumptions require scrutiny. Historical sequence can reveal how a distributed pattern stabilized. Field reconstruction can show positional dependencies that individual-level accounts omit. Convergence among these forms of evidence can strengthen the attribution

without converting any one method into a universal standard.

Proposition 5.103 (Minimum warrant for generative attribution)**.** *A generative attribution is comparatively well warranted when the inquiry specifies the target effect and temporal horizon, identifies the candidate relation or configuration and its proposed contribution, examines plausible alternative contributors, provides evidence for relevant mechanisms or dependencies, states the boundary and scale of the claim, and preserves uncertainty arising from multiple causation, distributed organization, delay, branching, or emergence where these are materially relevant.*

Proposition 5.103 summarizes the section without imposing a rigid checklist on every empirical design. Different research settings provide different evidential opportunities. Experimental or quasi-experimental identification can be strong in some cases; historical process evidence, comparative reconstruction, network or field analysis, simulation, legal and administrative records, or qualitative inquiry can be more informative in others. The epistemic requirement is that the form of evidence fit the structure of the attribution being made.

The resulting conception is deliberately graded. Generative attribution can be weakly supported, strongly supported, locally identified, historically plausible, mechanism-rich but counterfactually uncertain, or counterfactually well identified while mechanistically incomplete. These differences should remain visible in GRE rather than being compressed into a single binary label. The next section extends this temporal discipline from attribution at a bounded interval to the reconstruction of longer trajectories and historical knowledge, where relations and their generative effects accumulate, transform, disappear, and leave residues across time.

5.14 Trajectories and Historical Knowledge

Sections 5.12 and 5.13 established what counts as a generative effect and how a contribution to such an effect may be attributed within a specified temporal horizon. The present section extends that epistemic problem across longer historical sequences. Its role is to explain how GRE can know relations and generative processes when their significance depends on order, duration, inherited conditions, interrupted traces, and later reinterpretation. The objective is to distinguish several historical objects that are often compressed into a single narrative of "development": relational trajectories, generative trajectories, path-dependent sequences, genealogies of present configurations, historically situated evidence, constrained historical counterfactuals, and later re-epistemization. The method is reconstructive and sequence-sensitive. Historical claims should preserve temporal ordering, changes in meaning and category, evidence provenance, relevant alternatives, and the possibility that later knowledge revises how an earlier process is understood.

Historical knowledge matters to GRE because generative significance can be temporally displaced. A relation can appear inconsequential at one moment and become important after later complementarities arise. A constraint can disappear formally while continuing to shape capacities accumulated under it. A classification can be revised while leaving institutions built around the earlier classification intact. An intervention can alter a possibility structure whose consequences emerge only after

subsequent actors occupy it. The evidential object is therefore frequently a temporally extended configuration rather than an isolated state or event.

This historical orientation does not imply that every economic outcome is path dependent or that chronological narrative is sufficient explanation. Historical reconstruction becomes analytically valuable when order, duration, inherited conditions, or changing interpretive frameworks materially affect the claim. The task is to identify which parts of a sequence carry explanatory or epistemic significance and which are merely antecedent. GRE therefore treats historical depth as a source of possible warrant that must itself be justified.

5.14.1 Relational Trajectories

A relational trajectory records how a specified relation or relational configuration changes across time. The object may be a contractual relation, a collaboration, an authority relation, a household relation, a credit relation, a network position, an institutional linkage, or a wider relational configuration. What makes the object a trajectory is not simply the availability of observations at several dates. The observations must be connected by an explicit continuity judgment of the kind developed in Section 5.9, together with evidence about changes in participants, rules, intensity, meaning, position, or causal efficacy.

Definition 5.104 (Relational trajectory)**.** A *relational trajectory* is a temporally ordered reconstruction of the formation, persistence, transformation, interruption, or dissolution of a specified relation or relational configuration under an explicit criterion of continuity and a stated observational horizon.

Definition 5.104 makes trajectory reconstruction dependent on relational identity rather than on labels alone. An organization can retain the same name while its authority structure changes substantially. Two actors can remain formally connected while the practical content of their relation shifts from cooperation to dependence. A legal category can persist while administrative procedures alter the relations it produces. Conversely, a relation can retain substantial continuity through changes in personnel, representation, or institutional form. Historical reconstruction should therefore identify the dimensions across which continuity is claimed and the dimensions across which transformation occurs.

A trajectory is also boundary- and scale-dependent. A firm-level supplier relation can appear stable while the wider field in which it is embedded changes sharply; a national policy relation can look discontinuous while local routines preserve practical continuity. The boundary and scale principles established in Section 5.8 therefore remain active throughout historical analysis. A trajectory should state the observational unit, the temporal granularity, and the relations treated as relevant context. Changing these choices can alter where formation, transformation, and dissolution appear to occur.

Temporal granularity deserves particular attention. Annual observations can hide short-lived interruptions, bargaining episodes, or rapid reconfigurations. Fine-grained event data can make enduring structure difficult to see. Historical knowledge therefore requires a resolution appropriate to the target claim. Where several resolutions are plausible, researchers should examine whether the inferred trajectory

remains stable across them. A continuity judgment that exists only after aggressive temporal aggregation should be stated more cautiously than one supported across several resolutions.

Relational trajectories can also contain periods of latency. A relation may cease to produce visible manifestations while its obligations, expectations, reputational effects, or stored capacities continue. Section 5.9 introduced residual efficacy after dissolution; historical reconstruction extends this idea by asking whether later states still carry traces of an earlier relation. The absence of continuous visible interaction therefore does not by itself establish historical discontinuity.

Proposition 5.105 (Trajectory reconstruction and continuity)**.** *A relational trajectory is comparatively well supported when the inquiry states its identity criterion, temporal resolution, boundary and scale, documents relevant transformations and interruptions, and distinguishes continuity of the relation from continuity of its manifestations or representations.*

Proposition 5.105 prevents retrospective smoothing. Historical narratives often become cleaner than the processes they describe. Explicit continuity criteria preserve ruptures, ambiguities, and periods for which the evidence supports several reconstructions.

5.14.2 Generative Trajectories

A generative trajectory tracks a different object. It follows a sequence in which earlier relations or generative effects alter the conditions from which later relations, capacities, structures, constraints, or possibilities emerge. The trajectory can therefore include several different kinds of generative effect from Section 5.12. A training relation can generate capability; that capability can enable entry into a professional relation; the professional relation can create access to information and collaborators; the resulting position can later affect organizational authority. The continuity lies in a chain of historically connected contributions rather than in persistence of one relation.

Definition 5.106 (Generative trajectory)**.** A *generative trajectory* is a temporally ordered reconstruction in which earlier relations, configurations, or generative effects materially alter the conditions under which later target-relevant relations, capacities, structures, constraints, or possibility sets emerge or transform.

This definition separates generative trajectory from simple chronology. Event A occurring before event B is insufficient. The reconstruction should identify how conditions created or modified earlier remain connected to later developments. The generative carriers introduced in Section 5.13 are especially important here. Skills, routines, infrastructures, legal statuses, debts, classifications, expectations, reputations, organizational memory, and material assets can transmit earlier effects across intervals in which the initiating relation is no longer active.

Generative trajectories can branch. An earlier relation may open several pathways, only one of which becomes realized. Later relations can redirect, amplify, suppress, or reverse earlier contributions. Historical reconstruction should therefore avoid reading the realized sequence as if it were uniquely implied by its beginning. The

branching concept introduced in Section 5.13 becomes historical when the inquiry reconstructs both the path taken and evidence about alternatives that remained feasible at relevant moments.

A further complication is sign change across time. A relation that initially generates capacity can later create lock-in or dependence. An infrastructure that expands access can later become a bottleneck. A regulatory privilege can support early investment and later inhibit entry. A historical generative claim should therefore state the horizon over which its evaluative or causal description applies. Long-run significance cannot be inferred by extending a short-run effect indefinitely.

Generative trajectories may also contain second-order transformations. Section 5.12 defined these as changes in the conditions through which later transformation occurs. Historically, such changes are especially consequential because they alter subsequent rates, channels, or admissible forms of generation. A new accounting system can change what organizations can observe and govern; a new legal form can alter the kinds of relations that can be stabilized; a new communication infrastructure can change the speed and reach of association. These transformations can make later history difficult to compare directly with earlier periods because the process generating change has itself changed.

The epistemic burden therefore grows with trajectory length. Each link introduces possible alternative explanations, missing traces, changing categories, and boundary shifts. A long generative trajectory should not be treated as one undifferentiated causal claim. Stronger reconstructions identify which links are directly supported, which are mechanism-rich but uncertain, which remain conjectural, and where later developments cease to be attributable to the earlier process with useful precision.

5.14.3 Path Dependence

Path dependence concerns sequences in which earlier developments alter the relative feasibility, cost, probability, or stability of later alternatives. Economic and political scholarship has used the concept to explain cases in which increasing returns, complementarities, learning, coordination effects, institutional feedback, or quasi-irreversibility make sequence and timing consequential. David's analysis of QWERTY helped establish an economic-historical vocabulary for such mechanisms, while subsequent debate also illustrates why a path-dependence claim should not be inferred from persistence alone (David 1985). Pierson extends increasing-return reasoning to political development and emphasizes timing, sequence, and self-reinforcing processes under specified mechanisms (Pierson 2000).

For GRE, path dependence is best treated as a mechanism-sensitive historical claim. Persistence is not enough. An institution can persist because current conditions continue to favor it independently of its history. A practice can recur because actors repeatedly choose it under unchanged incentives. A technology can dominate because it remains technically superior. Path dependence requires evidence that the route taken has itself modified later conditions in a way that makes alternative routes differently accessible than they would have been under another plausible sequence.

Definition 5.107 (Relational path dependence)**.** A *relationally path-dependent process* is a historical process in which earlier relational developments materially modify

the conditions governing later relational possibilities, so that later outcomes depend partly on the sequence through which the system arrived at its current configuration.

This formulation makes path dependence compatible with several mechanisms. Repeated interaction can accumulate trust or distrust. Standards can create compatibility networks. Institutional rules can generate constituencies that defend them. Learning can make some capabilities cheaper to reproduce. Contracts can create obligations that narrow later choices. Reputational histories can alter access to future relations. The key epistemic task is to identify the carrier and feedback process through which history changes the later opportunity structure.

Path dependence should also be distinguished from historical contingency. A contingent event can redirect a trajectory without generating a self-reinforcing process. Conversely, a path-dependent sequence can begin from deliberate choice rather than chance. The concepts answer different questions: contingency concerns openness among possible events, whereas path dependence concerns how realized history changes subsequent possibilities.

The concept of lock-in requires further restraint. Some path-dependent processes narrow alternatives without making them practically irreversible. New technologies, coalitions, crises, legal changes, or shifts in complementary institutions can reopen pathways. GRE should therefore represent degrees of path dependence and the conditions under which reversal becomes feasible. Such a representation is more informative than treating history as deterministic once an early branch has been selected.

Proposition 5.108 (Path dependence and historical mechanism)**.** *A path-dependence claim gains warrant when the reconstruction identifies a sequence-sensitive mechanism through which earlier relational developments alter later transition conditions and when persistence can be distinguished from contemporaneous causes that would support the same configuration independently of the earlier path.*

Proposition 5.108 makes historical dependence empirically contestable. It invites comparison with alternative sequences, evidence about feedback and switching costs, and attention to moments when the process could plausibly have moved differently.

5.14.4 Genealogical Reconstruction

Genealogical reconstruction asks how a present relation, category, institution, practice, or field became historically possible. Its object differs from a trajectory defined around a stable identity criterion. Genealogy may begin with a present configuration and work backward through heterogeneous predecessors, category changes, institutional transformations, and episodes that do not form one continuous object. The purpose is to reconstruct formation rather than to presume a continuous essence that has merely changed its appearance.

This distinction is particularly important for economic categories. Terms such as unemployment, productivity, household, enterprise, market, creditworthiness, or risk can appear to name stable objects while their operational definitions, institutional settings, measurement practices, and practical consequences change historically. Hacking's work on historical ontology provides a relevant precedent for examining how concepts and objects become possible through historically situated styles

of reasoning, language, and classification (Hacking 2002). GRE draws a narrower epistemic lesson: present categories should not be projected backward without examining whether the relations they organize were constituted and rendered visible in comparable ways.

Definition 5.109 (Genealogical reconstruction)**.** A *genealogical reconstruction* is a historically situated account of the heterogeneous relations, practices, classifications, institutions, material conditions, and interpretive transformations through which a present target became possible, stabilized, or intelligible in its current form.

Genealogical reconstruction can reveal several kinds of discontinuity. The same word can designate different objects across periods. Different words can organize substantially related practices. An institution can inherit routines from predecessors while changing their justificatory language. A statistical category can create comparability where earlier records were organized around different administrative purposes. These discontinuities matter because historical evidence is interpreted through categories that may themselves be products of the history under investigation.

Genealogy also guards against teleology. Present arrangements should not be treated as the latent destination of earlier processes. Earlier actors faced possibility structures that included paths later abandoned, defeated, forgotten, or rendered illegible by subsequent classifications. Sewell's analysis of historical events emphasizes that consequential events can transform structures through linked changes in action, interpretation, schemas, and resources (Sewell 1996). Such transformations make later categories poor guides to what earlier actors could see or expect before the event occurred.

A GRE genealogy should therefore preserve superseded alternatives where evidence permits. Draft laws, failed standards, abandoned organizational forms, dissident classifications, unrealized plans, informal arrangements, and contested interpretations can be epistemically valuable because they reveal the field of possibilities within which the realized configuration emerged. Their historical importance does not depend on eventual success.

Genealogical reconstruction remains distinct from normative debunking. Showing that a category or institution has a history does not establish that it is false, illegitimate, or dispensable. Historical formation can be compatible with present usefulness or normative importance. The epistemic contribution is to make constitution, contingency, and inherited structure visible so that current claims are not mistaken for timeless descriptions.

5.14.5 Historical Evidence

Historical knowledge depends on traces that survive unevenly. Documents, administrative records, legal instruments, correspondence, artifacts, testimony, organizational data, statistics, media, physical infrastructure, and later recollections can each disclose parts of earlier relational configurations. Section 5.7 already established that observational access is partial and position-dependent; historical inquiry adds a preservation filter. What can be observed later depends on what earlier actors recorded, what institutions retained, what survived material loss, what became ac-

cessible, and what later researchers know how to interpret.

The survival of evidence is itself relationally structured. Powerful institutions often generate and preserve abundant records because administration requires documentation. Informal, stigmatized, precarious, clandestine, or rapidly changing relations may leave fewer durable traces. Strategic concealment can further distort the archive. Historical absence from records therefore requires the same caution that Section 5.4 applied to absence of traces more generally: non-observation becomes evidence of absence only when the inquiry has reason to expect that the relevant relation would have generated and preserved an accessible trace.

Historical evidence also changes meaning across contexts. A wage register can support claims about payment while leaving household dependence, bargaining, informal exchange, or care relations largely invisible. A contract can show formal obligation while underrepresenting coercion or practical non-enforcement. A statistical series can enable longitudinal comparison while embedding changing definitions. A retrospective interview can recover experience unavailable in administrative records while being shaped by later memory and interpretation. Evidence should therefore be evaluated relative to the target claim rather than through a fixed hierarchy of source types.

Provenance becomes especially important when historical traces are repeatedly copied, standardized, digitized, or summarized. A later dataset can contain values inherited from earlier administrative systems whose definitions changed across time. A secondary narrative can cite several accounts that ultimately derive from one original report. Digitization can improve access while severing contextual metadata. The provenance principle developed for distributed observation in Section 5.7 therefore extends naturally to historical reconstruction.

Proposition 5.110 (Historical evidential adequacy)**.** *Historical evidence is comparatively adequate for a relational claim when its provenance, production context, preservation conditions, category semantics, temporal coverage, and expected relation to the target are sufficiently explicit for alternative reconstructions and evidential gaps to be assessed.*

Proposition 5.110 does not demand complete archives. Many important historical questions cannot satisfy such a standard. It instead requires that evidential limitations remain part of the claim. A reconstruction can be strong despite missing evidence when surviving traces converge, rival interpretations are tested, and the pattern of missingness is itself historically understood. Conversely, a large archive can still produce weak knowledge if its categories or selection mechanisms remain opaque.

The next section will classify evidential forms for relational claims in greater detail. The present concern is narrower: historical evidence acquires epistemic force through an account of how traces were produced, preserved, transformed, and made available across time.

5.14.6 Historical Counterfactuals

Historical counterfactuals ask how a trajectory might have differed under a plausible alteration to an earlier relation, event, institution, or sequence. Their epistemic role is closely related to the counterfactual reasoning developed in Section 5.13, but historical application adds a demanding constraint: the alternative should be specified from the possibility structure available at the relevant historical moment rather than from later knowledge alone.

A counterfactual can be useful for testing whether an earlier development materially constrained later outcomes. If an institutional rule had differed, would the later relation still have been feasible? If a standard had failed to coordinate adoption, would the same network effects have emerged? If a legal recognition had occurred later, would the relevant organizational form have stabilized? These questions can reveal which links in a generative trajectory carry attributional weight.

Historical counterfactuals become weak when they alter too many connected conditions without specifying the consequences of those changes. Replacing one institution can change coalitions, expectations, resource flows, legal interpretation, and later opportunities. The relational counterfactual specification from Section 5.13 remains relevant: the inquiry should state what is changed, which connected conditions are permitted to change with it, what is provisionally held stable, and the horizon over which consequences are considered.

The criterion of historical plausibility is equally important. A later technology, category, or institutional design may provide an imaginable alternative while having been unavailable to actors at the time. Such a comparison can still serve a theoretical purpose, but it should not be confused with a historically grounded counterfactual. Stronger historical counterfactuals draw on alternatives that were materially, institutionally, or conceptually available, including unrealized proposals, neighboring cases, contested reforms, known technologies, or paths that were attempted and abandoned.

Definition 5.111 (Historically situated counterfactual)**.** A *historically situated counterfactual* is a counterfactual reconstruction whose altered condition and connected consequences are specified with reference to the relations, resources, institutions, knowledge, and feasible alternatives evidenced for the historical period under study.

Definition 5.111 does not require researchers to reproduce the subjective beliefs of every historical actor. The constraint is epistemic: alternatives should be disciplined by evidence about the period rather than by unrestricted retrospective imagination. Counterfactual uncertainty should increase as the imagined branch moves farther from historically evidenced possibilities or extends across longer downstream horizons.

Historical counterfactuals can also test path-dependence claims. If changing an early event while preserving plausible surrounding conditions yields little difference in the later reconstructed process, the alleged path dependence becomes weaker. If the altered sequence changes later transition conditions through a documented feedback mechanism, the claim gains support. Such reasoning remains conditional rather than demonstrative, especially where historical systems contain multiple interacting pathways.

5.14.7 Re-Epistemization through Historical Change

Historical change can alter not only the object of knowledge but also the conditions under which earlier evidence becomes intelligible. New records can be released; classifications can be revised; social practices can make previously invisible relations legible; later consequences can reveal the significance of earlier events; new methods can extract patterns from old data; and normative or conceptual developments can create questions that earlier inquiries did not ask. GRE uses the term *re-epistemization* for the disciplined reconstruction of an earlier epistemic object under such changed conditions.

Definition 5.112 (Historical re-epistemization)**.** *Historical re-epistemization* is the revisable reconstruction of an earlier relational or generative claim when later evidence, categories, methods, consequences, or interpretive conditions materially change what can be warranted about the earlier process.

Re-epistemization differs from simple correction. Sometimes later evidence shows that an earlier claim was wrong. In other cases the earlier claim was reasonable under the evidence then available but becomes too narrow after new traces or categories appear. A third possibility is that the object itself changes: a relation later acquires causal efficacy, legal recognition, or social meaning that it did not possess previously. Historical knowledge must therefore distinguish revision of evidence, revision of interpretation, and transformation of the target relation.

Hermeneutic traditions provide an important precedent for this temporal openness. Ricoeur emphasizes interpretation across distance and the interaction of explanation and understanding in the interpretation of text and action (Ricoeur 1991). GRE adapts a limited epistemic lesson: later interpretation can legitimately reopen earlier material without implying that interpretation is unconstrained. Re-epistemization remains answerable to preserved traces, provenance, historical context, rival interpretations, and the consequences of the distinctions introduced.

The emergence of new categories also requires care. Hacking's historical analysis of categories and styles of reasoning shows why later conceptual resources can reveal historically constituted objects while simultaneously changing the terms through which they are understood (Hacking 2002). A later category can illuminate relations that earlier records rendered poorly visible, yet it can also distort if projected backward as though actors and institutions already organized reality in the same way. Re-epistemization therefore requires a two-sided discipline: exploit the analytical resources of the present while preserving the historical semantics and possibility structures of the past.

Later outcomes can similarly alter retrospective significance. An early technical standard can look minor until network effects accumulate around it. A local legal classification can become historically consequential after administrative systems are built on it. A failed experiment can later become informative when a new theory identifies a mechanism that the original researchers could not articulate. Such retrospective significance does not mean that the later outcome was already contained in the earlier event. It means that historical knowledge can change when the downstream relations through which significance is assessed become visible.

Proposition 5.113 (Historical preservation)**.** *The future re-epistemization of a rela-*

tional or generative claim is strengthened when evidence, provenance, category definitions, alternative interpretations, model assumptions, uncertainty, and relevant negative or unresolved results are preserved in forms that allow later inquiry to reconstruct how the earlier claim was produced.

Proposition 5.113 connects historical epistemology to research design. Preservation is not merely archival housekeeping. It maintains future epistemic options. A dataset without category history, a model without assumptions, a summary without provenance, or a decision record without excluded alternatives can make later reinterpretation substantially harder even when the nominal evidence survives.

Historical re-epistemization also places a limit on claims of final closure. A well-supported historical account can be provisionally stable while remaining open to later evidence or reinterpretation. This revisability does not reduce every account to equal plausibility. Evidence can strongly favor one reconstruction, and some alternatives can be rejected. The point is narrower: the warrant of a historical claim remains indexed to the evidential and conceptual conditions under which it was assessed.

The seven subsections together establish history as an epistemic dimension of GRE rather than merely a background chronology. Relational trajectories track continuity and transformation; generative trajectories reconstruct historically connected contributions; path dependence identifies sequence-sensitive changes in later possibility; genealogy reconstructs the formation of present objects without assuming continuous essence; historical evidence is evaluated through production and preservation conditions; historical counterfactuals are constrained by period-specific possibility structures; and re-epistemization keeps historical knowledge open to disciplined reconstruction. The next section shifts from this temporal architecture to a systematic comparison of the evidential forms through which relational claims are supported.

5.15 Evidence for Relational Claims

Sections 5.1–5.14 have progressively specified the objects and epistemic conditions of relational inquiry: manifestation, trace, representation, observation, boundary, scale, persistence, higher-order configuration, fields, generative relations, causal-generative attribution, and historical trajectory. The present section turns from these conceptual conditions to the evidential materials through which relational claims are actually warranted. Its role is to distinguish major evidence forms without assigning any one of them universal priority. Its objective is to show what documentary, administrative, legal, behavioral, testimonial, ethnographic, network, longitudinal, and computationally inferred materials can establish about relations, together with the characteristic inferential limits attached to each. The structure follows these evidence forms in turn. The method is trace-sensitive and target-relative: each evidential source is evaluated by asking how it was produced, what relational property it can reveal, what conditions mediate its accessibility, and what forms of error or underdetermination remain.

The central premise is that evidence is not interchangeable simply because several sources refer to the same actors or event. A contract, a transaction record, an inter-

view, a fieldnote, a network edge, and a model-inferred tie can each concern the same apparent relation while recording different manifestations of it. A legal instrument may establish an authorized relation without showing how that relation is enacted in practice. Administrative data may record repeated interaction while omitting informal obligations. Testimony can disclose meanings or concealed dependencies that leave few institutional traces, while remaining situated and potentially contested. Computational inference can extend observation beyond manually coded relations while introducing model dependence. Evidential diversity therefore increases epistemic reach only when the relation between source, trace, and target claim remains explicit.

Definition 5.114 (Relational evidence)**.** *Relational evidence* is an observation, record, trace, testimony, representation, or warranted inference that bears on a specified claim concerning the existence, form, properties, persistence, transformation, boundary, position, or configuration of one or more relations.

Definition 5.114 makes evidence claim-relative. A payroll record can provide strong evidence of a formal employment relation during a specified interval while offering limited evidence about authority in day-to-day work. A sequence of messages can support a claim of repeated communication while leaving trust, obligation, or influence unresolved. A participant's account can support knowledge of experienced dependence while requiring additional evidence before the same account is used to establish the prevalence of that dependence across a population. The strength of evidence therefore depends partly on the distance between the trace that is available and the relational property being claimed.

This section accordingly resists a simple hierarchy in which quantitative evidence is treated as intrinsically stronger than qualitative evidence, institutional records as intrinsically more objective than testimony, or direct observation as automatically superior to inference. Each evidence form is generated within particular institutions, practices, categories, instruments, and access arrangements. Administrative and statistical data are especially powerful because they can provide large-scale and repeated observations, but their categories and collection systems also shape what becomes visible (Desrosières 1998; World Bank 2021). Qualitative and ethnographic evidence can recover relational meaning and practice that standardized records omit, while their scope and observer position must remain explicit. The epistemic problem is therefore one of evidential fit, combination, and calibrated inference.

5.15.1 Documentary Evidence

Documentary evidence includes letters, contracts, minutes, reports, correspondence, memoranda, organizational records, policy documents, archival files, diaries, technical specifications, media records, and other durable inscriptions produced within or around a relational process. Such documents can establish that actors communicated, recognized obligations, created categories, recorded decisions, asserted authority, coordinated activity, or represented a relation in a particular way. Their durability also makes them especially important for historical reconstruction, where direct observation is unavailable and relational trajectories must be recovered from surviving traces.

A document should nevertheless be treated as a produced object rather than a transparent window onto the relation. Documents have authors, audiences, genres, institutional purposes, preservation histories, and conditions of access. A memorandum may record the position that an organization was prepared to state formally rather than the full structure of disagreement that preceded it. Meeting minutes can establish that a decision was recorded while compressing uncertainty, dissent, or informal negotiation. A contract can preserve explicit obligations while leaving tacit expectations and practical dependence outside the written text. Ricoeur's hermeneutics of text is useful here because textual inscription creates a degree of distance between an act of writing, its immediate context, and later interpretation (Ricoeur 1991). For GRE, that distance is an epistemic condition to reconstruct rather than a defect that automatically disqualifies documentary evidence.

Documentary evidence is especially strong when the target claim concerns representation, formal acknowledgment, declared intention, authorized procedure, recorded sequence, or institutional memory. It becomes more inferential when used to establish relations that the document was not designed to record. The evidential task should therefore specify whether the document is being used as evidence of the represented relation, evidence of the practice that produced the document, evidence of the institutional categories available at the time, or evidence of a later archival selection process. These are different claims.

Preservation also creates selection. Surviving documents are rarely a neutral sample of past relational life. Powerful organizations often preserve records more systematically than marginal or informal actors. Routine success can be recorded differently from conflict, failure, or activity outside institutional reporting requirements. Section 5.14 treated provenance and preservation as conditions of historical re-epistemization. Documentary inquiry therefore benefits from recording archive provenance, gaps, destruction, access restrictions, and changes in filing or classification practice where these materially affect the relational reconstruction.

Proposition 5.115 (Document–relation distinction)**.** *A documentary source can warrant a relational claim only to the extent that the inquiry states how the document was produced, what aspect of the relation it records or represents, and what inferential steps connect the inscription to the target relational property.*

Proposition 5.115 prevents documentary existence from becoming automatic relational proof. A document can itself be relationally consequential, especially when it authorizes, classifies, obligates, or coordinates, while still remaining incomplete evidence about the wider relation in which it operates.

5.15.2 Administrative Evidence

Administrative evidence is produced through systems that register, classify, monitor, allocate, authorize, bill, tax, employ, enroll, license, inspect, or otherwise administer persons, organizations, resources, and transactions. Contemporary administrative systems can generate relational data at a scale and temporal resolution that would be difficult to obtain through direct observation. The expansion of administrative and private-sector data has materially increased the observability of many economic behaviors (Einav and J. Levin 2014), while public data systems increasingly combine ad-

ministrative, survey, citizen-generated, and machine-generated sources (World Bank 2021).

For relational inquiry, administrative records can reveal repeated transactions, institutional membership, transfers, claims, service use, organizational affiliation, co-location, authorization, sanction, or other patterned connections. Their major strength is often coverage and repetition. When identifiers are stable and collection procedures are known, administrative data can support large-scale reconstruction of relational neighborhoods, trajectories, and institutional positions.

Their major limitation is equally important: administrative systems observe through categories created for administrative purposes. A database records the relations that its schema permits and that its procedures require participants or officials to enter. Statistical and administrative classifications have histories of construction, coding, aggregation, and comparability rather than arising as neutral descriptions of social reality (Desrosières 1998). A household category, employment status, beneficiary identifier, ownership code, or provider relationship can therefore carry institutional assumptions into the evidence base.

Administrative evidence should consequently be evaluated along at least four dimensions: coverage, category validity, record-generation incentives, and linkage quality. Coverage asks who and what enters the system. Category validity asks whether administrative variables correspond sufficiently to the relational property under study. Record-generation incentives ask whether actors gain from accurate reporting, strategic reporting, or avoidance. Linkage quality asks whether records belonging to the same actor, organization, or relation can be connected reliably across sources and time. Failures in any of these dimensions can generate false absence, false continuity, or spurious connection.

Administrative silence is particularly ambiguous. A missing record can indicate that a relation did not exist, that it existed outside administrative jurisdiction, that it was exempt, informal, misclassified, unreported, technically lost, or deliberately concealed. The negative-evidence conditions developed in Section 5.4 therefore apply directly. Administrative nonobservation becomes stronger evidence of relational absence only when coverage, reporting, detection, and preservation conditions make the missing trace genuinely expected under the hypothesis that the relation existed.

5.15.3 Legal Evidence

Legal evidence is especially important when relational claims concern rights, duties, statuses, authority, jurisdiction, ownership, organizational personality, enforceability, or recognized procedures. Statutes, regulations, judicial decisions, contracts, charters, registries, licenses, and legally operative records can establish relations that have institutional force because relevant actors recognize and act through legal rules. Hart's analysis of legal systems through primary and secondary rules provides one established account of how recognized rules structure obligations and authoritative legal change (Hart 2012); Searle's account of institutional facts likewise emphasizes status functions, constitutive rules, and collectively recognized deontic powers (Searle 1995).

Legal evidence has a distinctive epistemic advantage: in some domains the legal

record does not merely describe an independently existing relation but helps constitute the formal relation itself. Incorporation documents and organizational law, for example, can create legally recognized entities and asset-partitioning relations that alter creditor and ownership claims (Hansmann and Kraakman 2000). A legal instrument can therefore be simultaneously evidence of a relation and part of the mechanism through which that relation is stabilized.

This constitutive role should not be extended beyond its evidential scope. Formal entitlement does not establish practical access. A statutory right does not demonstrate that administrative agencies implement it consistently. A contractual duty does not reveal the bargaining conditions under which the contract was accepted. Formal ownership does not by itself identify operational control. Legal evidence is therefore strongest for claims about legally recognized relations and weaker when transported without additional evidence into claims about enacted, experienced, or effective relations.

Legal interpretation introduces a further layer. Rules can contain open terms, conflicts, exceptions, jurisdictional boundaries, and historically changing precedents. The evidential task may therefore require identifying which legal source was authoritative for the time, place, actor, and issue under study. Where several interpretations were institutionally plausible, the reconstruction should preserve that contestability rather than reading a later settlement backward into an earlier period.

A useful distinction is thus between *formal relational validity* and *relational realization*. The first concerns whether a relation was legally recognized, authorized, prohibited, or constituted. The second concerns how that relation operated through practice, enforcement, compliance, evasion, negotiation, and institutional capacity. GRE often needs both because economic consequences can depend on the interaction between formal status and practical realization.

5.15.4 Behavioral Evidence

Behavioral evidence concerns actions and interaction patterns through which relations become manifest. Exchanges, transfers, communication, coordination, compliance, reciprocity, sanctions, referrals, mobility, repeated cooperation, avoidance, and other observable behaviors can provide evidence that actors are connected in ways that formal records do not fully capture. Behavioral approaches to collective action, for example, have examined how reciprocity, reputation, and trust are manifested through repeated interaction rather than inferred solely from abstract preference assumptions (Ostrom 1998).

The evidential strength of behavior lies in enacted relation. Repeated transfers can demonstrate a material connection even when participants never label it formally. Coordinated timing can reveal practical interdependence. Patterns of sanction can reveal authority or norm enforcement. Repeated referral can reveal brokerage or reliance. Behavioral traces can therefore help bridge the gap between formally represented relations and relations enacted in practice.

Behavior remains multiply interpretable. The same observed act can be compatible with several relational meanings. A transfer can represent payment, gift, repayment, obligation, coercion, care, strategic investment, or accounting adjust-

ment. Silence can indicate agreement, exclusion, indifference, deference, or lack of opportunity to respond. Frequent communication can reflect collaboration, monitoring, conflict, or procedural necessity. Behavioral evidence therefore warrants a relational claim most strongly when the mapping from action to relational property is supported by context, sequence, institutional knowledge, comparison, testimony, or other evidence.

Selection also matters. Actors choose whether to enter, continue, or leave relations, and their behavior within a relation may reflect capacities or constraints that preceded the observed interaction. Behavioral evidence can establish that an interaction occurred without by itself establishing why the actors were positioned to participate. This limitation becomes especially important when behavioral data are later used for generative attribution, which the next section addresses separately.

GRE should therefore distinguish *behavioral manifestation* from *relational interpretation*. The former identifies an observed action pattern. The latter identifies the relation for which that pattern is taken as evidence. The inferential bridge between them should remain open to revision when new contextual or comparative evidence becomes available.

5.15.5 Testimonial Evidence

Testimonial evidence includes interviews, oral histories, declarations, participant accounts, expert statements, complaints, witness reports, and other communicated accounts of relations or relational experience. It is indispensable when the relevant relation includes meanings, expectations, fear, trust, obligation, dependence, informal coordination, concealed practice, or other dimensions that may not produce adequate documentary or administrative traces. Participants can possess access to relational processes that external observers cannot recover from behavior alone.

Testimony should be evaluated neither as an unmediated report of reality nor as merely subjective material. A speaker occupies a position within the relation and therefore has both epistemic access and epistemic limits associated with that position. Participants can know tacit routines, informal expectations, coercive pressures, and historical context unavailable to an administrative database. They can also misremember, strategically represent, reinterpret retrospectively, or observe only one part of a distributed relation. Section 5.7 developed the idea of observer-position profiles; testimonial evidence is one setting in which such positionality is especially explicit.

Credibility itself is socially structured. Fricker's analysis of testimonial injustice shows how credibility can be unevenly allocated through identity and power relations, while hermeneutical disadvantage can affect the concepts available for making an experience intelligible (Fricker 2007). For GRE, this means that disagreement among testimonies cannot be resolved simply by assigning equal weight to all accounts or by privileging institutionally authoritative speakers. The inquiry should examine access, incentives, vulnerability, dependence, interpretive resources, corroboration, and the relational conditions under which testimony is produced and received.

Testimony can also be evidence about representation rather than only about the

represented relation. How actors name a relation, justify it, refuse a category, or contest an institutional description can reveal symbolic and classificatory structures that affect the relation itself. Divergent accounts may therefore constitute substantive evidence. A worker and a manager can describe the same arrangement differently because they occupy different positions, possess different information, or contest the normative meaning of the relation. The disagreement need not be reduced prematurely to a single corrected narrative.

Definition 5.116 (Testimonial position)**.** A *testimonial position* is the combination of relational location, access, dependence, incentives, interpretive resources, and exposure to consequences that conditions what a speaker can observe, experience, articulate, or strategically disclose about a target relation.

Definition 5.116 turns positionality into part of the evidence record. Testimonial triangulation then involves comparison across positions, not merely accumulation of speakers.

5.15.6 Ethnographic Evidence

Ethnographic evidence is produced through sustained situated engagement with practices, interactions, artifacts, environments, and participants. Its distinctive contribution to relational inquiry lies in recovering relations in operation: how formal rules are enacted, how actors coordinate without explicit articulation, how meanings are negotiated, how material arrangements organize interaction, and how routines distribute knowledge across persons and artifacts. Hutchins's study of navigation provides a well-known example of analysis in which cognitive work is reconstructed across people, procedures, instruments, and organizational arrangements rather than located within one individual (Hutchins 1995). GRE can draw on this evidential sensibility without treating its own relational categories as identical to distributed cognition.

Ethnographic evidence is particularly valuable when relational properties are tacit, situational, performative, or difficult to separate from context. An organizational chart can record formal authority, while observation may reveal who is actually consulted before decisions. A platform rule can specify an official workflow, while field engagement may reveal workarounds, informal assistance, or avoidance practices. A legal entitlement can exist formally, while situated observation reveals the interactional conditions that make claiming it easy, costly, humiliating, risky, or practically impossible.

The observer is part of the evidential situation. Access can depend on gatekeepers, rapport, timing, language, institutional permission, and the willingness of participants to permit observation. Presence can also alter behavior. Ethnographic evidence therefore requires explicit attention to observer position, field access, temporal coverage, note production, and transitions between observation and interpretation. Reflexivity here is an epistemic practice: it records conditions under which the evidence became available and the ways those conditions may have shaped what was observed.

Local richness does not automatically establish wider prevalence. Ethnographic evidence can strongly support a mechanism, practice, meaning, or relational form

within the observed setting while leaving its distribution across other settings uncertain. Generalization therefore requires an explicit bridge, such as comparative cases, purposive variation, theoretical sampling, administrative prevalence evidence, survey evidence, or other forms of cross-context support. The same caution applies in reverse: population-level regularities can establish distribution while missing the situated processes through which relations acquire practical meaning.

Ethnographic inquiry thus contributes a form of *context-preserving relational evidence*. Its epistemic strength lies less in escaping mediation than in documenting enough of the relational setting that actions, categories, artifacts, and accounts can be interpreted together.

5.15.7 Network and Relational Data

Network and relational data represent actors together with explicitly recorded connections among them. These connections can be directed or undirected, weighted or binary, multiplex, signed, temporal, observed, reported, or inferred. Network analysis developed precisely to study patterned relations rather than reducing social structure to aggregated individual attributes (Wellman 1983), while contemporary network science provides extensive tools for describing connectivity, clustering, centrality, degree structure, community organization, and dynamical processes on networks (Newman 2003).

For GRE, the main advantage of network data is explicit relational representation. A dyadic data structure makes it possible to ask whether actors occupy brokerage positions, whether relations cluster, whether some ties are reciprocal, whether paths connect otherwise separated groups, or whether relational patterns differ across layers. Such data are especially useful for the higher-order and field problems introduced in Sections 5.10 and 5.11.

A recorded edge is nevertheless only as meaningful as its operational definition. Co-authorship, communication, trade, co-location, friendship nomination, legal ownership, financial transfer, shared membership, and algorithmically inferred association are different relations. Combining them without preserving type can erase distinctions that matter for explanation. Conversely, treating every recorded edge as equivalent can make formal network precision conceal substantive ambiguity.

Boundary selection is another major source of uncertainty. Network measures can change when omitted actors, external ties, or missing relation types are restored. Sampling is therefore not merely an issue of sample size. Missing nodes and edges can alter the apparent position of observed actors and the architecture of the network itself. The boundary principles of Section 5.8 should be recorded directly in network-data construction: who could enter the network, what relations were detectable, over what period, through which data-generating procedure, and with what missingness.

Definition 5.117 (Relational data provenance)**.** *Relational data provenance* is the recoverable account of how nodes, relation types, edge values, time stamps, boundaries, missingness rules, and transformations were produced from underlying observations, records, reports, or inference procedures.

Provenance is especially important when relational data are repeatedly trans-

formed before analysis. Deduplication, entity resolution, thresholding, aggregation, projection from two-mode data, temporal binning, and privacy-preserving transformations can all change the represented relation. A reproducible relational analysis should therefore preserve these operations as part of the evidential record rather than treating the final adjacency structure as raw observation.

5.15.8 Longitudinal Evidence

Longitudinal evidence observes relational objects across more than one time point or records events with sufficient temporal information to reconstruct change. It is essential for claims about formation, persistence, transformation, dissolution, sequence, and trajectory. A cross-sectional network can show that two actors are connected at a given moment; longitudinal evidence can show whether the relation is newly formed, long-standing, intermittent, intensifying, weakening, or reconstituted after interruption.

Temporal network research demonstrates why timing and duration can alter the analysis of relational processes: the order of contacts can determine which paths are actually available and how processes propagate through a network (Holme and Saramäki 2012). GRE generalizes this temporal discipline beyond formal network models. The evidential question is whether observations preserve enough temporal resolution to support the identity and sequence claims being made.

Longitudinal evidence creates problems of comparability. Categories, measurement instruments, identifiers, organizational boundaries, and reporting rules can change across waves or periods. Apparent relational change can therefore arise from a changed observation regime. Conversely, harmonization can suppress historically meaningful category change by forcing later and earlier records into one coding scheme. Section 5.3 treated manifestation relations as historically variable; longitudinal inquiry must preserve this possibility rather than assuming that repeated variables have constant meaning.

Attrition and survivorship also matter. Relations that dissolve can disappear from later datasets, actors can leave panels, organizations can cease to report, and archives can become less complete farther into the past. Longitudinal evidence is strongest when entry, exit, censoring, missingness, and changing coverage are themselves documented. When these processes are related to the relational phenomenon under study, treating them as random missing data can bias the reconstructed trajectory.

A further distinction is needed between repeated observation and historical continuity. Multiple records bearing the same label do not establish that the same relation persisted. Continuity requires an identity criterion and evidence of the carriers through which the relation remained connected across time, as developed in Sections 5.9 and 5.14. Longitudinal evidence provides the temporal material for that judgment; it does not replace the judgment itself.

5.15.9 Computationally Inferred Evidence

Some economically important relations cannot be observed directly at the desired scale, speed, or granularity. They are reconstructed computationally from text, im-

ages, transactions, communication logs, sensor data, mobility traces, platform events, registries, or other high-dimensional observations. Computational methods can infer entity matches, latent affiliations, predicted ties, similarity relations, communities, roles, influence patterns, or probable interaction structures. Such inference can greatly expand epistemic access, especially where manual coding is infeasible.

Computational inference should be represented as an evidential layer rather than silently converted into observation. A predicted edge and an observed transaction are different epistemic objects even when both appear in the same graph. The distinction parallels Giere's pragmatic account of models as purposive representations of selected aspects of a target rather than identical copies of reality (Giere 2004). Computational simulation and modelling likewise mediate theory, data, approximation, and evidential judgment rather than eliminating those judgments (Winsberg 2010).

At least four components of computationally inferred evidence should remain recoverable. First, the input evidence should be documented, including its coverage and provenance. Second, the target relation should be operationally specified: the model must be trained or designed to infer something more precise than an unspecified notion of connection. Third, model assumptions and transformations should be visible, including thresholds, embeddings, priors, training labels, entity-resolution rules, or other procedures that materially affect the inferred relation. Fourth, validation should compare inferred relations with evidence that is sufficiently independent of the inference process where such evidence is available.

Error structure also matters more than aggregate predictive performance when the downstream object is relational. A small overall error rate can still distort centrality, community boundaries, brokerage positions, or the apparent isolation of a minority group if errors are concentrated systematically. Validation should therefore examine whether false positive and false negative relations vary by position, relation type, subgroup, time, or observation regime.

Computationally inferred relations can become recursive when institutions act on them. A fraud score, recommendation, risk classification, inferred social connection, or predicted affiliation can alter access, monitoring, visibility, or future interaction. Section 5.6 treated this as a performative-representation problem. The evidence file should therefore distinguish the period in which an inference was merely analytical from periods in which it entered the relational system and began to affect the very relations later used for validation.

Proposition 5.118 (Evidential fit for relational claims)**.** *A relational claim is comparatively well warranted when the evidence form is appropriate to the relational property being claimed, the trace-production process and access conditions are documented, characteristic sources of omission or distortion are examined, and materially different evidence forms converge or their disagreements are preserved and explained.*

Proposition 5.118 summarizes the section without requiring every inquiry to collect every evidence type. Some relations are documented densely but difficult to observe behaviorally; others are enacted repeatedly while remaining legally informal; still others become visible mainly through testimony, ethnography, network traces, or computational reconstruction. The appropriate evidential profile depends on the target relation and the strongest inferential gaps that remain.

The resulting stance is one of evidential pluralism under explicit provenance. Documentary, administrative, legal, behavioral, testimonial, ethnographic, network, longitudinal, and computational materials are partially complementary because they expose different manifestations and dimensions of relational reality. Their combination can strengthen reconstruction when differences among them remain visible rather than being collapsed into a single undifferentiated dataset. The next section applies the same discipline to a stronger epistemic target: evidence that a relation, configuration, or field generated a specified effect rather than merely existed or possessed a particular form.

5.16 Evidence for Generative Claims

Section 5.15 classified major evidential forms for establishing that relations exist, possess particular properties, persist, change, or compose into wider configurations. The present section addresses a stronger epistemic target. Its role is to specify what additional evidence is required when GRE claims that a relation, configuration, field, or trajectory contributed to generating a specified effect. Its objective is to differentiate evidence for immediate effects, downstream effects, capacity formation, relation formation, structural transformation, value propagation, recirculation, and generative foreclosure. The structure follows these generative targets in increasing temporal and structural depth. The method is attribution-sensitive: for each target, the analysis asks what change must be evidenced, what temporal and relational linkage must be reconstructed, what alternative explanations remain plausible, and what uncertainty should accompany the resulting claim.

The distinction between relational and generative evidence follows directly from Sections 5.12 and 5.13. Evidence that a relation existed establishes a candidate generative condition. Evidence that an outcome followed establishes temporal succession. A generative claim adds a further requirement: the inquiry must warrant the proposition that the candidate relation or relational configuration contributed to producing, enabling, suppressing, redirecting, or transforming the target effect. Mechanism evidence, counterfactual reasoning, temporal reconstruction, comparison, and heterogeneous traces can contribute to this warrant in different combinations (Woodward 2003; Hedström and Ylikoski 2010; Gangl 2010). The relevant combination depends on the generative object rather than on a universal methodological hierarchy.

Definition 5.119 (Generative evidence)**.** *Generative evidence* is evidence that bears on a specified claim that a relation, relational configuration, field, or historically connected process contributed to producing, enabling, constraining, redirecting, sustaining, or suppressing a target change under stated boundary, scale, and temporal conditions.

Definition 5.119 makes the target effect explicit. A record of collaboration can support a relational claim; evidence that the collaboration produced a new capability requires additional observations concerning capability before and after participation, the process through which learning or access occurred, and plausible competing sources of the change. A transfer can establish resource movement; a claim of recirculation requires evidence that some generated value returned to and altered

the conditions of further generation. A new institutional rule can establish formal change; a claim of structural transformation requires evidence that the rule reorganized recurring relations or possibilities at the relevant scale.

Generative evidence is therefore layered. At minimum, an inquiry normally requires evidence for the candidate relation or configuration, evidence for the target change, and evidence linking the two. Stronger claims can require additional layers: evidence of intermediate carriers, persistence across time, transformation at multiple scales, altered opportunity structures, or feedback into later generative conditions. These layers can be supplied by different source types. Administrative data may establish temporal patterns, testimony may reveal a mechanism, ethnography may identify changed practice, legal materials may establish altered authority, longitudinal network data may show relation formation, and computational models may test whether a specified mechanism is sufficient under explicit assumptions. Evidential pluralism becomes especially important as generative claims extend beyond immediate and directly observable effects.

5.16.1 Evidence of Immediate Effects

Immediate effects are changes that occur within a temporal interval sufficiently close to the candidate generative process for the inquiry to observe the initial response before extensive downstream mediation accumulates. Examples include a change in access following an eligibility decision, altered behavior following a new rule, a resource gain following a transfer, a coordination response following information exchange, or an initial skill improvement following instruction. The relevant meaning of *immediate* is empirical and process-relative. Minutes can be immediate in a market microstructure study, while months can be immediate in institutional or educational change.

Evidence of an immediate effect should normally establish four elements. First, the candidate generative condition must be identified with sufficient temporal resolution. Second, the target outcome must be measured or reconstructed before and after the relevant exposure or event, where the design permits such comparison. Third, the temporal order should place the candidate condition before the observed change. Fourth, plausible contemporaneous causes should be examined to the extent required by the strength of the attribution being made. Experimental, quasi-experimental, counterfactual, and mechanism-based strategies can each contribute to these elements under different research conditions (Woodward 2003; Gangl 2010; Hedström and Ylikoski 2010).

Temporal proximity is useful because it narrows the interval in which competing processes can intervene, yet proximity alone supplies limited causal information. A policy announcement can coincide with a behavioral response because both reflect a third process. A payment can precede increased activity when seasonal demand also rises at the same time. A newly recorded relation can appear shortly before an outcome because the relation itself became observable only after an administrative change. Evidence of immediate effects therefore benefits from combining temporal ordering with a specified mechanism, a credible comparison, intervention variation, or other evidence capable of discriminating among competing explanations.

Proposition 5.120 (Temporal proximity in generative evidence)**.** *Temporal proximity strengthens evidence concerning sequence and the timing of a response. Attribution of generation additionally requires evidence connecting the candidate relation or process to the target change and examining materially plausible contemporaneous alternatives.*

Proposition 5.120 also clarifies why immediate-effect evidence can be strong while remaining narrow. An intervention may have an identifiable first-order effect while its later consequences remain uncertain. Conversely, weak or absent immediate change does not settle whether delayed or mediated effects will emerge. Immediate evidence should therefore specify its temporal horizon and avoid silently extending a short-run result into a claim about a longer generative trajectory.

5.16.2 Evidence of Downstream Effects

Downstream effects occur after one or more mediating stages separate the candidate generative condition from the target outcome. An educational relation can alter competence, which later changes occupational access; an infrastructure investment can alter connectivity, which changes firm location and then local employment; a classification can affect eligibility, which changes resource access and later household behavior. The epistemic burden increases with each mediating stage because additional processes can enter the trajectory.

Evidence for downstream generation therefore requires more than observing a distant association between an earlier relation and a later outcome. The inquiry should reconstruct at least part of the intervening pathway. This can involve records of intermediate states, repeated observations, process-tracing evidence, institutional sequences, participant accounts, network changes, or other traces showing how the effect was carried through time. Mechanism-based explanation is especially useful here because it asks which processes connect earlier and later states rather than treating temporal distance as an unexplained gap (Hedström and Ylikoski 2010).

Definition 5.121 (Downstream evidential chain)**.** A *downstream evidential chain* is a temporally ordered set of evidentially supported intermediate states, relations, carriers, or mechanisms connecting a candidate generative condition to a later target effect.

The chain need not document every micro-event. Its adequacy depends on whether the omitted intervals contain plausible alternative pathways capable of changing the attribution. A long-term effect can be well supported when several independent traces establish the crucial transitions, while a densely recorded sequence can remain weak if its observations all derive from the same unvalidated administrative category or model. The quality of the chain therefore depends on both continuity and evidential independence.

Delayed effects also require attention to stored or latent carriers. Section 5.13 introduced the generative carrier for cases in which an effect is preserved through capabilities, records, infrastructure, expectations, obligations, or other intermediate conditions before becoming manifest. Evidence of downstream generation should identify such carriers where they are central to the explanation. A later outcome that appears after a long interval can then be linked to an earlier generative process through persistent relational or material conditions rather than through temporal

proximity alone.

A further difficulty concerns branching. The same initial condition can generate several pathways, and a downstream target may depend on only one branch. Evidence should therefore preserve branch-specific sequences where possible. Aggregating all later outcomes into a single average can conceal that one subgroup gained access through a generated relation while another encountered a new constraint. The evidential object is the historically realized generative pathway under the stated boundary and scale, together with credible alternatives relevant to the attribution.

5.16.3 Evidence of Capacity Formation

Capacity formation concerns changes in what an actor or collectivity can effectively do, sustain, access, coordinate, understand, create, or become within the relevant relational environment. The capability approach provides an established reason to distinguish resources from substantive opportunities and achieved functionings (Sen 1999). GRE extends this distinction toward an evidential question: what supports the claim that participation in a specified relation contributed to forming or transforming a capacity?

Evidence of capacity formation should identify a capacity with sufficient operational clarity to distinguish it from the inputs believed to support it. Training hours, funding, tools, credentials, or network membership can be enabling resources, while the target capacity may concern independent performance, coordination ability, access to institutions, problem-solving competence, bargaining ability, or the practical feasibility of undertaking a valued activity. Observing the input therefore provides evidence of exposure. Evidence of formation additionally requires traces of changed ability or changed effective opportunity.

Several evidential strategies can contribute. Repeated performance measures can show changed competence; independent task completion can show that a capability persists beyond the immediate instructional relation; new access to partners or institutions can reveal relational capacity; participant testimony can identify changes in confidence or practical feasibility; administrative or market records can show newly realized activities; and longitudinal observation can establish whether the capability persists, decays, or transfers across contexts. The strongest profile often combines demonstrated ability with evidence about the process through which the capacity was acquired.

Definition 5.122 (Capacity-formation evidence)**.** *Capacity-formation evidence* supports a claim that a specified relation or generative process contributed to a change in effective ability or opportunity by documenting the relevant pre-existing condition, the changed capacity, and a plausible pathway connecting relational participation to that change.

This definition leaves room for capacities that are collective or infrastructural. A research consortium can acquire a capacity for coordinated experimentation that no member possesses independently. A community can develop governance capacity through repeated participation and record keeping. A platform can create technical capacity for exchange while simultaneously concentrating control over access. Capacity evidence should therefore specify the bearer of the capacity and the relational

conditions required for its exercise.

Persistence also matters. A short-lived performance improvement and a durable capacity are different claims. The temporal window should match the intended conclusion. Where capacity depends continuously on a supporting relation, the inquiry should state that dependence rather than representing the capacity as fully internalized by the actor. This is especially important for economic capacities that rely on infrastructure, legal recognition, care, credit, data access, language, reputation, or membership in an institutional field.

5.16.4 Evidence of Relation Formation

Relation formation becomes a generative target when an earlier relation, configuration, or field contributes to creating a later relation. Examples include collaboration that creates later partnerships, membership that produces new professional ties, platform participation that creates buyer-seller relations, institutional recognition that enables contracting, or conflict that reorganizes alliances. Section 5.12 defined relationally generated relations; the present question concerns the evidence required to support that attribution.

The evidential burden has two parts. The inquiry must first establish that the later relation formed or changed in the relevant interval. It must then connect that formation to the prior relation. Longitudinal network data can establish temporal ordering, but the observed sequence can arise through selection: actors who were already likely to form the later relation may also have entered the earlier one. Mechanism evidence can help by showing how participation created information, trust, reputation, compatibility, access, obligation, or shared infrastructure that made the later relation possible or more likely.

Interorganizational research provides an illustrative precedent. Powell, Koput, and Smith-Doerr show how collaboration can operate as a locus of learning and how participation in interorganizational networks can shape later organizational opportunities (Powell et al. 1996). Such findings illustrate the kinds of traces that can support generative relation-formation claims: dated collaboration records, subsequent ties, partner histories, learning processes, reputational changes, and comparison with actors lacking similar prior participation. The specific GRE claim still requires target-relative reconstruction rather than assuming that network participation is generative in every setting.

Evidence is especially strong when the later relation would have been inaccessible, substantially less feasible, or materially different without the earlier generative condition. Formal authorization can provide one such bridge: a credential, legal status, or institutional membership may create eligibility for later relations. Informal processes can also be decisive: repeated interaction can create trust, shared language, recognition, or knowledge of available partners. These mechanisms leave different traces and therefore require different evidence forms.

Relation formation can also be negative. An earlier process can generate exclusionary ties, dependency, or relations of monitoring and control. The evidential standard should remain symmetrical with respect to desirability. Establishing that a relation was generated does not establish that it was beneficial, just, voluntary, or stable. Nor-

mative evaluation enters through separate criteria.

5.16.5 Evidence of Structural Transformation

Structural transformation concerns changes in relatively persistent arrangements that organize multiple subsequent relations. Relevant objects can include institutional rules, recurrent role structures, market architectures, organizational routines, technical standards, infrastructures, category systems, ownership arrangements, or patterned distributions of authority and access. Institutions are an established economic example because rules and constraints can organize interaction over time (North 1990). For GRE, the evidential question is whether a generative process altered such an organizing structure at the scale claimed.

Evidence of structural transformation should therefore extend beyond isolated local outcomes. A new rule can be documented legally, yet structural transformation requires evidence that the rule altered recurring relations or the conditions under which those relations form. A technological standard can be formally adopted, while evidence of structural transformation concerns its effects on compatibility, entry, coordination, or dependence across the relevant system. A reorganization can change an organizational chart while leaving actual authority patterns largely intact. Structural evidence consequently benefits from combining formal change with repeated behavioral, relational, or institutional traces.

Definition 5.123 (Structural-transformation evidence)**.** *Structural-transformation evidence* supports a claim that a generative process altered a persistent organizing condition of multiple relations by documenting the prior structure, the transformed structure, the mechanisms or sequence linking them, and recurring consequences at the boundary and scale specified by the inquiry.

Persistence is relevant because structural claims concern organizing conditions that continue to shape later interaction. The required duration varies by object. A market rule can transform trading immediately, while an educational classification may take years to alter institutional trajectories. Historical institutional research on increasing returns and path dependence shows how earlier arrangements can become progressively consequential when feedback alters the costs or feasibility of alternatives (Pierson 2000). Such work provides one evidential lineage for examining whether a change became structurally reproduced over time.

Structural transformation also requires boundary sensitivity. A change can be structural within one organization and local within an industry; structural within a national legal system and peripheral within a transnational production network. The claim should therefore state the population of relations organized by the transformed condition. Cross-scale claims require bridge evidence showing how the local transformation propagated into wider arrangements, following the scale discipline established in Section 5.8.

A useful evidential profile combines evidence of rule or architecture change, repeated relational consequences, persistence, and altered pathways for actors entering the structure later. This last component matters because a transformed structure often becomes most visible through how it conditions actors who did not participate in producing the original change.

5.16.6 Evidence of Value Propagation

Value propagation concerns the movement, transformation, recognition, or reproduction of a specified form of value across relations or sites. The term requires care because economic, cultural, social, symbolic, ecological, informational, and other forms of value need not share one metric. Throsby's distinction between economic and cultural value provides an established example of multidimensional valuation (Throsby 2001), while Appadurai's analysis of commodities emphasizes that value is organized through socially and politically structured trajectories of exchange (Appadurai 1986). GRE therefore treats value propagation as an evidential problem only after the relevant value form and its indicators have been specified.

Evidence of propagation requires more than repeated appearance of the same nominal quantity. A financial transfer can be traced through accounting records, but a claim that knowledge value propagated through a collaboration may require evidence that information was learned, reused, recombined, or made available to additional actors. Cultural value can persist while monetary price changes; reputational value can propagate through recognition networks without a direct transfer of assets. The evidential object is therefore the continuity or transformation of value-relevant effects across relational steps.

Definition 5.124 (Value-propagation evidence)**.** *Value-propagation evidence* supports a claim that a specified form of value or value-relevant capacity moved, transformed, or became effective across a sequence of relations by identifying the value form, the relational carriers or conversion interfaces, and the traces through which continuity or transformation can be reconstructed.

Conversion creates a major epistemic challenge. If financial support funds education and later competence contributes to scientific collaboration, the sequence contains several heterogeneous objects. Treating the entire sequence as propagation of one conserved quantity would erase the transformations that make the process economically and socially significant. Evidence should instead record where the value form changes, which actors or institutions perform the conversion, what is lost or created in conversion, and which indicators remain comparable across stages.

Propagation also differs from attribution of final benefit. Value can pass through an actor without remaining there; it can be amplified, diluted, redirected, captured, or transformed. A platform can propagate information while capturing monetary value; a community can generate cultural value that later acquires commercial value elsewhere; a public infrastructure can create access whose benefits disperse across many actors. The evidential design should preserve these directional and distributive differences rather than compressing them into one aggregate outcome.

This subsection remains epistemic rather than a completed theory of value. Its purpose is to state what evidence would be needed when later GRE chapters make substantive claims about heterogeneous value propagation. Those claims will require value-specific operationalization and cannot be inferred solely from the existence of a relational chain.

5.16.7 Evidence of Recirculation

Recirculation concerns a more specific temporal structure than propagation. Something generated through a relational process returns, directly or through mediated pathways, to replenish, maintain, repair, expand, or transform the conditions from which further generation can occur. The generative-justice literature provides an important precedent through its emphasis on unalienated circular value flows and the return of value toward the people and communities involved in its generation (Eglash 2016; Eglash et al. 2024). GRE uses this lineage while keeping its broader categories of heterogeneous value, capacity, relation, and generative condition analytically distinct.

Evidence of recirculation should identify at least four components: the generative configuration or condition from which the relevant value or capacity emerged; the generated object or benefit being traced; the pathway through which some portion returns; and evidence that the return affects the later generative condition. Repeated transfer alone establishes circulation. Recirculation, in the GRE sense used here, requires a return relation whose effects can be connected to renewed or transformed generative capacity.

Definition 5.125 (Recirculation evidence)**.** *Recirculation evidence* supports a claim that a generated resource, value form, capacity, or other consequential object returned through a specified relational pathway and contributed to maintaining, replenishing, repairing, expanding, or transforming the conditions of subsequent generation.

This definition allows recirculation to be partial and mediated. Revenue can return through taxation to public infrastructure; knowledge generated in research can return through teaching to a community of practice; cooperative surplus can finance shared equipment; reputational gains can attract new partners whose participation expands later capacity. In each case, the returning object may change form before it affects the generative condition. Evidence should preserve the conversion pathway rather than requiring literal return of an identical object.

The temporal horizon can be long. A generated surplus invested in training may affect productive capacity years later. Recirculation evidence therefore often combines accounting or transfer records with longitudinal evidence of changed capacity, infrastructure, membership, or relation formation. Where several cycles occur, the inquiry should distinguish a single return episode from a self-reinforcing recurrent process. A durable cycle claim requires evidence that the return repeatedly alters subsequent generation and that the cycle persists across more than one iteration.

Recirculation also has distributional structure. Value can return to one component of a generative system while leaving other contributors uncompensated or depleted. Evidence of recirculation therefore does not establish equitable return. The inquiry should identify which actors, infrastructures, ecosystems, or relations receive the return and which generative conditions remain unreplenished. This distinction will later matter for substantive analysis of extraction, capture, regeneration, and justice.

5.16.8 Evidence of Generative Foreclosure

Generative foreclosure occurs when a prior relation or generative process contributes to narrowing, disabling, making prohibitively costly, or otherwise suppressing future capacities, relations, trajectories, or transformation possibilities. The target is therefore an altered possibility structure rather than merely an unfavorable realized outcome. Evidence of foreclosure is demanding because unchosen possibilities leave weaker traces than realized events.

The first requirement is a historically credible account of the alternatives that were feasible before the relevant generative process. These alternatives should be grounded in contemporary resources, technologies, institutional rules, available partners, legal permissions, knowledge, or demonstrated practices. Section 5.14 established the same constraint for historical counterfactuals: later possibilities should not be projected backward into periods in which their enabling conditions were absent.

The second requirement is evidence of a mechanism through which the candidate process narrowed the option set. Increasing returns and lock-in provide one established family of mechanisms. Arthur shows how early contingent adoption under increasing returns can alter the later viability of competing technologies (Arthur 1989), while Pierson extends sequence-sensitive increasing-return reasoning to institutional development (Pierson 2000). GRE treats these as specific mechanisms rather than a complete theory of foreclosure. Other mechanisms can include legal exclusion, resource depletion, reputational penalties, loss of interoperability, concentrated ownership, dependency, destruction of infrastructure, accumulated switching costs, or suppression of alternative relation formation.

Definition 5.126 (Generative-foreclosure evidence)**.** *Generative-foreclosure evidence* supports a claim that a specified relation or generative process contributed to reducing a historically feasible set of future capacities, relations, trajectories, or transformation pathways by documenting the prior possibilities, the mechanism of narrowing, and the subsequent reduction in effective feasibility at the stated boundary, scale, and temporal horizon.

The third requirement is evidence that the narrowing affected effective feasibility. A formally available alternative can become practically inaccessible because costs, skills, infrastructure, recognition, financing, or partner availability have changed. Sen's distinction between resources and substantive opportunities is again useful here because nominal permission can coexist with severely reduced practical capability (Sen 1999). Evidence of foreclosure can therefore include rising switching costs, disappeared suppliers, loss of skills, withdrawn legal recognition, infrastructure incompatibility, shrinking partner sets, increased dependency, or repeated failure of alternatives that were previously feasible.

Reversibility should also be assessed. Some foreclosure is temporary and can be reversed through modest intervention; other forms become increasingly costly to undo as complementary investments, expectations, and institutions accumulate. The strength of the foreclosure claim should reflect this degree of persistence. A reversible local constraint and a historically entrenched reduction in system-level possibility are different generative objects.

Foreclosure remains analytically distinct from normative condemnation. Safety rules can intentionally eliminate hazardous options, environmental restrictions can close destructive extraction pathways, and compatibility standards can reduce certain forms of variation while enabling wider coordination. Evidence can establish which possibilities were narrowed, through what mechanism, for whom, and with what reversibility. Normative assessment requires additional criteria concerning the values, rights, harms, benefits, and distributional consequences involved.

Proposition 5.127 (Minimum evidential burden for generative claims)**.** *A generative claim is comparatively well warranted when the inquiry identifies the candidate generative relation or configuration, specifies and evidences the target change, reconstructs a plausible mechanism or dependency connecting candidate and target, examines materially relevant alternatives, and states the boundary, scale, temporal horizon, and uncertainty under which the attribution is made. Claims involving downstream mediation, structural transformation, recirculation, or foreclosure require additional evidence for the intermediate carriers, recurrent effects, return pathways, or altered possibility structures that define those generative objects.*

Proposition 5.127 summarizes the evidential difference between relation and generation. The burden does not demand one privileged research design. Immediate effects may sometimes be identified through intervention or quasi-experimental variation; downstream processes may require longitudinal reconstruction and mechanism evidence; capacity formation can require demonstrated ability and situated interpretation; relation formation can require temporal network and institutional evidence; structural transformation can require persistent cross-relational effects; value propagation and recirculation require traceable carriers and conversion pathways; foreclosure requires evidence about historically feasible alternatives and their later loss of effective accessibility.

The section therefore establishes a graded evidential architecture for GRE. Stronger claims require evidence that reaches farther into temporal sequence, mediation, structure, and possibility. Evidential pluralism remains compatible with demanding attribution because each evidence form is assigned a specific role in the generative reconstruction. The next section turns from the kinds of evidence that can support relational and generative claims to the uncertainty that remains after such evidence has been assembled, including uncertainty about relations, manifestations, generative effects, boundaries, scales, time, models, and competing explanations.

5.17 Uncertainty and Degrees of Epistemic Confidence

Sections 5.15 and 5.16 specified evidential forms for relational and generative claims. The present section addresses the epistemic remainder that persists after relevant evidence has been assembled. Its role is to organize uncertainty within GRE so that uncertainty is reported at the level where it arises rather than being compressed into a single undifferentiated judgment. Its objective is to distinguish relational, manifestational, generative, boundary, scale, temporal, and model uncertainty, and to specify how competing relational explanations affect degrees of epistemic confidence. The structure follows these sources of uncertainty from the target relation through the

observational and representational process to the explanatory model. The method is claim-relative and profile-based: confidence is assessed with respect to a specified proposition, boundary, scale, temporal horizon, evidence base, and inferential route.

Uncertainty enters relational inquiry through several routes. The relation itself can be incompletely identified; manifestations can underrepresent or distort it; generative contribution can remain only partially attributed; analytical boundaries can be contestable; scale changes can alter the pattern observed; temporal coverage can be insufficient; and alternative models can organize the same traces differently. Partial identification provides one useful precedent for disciplined restraint: Manski argues that researchers should distinguish what data identify from what follows only after stronger assumptions are imposed (Manski 2008). The broader philosophical problem of underdetermination similarly concerns cases in which available evidence remains compatible with more than one theoretical or explanatory account (Stanford 2023). GRE incorporates these concerns without reducing all uncertainty to statistical sampling error or to a single philosophical problem.

Definition 5.128 (Epistemic uncertainty in GRE)**.** *Epistemic uncertainty in GRE* is the residual openness concerning a specified relational or generative claim that remains after available evidence, assumptions, boundary and scale choices, temporal coverage, representational decisions, and competing explanations have been stated.

Definition 5.128 makes uncertainty conditional on an articulated inquiry. The same body of evidence can warrant high confidence in one proposition and limited confidence in another. Repeated administrative records can strongly support the persistence of a recorded eligibility status while providing weaker support for the lived relation between an institution and a household. Longitudinal network data can establish repeated interaction while leaving the meaning, authority, or generative significance of those ties uncertain. A credible quasi-experimental design can support a local causal effect while leaving the long-run trajectory, cross-scale consequences, or mechanism comparatively open.

For this reason, GRE treats epistemic confidence as a profile rather than presuming that every claim can be summarized by one scalar quantity. Quantified probabilities, confidence intervals, posterior distributions, sensitivity ranges, or partial-identification regions can be appropriate when the inferential design supports them. Other uncertainties are better expressed through bounded alternatives, competing reconstructions, graded qualitative judgments, or explicit statements of unresolved assumptions. Numerical expression gains epistemic force only when the quantity being represented and the assumptions generating it are themselves adequately specified.

Definition 5.129 (Epistemic confidence profile)**.** An *epistemic confidence profile* is a structured statement of the degree and location of warrant for a specified claim across the dimensions materially relevant to that claim, including where appropriate relational identification, manifestation, generative attribution, boundary, scale, temporal coverage, model dependence, and competing explanations.

The profile in Definition 5.129 prevents strength in one evidential dimension from silently compensating for weakness in another. A large dataset cannot by its size alone settle whether the recorded variable adequately manifests the target relation.

Rich qualitative material cannot by local depth alone establish prevalence across a wider population. Agreement among several models can strengthen confidence when the models rely on meaningfully different assumptions; agreement among near-identical specifications can provide less independent support. Confidence therefore concerns the architecture of warrant rather than the quantity of evidence in the abstract.

5.17.1 Relational Uncertainty

Relational uncertainty concerns what relation exists, between which relata, with what properties, and with what degree of persistence or efficacy. It begins at the level of the target itself. Two actors may exchange messages, share an administrative category, enter repeated transactions, or appear adjacent in network data while the substantive relation remains uncertain. The inquiry may know that some interaction occurred yet remain uncertain whether the relation is cooperative, hierarchical, contractual, fiduciary, coercive, symbolic, informational, or composed of several of these dimensions.

Relational uncertainty can arise from incomplete access, ambiguous traces, changing participant identities, heterogeneous interpretations, hidden intermediaries, or insufficient evidence about the persistence criteria discussed in Section 5.9. It can also arise when the relation is real but only partially stabilized. An emerging collaboration, contested legal status, unstable alliance, or newly forming market relation can possess causal efficacy before its properties become settled enough for a simple classification.

The epistemic task is therefore to disaggregate the relational claim. Confidence that interaction occurred can exceed confidence concerning its content. Confidence concerning legal obligation can exceed confidence concerning actual compliance. Confidence concerning repeated exchange can exceed confidence concerning trust. Confidence concerning organizational membership can exceed confidence concerning effective participation. Reporting these distinctions avoids treating the relation as epistemically all-or-nothing.

Remark 5.130 (Relational confidence and classificatory resolution)*.* Increasing classificatory precision can lower warranted confidence when the available evidence supports a broad relational category more strongly than a fine-grained subtype. GRE therefore permits a well-supported coarse relational claim to coexist with uncertainty about its more specific characterization.

Remark 5.130 is important for historical and comparative work. A surviving archive can support the existence of a dependency relation while leaving its precise informal obligations unclear. Administrative data can establish repeated service contact while providing limited information about interpersonal recognition or coercion. Computationally inferred communities can reveal clusters of interaction while leaving the substantive relation among their members open. Epistemic discipline sometimes requires reducing classificatory resolution rather than increasing it.

Relational uncertainty should also remain distinct from normative ambiguity. An inquiry can be highly confident that a relation is asymmetric while remaining uncertain about whether the asymmetry is justified under the relevant normative criteria.

Conversely, normative concerns can be substantial even when the exact relational structure remains uncertain. Chapter 5 concerns the epistemic architecture of the claim; later normative analysis can build upon that architecture without substituting moral evaluation for evidential warrant.

5.17.2 Manifestational Uncertainty

Manifestational uncertainty concerns the relation between relational reality and the manifestations through which it becomes accessible to inquiry. Section 5.2 established that manifestation is generally non-invertible, while Sections 5.3–5.5 distinguished manifestation relations, traces, symbolization, and representation. Even when the observed trace is measured accurately, uncertainty can remain about what relational state produced it.

A decline in recorded transactions can reflect weakening exchange, migration to an unrecorded channel, strategic concealment, administrative reclassification, or a change in the recording system. A stable legal category can coexist with changing practice. A survey response can reflect experience, strategic presentation, interpretive framing, or the available answer categories. A model-generated score can aggregate traces that correspond only indirectly to the relational target. The uncertainty therefore lies partly in the manifestation mapping rather than in measurement noise alone.

Manifestational uncertainty can be reduced when the inquiry possesses evidence about the production of the trace. Knowledge of administrative procedures clarifies how categories enter a database. Ethnographic observation can reveal how survey terms are interpreted. Technical documentation can show how platform events are logged. Legal analysis can distinguish formal status from implementation. Repeated measurement across different manifestation channels can reveal whether a relational inference is robust to the particular trace used.

Definition 5.131 (Manifestational uncertainty)**.** *Manifestational uncertainty* is uncertainty concerning how observed manifestations, traces, or representations correspond to the relational state or process targeted by an inquiry, including uncertainty about omission, distortion, selective visibility, translation, and changes in the manifestation process itself.

Definition 5.131 implies that data quality and relational correspondence are related but distinct questions. A dataset can be internally consistent and accurately recorded while providing a limited manifestation of the target relation. Conversely, a noisy set of heterogeneous traces can sometimes support a relational conclusion when their independent production pathways converge on the same underlying structure. The relevant question is how the evidence bears on the target through the specific manifestation relation.

Manifestational uncertainty also changes historically. When reporting rules, platform architectures, legal definitions, or cultural conventions change, the same observed category can acquire a different relation to the underlying process. Longitudinal research should therefore assess continuity in the manifestation relation itself. Apparent change in the target relation can otherwise be produced by a changing observational interface.

5.17.3 Generative Uncertainty

Generative uncertainty concerns whether, how, and to what degree a relation or configuration contributed to producing a target change. Sections 5.12, 5.13, and 5.16 established that generative claims are stronger than claims of relational existence. Even when a relation and an outcome are both well evidenced, uncertainty can remain concerning the contribution that connects them.

Several sources are common. The mechanism can be only partially observed. Multiple sufficient or enabling causes can coexist. A candidate relation can matter only in conjunction with complementary conditions. Counterfactual dependence can vary across units or contexts. Effects can be delayed, distributed, or mediated by several stages. A process can redirect the form of change without determining its occurrence. The same relation can generate different consequences under different surrounding configurations.

Generative confidence should therefore specify the object of attribution. Confidence that a program increased access can exceed confidence that the resulting access produced durable capability. Confidence that a classification altered eligibility can exceed confidence concerning its longer-term effect on household trajectories. Confidence that a network position supplied information can exceed confidence that information was decisive for a later innovation. Local causal identification does not automatically settle wider generative significance.

Interventionist and counterfactual approaches provide tools for distinguishing causal contribution under explicit assumptions (Woodward 2003; Gangl 2010), while mechanism-based inquiry can reconstruct the processes connecting earlier and later states (Hedström and Ylikoski 2010). GRE uses these resources selectively. Confidence can increase when distinct forms of evidence support the same generative attribution, especially when they constrain different plausible alternatives.

Proposition 5.132 (Layered confidence in generative claims)**.** *Confidence in a generative claim depends jointly on warrant for the candidate relation or configuration, warrant for the target change, and warrant for the linkage between them. High confidence in either the relation or the outcome cannot by itself compensate for weak evidence concerning the generative linkage.*

Proposition 5.132 also applies to stronger objects such as recirculation and foreclosure. A recirculation claim inherits uncertainty about the initial generation, the conversion or transfer pathway, the return path, and the effect of the returned value on later generative conditions. A foreclosure claim inherits uncertainty about prior feasible alternatives, the mechanism of narrowing, and the persistence of reduced effective accessibility. Generative uncertainty often accumulates across a chain, although independent evidence at later stages can sometimes narrow parts of that uncertainty.

5.17.4 Boundary Uncertainty

Boundary uncertainty concerns which actors, relations, institutions, environments, and processes should be included in the analytical object. Section 5.8 showed that analytical boundaries can be epistemic constructions while some boundaries are simul-

taneously relationally real and causally efficacious. Uncertainty arises when several plausible boundary specifications produce materially different interpretations of the same process.

Consider a firm-level productivity analysis. A narrow boundary can attribute performance to internal organization. A wider boundary can reveal dependence on suppliers, public infrastructure, family care, ecological inputs, regulatory systems, or knowledge produced elsewhere. Neither boundary becomes adequate simply by being wider. Expanding the boundary can introduce processes irrelevant to the target and reduce analytical tractability. The relevant question is which boundary captures the relations materially necessary for the claim being evaluated.

Boundary uncertainty can be explored through sensitivity analysis. The inquiry can reconstruct the claim under nested or alternative boundary specifications and identify which conclusions remain stable. If an attribution survives reasonable boundary changes, confidence in its portability increases. If the conclusion changes sharply when one neighboring relation is included, the analysis should report that dependency rather than hide it inside a preferred specification.

Definition 5.133 (Boundary-sensitive confidence)**.** *Boundary-sensitive confidence* is confidence in a relational or generative claim stated together with the range of plausible analytical boundaries across which the claim remains adequately warranted and the boundary changes under which its interpretation materially changes.

Boundary uncertainty can also be asymmetric. Excluded relations may matter more for some actors than for others. A household boundary that omits informal care can distort the position of caregivers more strongly than that of other members. A national boundary can obscure transnational production or financial relations for sectors whose operation depends heavily on them. Boundary sensitivity should therefore be evaluated with attention to heterogeneous positional effects rather than only to aggregate model fit.

The objective is conditional closure rather than exhaustive inclusion. An inquiry can legitimately delimit an object when the boundary is explicit, relevant external relations are examined, and the claim remains scoped to the resulting domain. Epistemic confidence weakens when a bounded result is silently generalized beyond the relations that made it possible.

5.17.5 Scale Uncertainty

Scale uncertainty concerns the level or resolution at which a relational pattern should be described and the extent to which a conclusion survives movement across scales. Section 5.8 established that relational claims can be scale-indexed. A regularity visible at an aggregate level can coexist with heterogeneous or contrary patterns at local levels, while a locally important relation can disappear when observations are aggregated.

Scale uncertainty therefore differs from boundary uncertainty. Boundary questions concern which elements are included; scale questions concern the level of organization or resolution at which their relations are represented. The two interact, but they can vary independently. The same bounded population can be studied at indi-

vidual, household, organizational, regional, or system level, and each representation can reveal different dependencies.

Confidence across scales requires bridge evidence. If an individual-level relation is used to explain an organizational pattern, the inquiry should specify how individual interactions aggregate, coordinate, or become institutionalized. If an aggregate relation is used to infer individual experience, the inquiry should establish the distributional or positional mechanism that carries the aggregate condition downward. A cross-scale inference gains strength when these bridge processes are directly evidenced rather than assumed.

Proposition 5.134 (Scale-indexed epistemic confidence)**.** *Epistemic confidence attaches first to a claim at the scale for which the evidence and inferential design provide warrant. Extension to another scale requires additional evidence concerning the relations that connect the two scales and the transformations introduced by aggregation or disaggregation.*

Proposition 5.134 protects against two common errors. The first is ecological extension, in which an aggregate pattern is attributed to individual relations without adequate bridge evidence. The second is atomistic extension, in which locally observed mechanisms are presumed to determine system-level outcomes despite coordination effects, institutional mediation, feedback, or compositional change. GRE's multiscale ambition therefore increases rather than reduces the need for scale-specific uncertainty statements.

Scale uncertainty can also be substantive. Some relations become causally efficacious only after sufficient aggregation or institutional stabilization; others are weakened by aggregation because their significance depends on local position or meaning. The appropriate epistemic response is to state which scale the evidence supports and which cross-scale claims remain provisional.

5.17.6 Temporal Uncertainty

Temporal uncertainty concerns when a relation begins, how long it persists, when an effect occurs, which historical interval is relevant, and whether an observed pattern can be transported across time. Sections 5.9 and 5.14 established that relational identity and historical trajectory require explicit continuity criteria. An inquiry can possess strong evidence about a relation at several time points while remaining uncertain about what occurred between them or whether the same generative mechanism persisted throughout the interval.

Temporal uncertainty is especially important when effects operate on different timescales. A policy can have a rapid administrative effect, a slower behavioral effect, and a much later institutional effect. A relational intervention can initially expand access while gradually creating dependency. An innovation can produce immediate efficiency gains while altering capability formation over a longer horizon. Confidence concerning one temporal window should therefore remain indexed to that window.

Historical evidence introduces additional asymmetry. Later periods can generate records that clarify earlier processes, yet later categories can also distort reconstruction when projected backward. Section 5.14 treated historical re-epistemization as

disciplined revision under later evidence. Temporal confidence should preserve both possibilities: later knowledge can strengthen an earlier reconstruction, and changing categories can make direct comparison more difficult.

Definition 5.135 (Temporal confidence horizon)**.** A *temporal confidence horizon* is the interval over which the available evidence and continuity assumptions provide adequate warrant for treating a relational or generative claim as applicable, together with the conditions that limit extension beyond that interval.

The temporal confidence horizon in Definition 5.135 can be short even when the underlying phenomenon is long-lived. Data availability, institutional change, altered measurement rules, or unobserved transitions can restrict the period for which a claim is warranted. Conversely, sparse records can sometimes support a longer continuity claim when independent historical evidence establishes stable mechanisms and persistent relational carriers.

Sequence also matters. Path-dependent processes can make the same intervention produce different outcomes depending on when it enters the trajectory. Pierson's analysis of increasing returns highlights how sequence and timing can shape institutional development (Pierson 2000). Temporal uncertainty therefore concerns more than duration; it also concerns historical ordering and the timing of relational entry into an evolving configuration.

5.17.7 Model Uncertainty

Model uncertainty concerns the dependence of an inference on the representational, statistical, computational, formal, or conceptual model through which evidence is organized. Every model selects variables, relations, functional forms, priors, categories, mechanisms, spatial or temporal resolutions, and criteria of relevance. These selections can materially affect the relational structure that appears in the analysis.

Model uncertainty includes specification uncertainty, parameter uncertainty, structural uncertainty, and uncertainty concerning the relation between the model and the target system. These forms should be distinguished. A model can have tightly estimated parameters while relying on a contested structural specification. Several models can fit observed data similarly while implying different relational mechanisms. A computational simulation can demonstrate that a mechanism is sufficient to produce a pattern under its assumptions while leaving open whether that mechanism generated the empirical case.

Partial-identification reasoning is especially useful when several assumptions remain plausible. Rather than selecting one strong assumption set merely to obtain a point estimate, an inquiry can report the range of conclusions consistent with weaker assumptions (Manski 2008). GRE generalizes the discipline behind this move: where the model does more inferential work than the evidence alone can support, the added assumptions should remain visible in the confidence statement.

Definition 5.136 (Model-dependent warrant)**.** *Model-dependent warrant* is epistemic support for a claim whose strength or content changes materially with the model class, specification, representational assumptions, or inferential constraints used to connect evidence to the target.

Model dependence does not make a claim unusable. It identifies where confidence resides. An inference can be highly robust within a well-justified model class and less secure across alternative classes. Sensitivity analysis, specification comparison, out-of-sample validation, qualitative cross-checking, mechanism evidence, and comparison with independently produced data can each reduce particular forms of model uncertainty. Their value depends on whether they probe genuinely different assumptions.

GRE should also distinguish model uncertainty from ontological uncertainty. Several models can remain empirically compatible because the evidence underdetermines the relational mechanism. This does not require a conclusion that the underlying relational reality itself is indeterminate. The epistemic claim is narrower: the current evidence and models do not yet warrant a unique reconstruction. Ontological suspension therefore remains compatible with strong comparative judgments among models when the evidence supports them.

5.17.8 Competing Relational Explanations

Competing relational explanations arise when two or more reconstructions remain materially compatible with the available manifestations and evidence while differing in the relations, mechanisms, boundaries, scales, or trajectories they posit. This problem appears throughout Chapter 5. The inverse problem of manifestation in Section 5.2 permits several relational realities to generate similar manifestations. Higher-order reconstruction in Section 5.10 can organize the same first-order ties into different structures. Field attribution in Section 5.11 can compete with aggregate or common-cause explanations. Generative attribution in Section 5.13 can remain open among several causal pathways.

The existence of competing explanations should therefore be represented as structured uncertainty rather than treated automatically as epistemic failure. Rival explanations can differ in their empirical commitments. New evidence can discriminate among them by targeting manifestations on which they diverge. A field explanation and a pairwise-network explanation may make different predictions about positional effects. A direct-causation account and a mediated account can imply different temporal sequences. A legal-institutional explanation and an informal-relational explanation can imply different responses to formal rule changes.

Definition 5.137 (Explanatory competition set)**.** An *explanatory competition set* is a stated collection of materially plausible relational or generative explanations that remain compatible with the current evidence at the relevant boundary, scale, and temporal horizon, together with the evidence that favors, weakens, or could discriminate among them.

The competition set in Definition 5.137 is narrower than an unrestricted list of imaginable alternatives. Plausible competitors should possess some evidential or theoretical basis and should address the same target claim. This discipline prevents manufactured uncertainty in which arbitrary possibilities are invoked merely because they cannot be logically excluded. Underdetermination matters when alternatives remain live under the actual evidence and reasonable background assumptions (Stanford 2023).

Competing explanations can also be partially complementary. An institutional rule can alter incentives while a social network shapes information diffusion and a cultural classification affects recognition. Inquiry should test whether the explanations truly compete for the same generative role or describe different parts of a composite process. Premature selection of a single explanation can be as misleading as premature synthesis. The appropriate reconstruction can retain several contributions while differentiating their domains and evidential status.

Proposition 5.138 (Profiled epistemic confidence)**.** *A relational or generative claim is epistemically stronger when confidence is stated at the level of the specific proposition and accompanied by the material uncertainties concerning relational identification, manifestation, generative attribution, boundary, scale, temporal horizon, model dependence, and competing explanations. Strength in one dimension should not silently erase unresolved uncertainty in another.*

Proposition 5.138 provides the organizing principle for degrees of epistemic confidence in GRE. Some inquiries can legitimately summarize particular uncertainties numerically. Others require intervals, sets of admissible explanations, sensitivity statements, or disciplined qualitative judgments. The common requirement is traceability: a reader should be able to identify which evidence supports the claim, which assumptions extend beyond that evidence, which dimensions remain open, and what additional observations could materially change the conclusion.

This profile-based approach also supports revisability. Confidence can increase when new evidence narrows the relation, manifestation mapping, boundary, scale, temporal sequence, or model class. It can decrease when new traces reveal omitted actors, changing classification rules, previously hidden pathways, or stronger competing explanations. Revision therefore becomes an expected epistemic operation rather than an exceptional admission of failure.

The next section turns from uncertainty within relational inquiry to the distribution of epistemic visibility, authority, and evidential capacity among differently positioned actors. Once uncertainty is recognized as structured and position-sensitive, questions arise concerning whose relations become visible, whose testimony receives uptake, whose classifications organize institutional reality, and whose capacities to produce evidence remain constrained. These questions provide the transition to epistemic justice in relational inquiry.

5.18 Epistemic Justice in Relational Inquiry

Section 5.17 treated uncertainty as structured across relational identification, manifestation, generative attribution, boundary, scale, time, and model choice. The present section adds a normative-epistemic dimension that becomes visible once those uncertainties are situated within unequal relations of observation, classification, testimony, documentation, and evidential production. Its role is to identify conditions under which the organization of inquiry can advantage some actors' capacities to make relations visible, intelligible, and evidentially consequential while constraining others. Its objective is to connect visibility, voice, classification, exclusion, institutional legibility, evidential capacity, representation, and generative

attribution without converting epistemic justice into a substitute for evidential warrant. The structure follows these sites of asymmetry in turn. The method is relational and process-sensitive: it asks how epistemic positions are produced, how they enter the evidential chain, and how inquiry can preserve contestability, provenance, and differentiated authority.

Fricker's account of testimonial and hermeneutical injustice provides an important philosophical precedent for analyzing credibility deficits and unequal participation in shared interpretive resources (Fricker 2007). GRE extends the problem into a wider architecture of relational inquiry. A participant can be disadvantaged before testimony is evaluated because the relevant relation leaves few institutionally recognized traces, because an administrative classification has already fixed the available categories, because access to data or instruments is concentrated, or because the actor lacks the resources required to convert situated experience into a form that travels within research and policy institutions. Longino's account of socially organized criticism is also relevant because epistemic robustness depends partly on whether criticism can enter a community and receive serious uptake (Longino 1990). These precedents motivate a concern with participation and contestability while leaving the specific GRE architecture open to domain-sensitive development.

Definition 5.139 (Epistemic justice in relational inquiry)**.** *Epistemic justice in relational inquiry* is the just organization of opportunities and capacities to become epistemically visible, contribute relevant testimony and interpretation, contest classifications and representations, produce or access evidence, and receive appropriately calibrated epistemic uptake concerning relations and generative processes in which actors are differently positioned.

Definition 5.139 separates justice from automatic deference. Situated actors can possess privileged access to particular manifestations, meanings, histories, or consequences while remaining uncertain about mechanisms outside their observational position. Institutional researchers can possess broad comparative data while lacking access to informal obligations or concealed dependencies. Technical systems can reveal regularities at scales inaccessible to unaided observation while inheriting the categories, missingness, and objectives embedded in their data-generating process. Epistemic justice therefore concerns the organization of access, authority, contestation, and evidential capacity together with disciplined calibration of what each source can support.

The section also remains narrower than a complete theory of social, political, or economic justice. Later GRE chapters can evaluate distribution, domination, exploitation, recognition, participation, and generative return more fully. Here the normative focus concerns the conditions under which relational knowledge is produced and attributed. A procedurally inclusive inquiry can still reach an empirically weak conclusion, and a well-identified empirical regularity can still emerge from an epistemically unjust process. GRE therefore keeps epistemic justice and evidential adequacy analytically distinct while examining the ways each can affect the other.

5.18.1 Visibility and Invisibility

Visibility is an epistemic condition through which a relation, actor, effect, or trace becomes available for observation, recording, comparison, or interpretation. Section 5.7 established that observational access is distributed unevenly across positions. Epistemic justice adds the question of how that distribution is organized and whose relations repeatedly enter the shared evidential field.

Institutional systems often privilege relations that generate standardized traces. Formal employment, registered ownership, taxable transactions, licensed activities, documented service use, and digitally mediated interaction can become comparatively visible because the relevant institutions already produce records. Informal care, tacit coordination, uncompensated maintenance, undocumented exchange, reputational dependence, ecological contribution, and many forms of exclusion can remain less visible because their traces are dispersed, privately held, weakly standardized, or absent from the categories through which administrative systems collect information. The resulting asymmetry can shape which relations appear empirically substantial and which appear marginal.

Visibility nevertheless requires a qualified normative treatment. Greater visibility can improve recognition, accountability, and evidential access, while intensified observation can also produce surveillance, exposure, strategic vulnerability, or new forms of classification. Strategic concealment in Section 5.7 already showed that opacity can be relationally produced. In some settings, limited visibility protects actors whose safety, autonomy, or bargaining position would be weakened by compulsory disclosure. Epistemic justice therefore concerns appropriate visibility relative to purpose, risk, consent, and relational position rather than maximal observability.

Claim 5.140 (Justice-sensitive visibility)**.** *A justice-sensitive account of epistemic visibility evaluates both access to relevant traces and the consequences of making those traces visible, including which actors gain interpretive or operational power from disclosure and which actors bear the resulting risks.*

Claim 5.140 matters for research design because the same data practice can increase knowledge while redistributing relational power. A survey that reveals hidden labor can support recognition and policy analysis; publication of highly granular records can expose vulnerable participants. A transparency requirement can make institutional decision rules contestable; disclosure of individual-level attributes can create new opportunities for profiling. The justice of visibility therefore belongs to the design of observation itself rather than appearing only after data have been collected.

In practical terms, GRE inquiry should record what is visible, through which infrastructure, to whom, and with what consequences. It should also identify relevant domains of invisibility and distinguish among absence of a relation, absence of a trace, lack of institutional recognition, and deliberate protection from observation. Such distinctions reduce the risk that institutional visibility becomes an implicit measure of relational importance.

5.18.2 Voice and Representational Authority

Voice concerns the capacity to contribute descriptions, interpretations, reasons, experiences, and contestations to the epistemic process. Representational authority concerns the degree to which those contributions can shape the categories and accounts through which a relation is understood. These are related but distinct. An actor may be invited to speak while the interpretive frame remains fixed elsewhere; another actor may possess formal authority to define a category despite limited situated access to the relation being classified.

Fricker's analysis of testimonial injustice is directly relevant where credibility is systematically discounted because of identity-mediated prejudice or other power-laden credibility practices (Fricker 2007). Within GRE, credibility assessment also interacts with relational position. A worker can have strong situated access to day-to-day authority relations while management possesses records of formal reporting lines. A patient can describe experienced dependence within a care relation while an institution possesses standardized clinical or administrative records. A platform user can observe recurrent consequences of ranking or moderation while the platform possesses aggregate behavioral data and internal system logs. These sources carry different epistemic strengths, and justice requires that the asymmetry among them be made explicit rather than resolved through institutional status alone.

Situated authority should remain bounded by the target of the claim. First-person or participant testimony can be especially strong regarding experienced treatment, local meaning, tacit practice, and consequences that remain weakly recorded. It does not automatically settle population prevalence, hidden mechanisms, or effects outside the participant's observational horizon. Institutional evidence can support broader comparison while remaining weak on lived interpretation or informal practice. Epistemic justice therefore supports differentiated authority: sources receive weight in relation to the forms of access they possess and the inferential distance between that access and the claim under consideration.

Definition 5.141 (Representational authority)**.** *Representational authority* is the institutionally or socially effective capacity of an actor, group, procedure, or system to shape how a relation or generative process is described, categorized, interpreted, and circulated within an epistemic domain.

Definition 5.141 directs attention beyond who speaks toward whose description becomes operational. A participant account can be heard and archived while a legal, administrative, statistical, or computational representation remains the version that allocates benefits, triggers investigation, determines eligibility, or structures later research. Section 5.6 showed that representations can become performative once they enter subsequent relational processes. Representational authority therefore has epistemic and generative consequences.

A justice-sensitive inquiry should preserve attribution and provenance so that different voices do not disappear into an anonymous synthesis. Where interpretations conflict, the disagreement can itself be evidentially informative. Recording who observed what, from which position, under which incentives and constraints, permits later readers to evaluate the relation between situated access and representational authority rather than treating a merged account as perspective-free.

5.18.3 Classification Power

Classification power concerns the capacity to establish categories that organize observation, comparison, eligibility, intervention, or subsequent interpretation. Sections 5.5 and 5.6 established that representation is selective and can become performative. Epistemic justice asks who participates in constructing those classifications, whose distinctions are preserved, and whose relations become difficult to express once a classificatory system stabilizes.

Statistical and administrative categories are historically produced rather than merely discovered. Desrosières shows how statistical reasoning depends on the construction of equivalences, coding practices, and institutions of comparability (Desrosières 1998). Hacking likewise emphasizes the historical emergence of categories and objects within styles of reasoning and classificatory practices (Hacking 2002). GRE draws a limited implication from these traditions: a classification can be epistemically useful and operationally necessary while still carrying assumptions about which differences matter, which entities can be compared, and which relations fit the available schema.

Classification power becomes justice-relevant when actors affected by a category have little capacity to contest its meaning, correct its application, or introduce distinctions that the schema suppresses. A household can be represented by an income band that is useful for aggregate analysis yet insensitive to unstable obligations or care burdens. A worker can be coded within an occupational category that obscures informal supervisory responsibility. A community can be represented through geographic or demographic units that fail to match the relational networks through which resources circulate. These examples concern mismatch and representational compression; they do not by themselves establish injustice. The normative question arises when the mismatch is consequential, systematically difficult to contest, and distributed through power-laden institutional arrangements.

Claim 5.142 (Classification power and epistemic consequence)**.** *When classifications govern observation, aggregation, or institutional response, power over their construction and revision can affect which relational distinctions acquire evidential visibility and which alternatives remain difficult to formulate within the dominant representational system.*

The claim is compatible with the practical necessity of classification. Research and administration require some reduction of complexity. Justice-sensitive classification therefore emphasizes revision mechanisms, explicit scope, documentation of category construction, preserved residual information where feasible, and channels through which affected or differently situated actors can challenge systematic mismatch. Espeland and Stevens' account of commensuration is relevant here because common metrics can reorganize attention and comparison while carrying political consequences (Espeland and Stevens 1998). The epistemic task is to preserve awareness of what a classification makes comparable and what relational differences it compresses.

5.18.4 Epistemic Exclusion

Epistemic exclusion occurs when actors or forms of knowledge are systematically prevented from entering, influencing, or contesting the processes through which relational claims are formed. Exclusion can operate through institutional membership, language, credentialing, technical access, proprietary data, security restrictions, meeting formats, publication channels, methodological conventions, or credibility practices. Its epistemic significance lies in the loss of observations, interpretations, objections, and alternatives that could materially alter the claim under examination.

This problem can occur without overt prohibition. A consultation may be formally open while requiring technical vocabulary, travel, digital access, unpaid time, or legal familiarity that distributes effective participation unevenly. A dataset can be publicly described while meaningful access requires computational resources or proprietary linkages. A research process can invite testimony while allocating interpretive decisions entirely to professional experts. In such cases, formal inclusion and effective epistemic participation diverge.

Longino's account of critical interaction helps clarify why this matters epistemically as well as normatively. The capacity of a community to expose background assumptions depends on the presence and uptake of criticism from differently positioned participants (Longino 1990). A homogeneous or access-restricted inquiry can therefore appear internally coherent partly because relevant objections never become operational within its critical process.

Definition 5.143 (Epistemic exclusion in relational inquiry)**.** *Epistemic exclusion in relational inquiry* is a patterned restriction on the effective capacity of relevant actors or knowledge-bearing positions to contribute evidence, interpretation, criticism, classification revision, or representational contestation concerning a relational or generative claim.

Definition 5.143 is deliberately process-focused. It does not imply that all viewpoints require equal evidential weight. A contribution can enter the inquiry and subsequently receive limited support because its evidence is weak, its scope is overstated, or stronger alternatives exist. Justice concerns the opportunity for relevant epistemic contribution and fair calibration of uptake; evidential evaluation still applies.

A useful diagnostic is to ask where in the epistemic chain exclusion operates: access to the phenomenon, recording of traces, preservation of records, admission to the dataset, category construction, interpretation, model specification, publication, institutional decision, or later revision. Different locations call for different remedies. Expanding testimony will have limited effect if the classification system cannot encode the relation described; opening a dataset will have limited effect if the relevant traces were never recorded.

5.18.5 Relations without Institutional Legibility

Institutional legibility concerns the extent to which a relation can be represented within the categories, records, procedures, and evidential formats recognized by an institution. Relational reality can exceed that legibility. Informal support networks, undocumented work, tacit obligations, community mediation, reciprocal care, eco-

logical dependence, reputational relations, and emergent coordination can exert substantial causal efficacy while remaining weakly represented in official records.

The epistemic problem is especially important because institutions often possess durable preservation systems. Once a relation enters administrative, legal, or statistical form, it becomes easier to retrieve, compare, cite, and incorporate into later decision making. Relations lacking such representation can leave fragmented traces that are costly to reconstruct. Over time, the archive can therefore make institutionally legible relations appear historically more substantial than relations whose manifestations were less systematically preserved.

Section 5.4 distinguished absence of evidence from evidence of absence, and Section 5.15 treated documentary and administrative materials as produced traces. Epistemic justice adds a distributional question: which actors and relations possess infrastructures that continually produce admissible traces? A relation can be socially important while generating little standardized evidence, particularly when the participants have weak access to documentation systems or when the relation falls outside the institution's operational categories.

Definition 5.144 (Institutional legibility of a relation)**.** The *institutional legibility of a relation* is the degree to which a relation can be recognized, encoded, preserved, retrieved, and acted upon through the categories and evidential procedures of a specified institution.

Institutional legibility is target- and institution-relative. The same care relation may be legible to a household, partially legible to a local organization, and weakly legible to a tax or employment system. A financial dependency can be visible to a lender while remaining obscure to a welfare agency. The same relation can also become differently legible over time as categories, reporting requirements, and data infrastructures change.

Justice-sensitive inquiry should therefore retain space for relations whose evidential form does not match the institution's preferred formats. This can involve qualitative reconstruction, community-held records, participant testimony, archival triangulation, or new measurement designs. Such inclusion still requires provenance and critical evaluation. Its purpose is to reduce the conflation of institutional readability with relational existence.

5.18.6 Unequal Capacity to Produce Evidence

Actors differ substantially in their capacity to produce evidence that travels across institutional settings. Governments, firms, universities, platforms, and large organizations can maintain databases, legal teams, standardized reporting systems, professional communication staff, archives, and computational infrastructure. Individuals, small organizations, informal groups, precarious workers, or dispersed communities may possess rich situated knowledge while lacking comparable means to preserve, aggregate, validate, or circulate it.

This asymmetry can influence the apparent evidential balance. Repeated standardized records often acquire institutional authority because they are searchable, comparable, and auditable. A diffuse set of experiences can remain epistemically weaker

in practice even when it concerns a consequential relation, because the experiences are costly to coordinate and translate into admissible form. The World Bank's treatment of modern data systems illustrates the growing institutional importance of administrative, survey, citizen-generated, and machine-generated data infrastructures (World Bank 2021). GRE emphasizes that access to such infrastructures is itself relationally distributed.

Evidence-production capacity includes more than data collection. It includes the ability to define variables, commission studies, retain experts, set reporting standards, choose temporal windows, maintain archives, control disclosure, and respond quickly when a dispute arises. It also includes the capacity to preserve uncertainty and provenance. An actor with extensive documentation can present a coherent historical record; another actor may rely on memory or fragmented traces partly because preservation resources were unavailable.

Claim 5.145 (Evidence-production asymmetry)**.** *Differences in resources, infrastructure, institutional standing, and access to recognized evidential formats can generate persistent asymmetries in whose relational claims are easiest to document, aggregate, circulate, and defend.*

The epistemic response should avoid compensatory romanticization. Scarce documentation does not make a claim true, just as abundant documentation does not make a representation complete. Justice-sensitive inquiry instead makes production conditions part of evidential assessment. It asks whether one side's documentary abundance reflects greater truth-tracking capacity, greater surveillance and archival capacity, or some combination of both. It also asks whether relevant counter-evidence was difficult to produce because access, preservation, or institutional recognition was unequally distributed.

Research design can partially address these asymmetries through data-access support, participatory documentation, translation, accessible reporting channels, preservation assistance, explicit recording of missingness mechanisms, and resources for independent analysis. The appropriate design depends on risk and context; some settings require strong privacy protections precisely because increased evidence production can expose vulnerable actors.

5.18.7 Justice in Relational Representation

Relational representation selects entities, relation types, directions, weights, boundaries, temporal windows, categories, and levels of aggregation. Section 5.5 treated those choices as epistemic mediation, and Section 5.6 showed that representations can subsequently shape relations. Justice in relational representation concerns how these choices distribute visibility, interpretive authority, contestability, and consequences among actors represented within or affected by the model.

A justice-sensitive representation should begin by making its standpoint and purpose explicit. A network built for fraud detection, a map built for community planning, a legal representation of obligation, and an ethnographic account of dependency can represent overlapping relations while selecting different features. Their differences can be legitimate when the analytical purpose is explicit. Problems arise when a purpose-specific representation travels into a new domain as though it were

a complete account of relational reality.

Representational justice therefore benefits from several practices. First, provenance should remain visible: readers should be able to reconstruct who generated the traces, who selected the categories, and what transformations were applied. Second, consequential category choices should be documented together with plausible alternatives. Third, affected or differently positioned actors should have channels to identify systematic mismatch and propose corrections. Fourth, uncertainty and missingness should remain attached to the representation rather than disappearing during aggregation. Fifth, when multiple representations capture materially different aspects of the same relation, preservation of plurality can be epistemically preferable to premature synthesis.

Proposition 5.146 (Justice-sensitive relational representation)**.** *A relational representation is comparatively more justice-sensitive when its purpose, provenance, categories, exclusions, uncertainty, and consequential uses are explicit; when materially affected or differently positioned actors possess meaningful opportunities for contestation; and when alternative representations with relevant evidential support can remain recoverable for comparison and revision.*

Proposition 5.146 does not establish the representation's empirical adequacy by itself. Contestable and well-documented models can still be wrong. The proposition concerns the epistemic conditions under which error, mismatch, and power-laden compression can become more visible and revisable. This aligns with the chapter's broader commitment to explicit mediation and revision rather than an ideal of perspective-free representation.

Young's critique of reducing justice to distribution is relevant to this process-centered orientation because participation, decision structures, domination, and cultural representation can themselves be justice-relevant (Young 1990). GRE does not import Young's framework wholesale. The narrower implication is that the justice of knowledge production cannot be assessed solely by distributing informational goods after representational structures have already been fixed.

5.18.8 Justice in Generative Attribution

Generative attribution assigns contribution to the relations, actors, infrastructures, institutions, environments, and prior processes that help produce capacities, structures, values, constraints, or later possibilities. Sections 5.12, 5.13, and 5.16 developed the epistemic burdens attached to such claims. Epistemic justice adds a further concern: contribution can be systematically misrecognized when some generative inputs are highly visible and others remain diffuse, backgrounded, informally organized, or weakly documented.

A familiar pattern is concentration of attribution at the most visible point of outcome realization. A product can be attributed primarily to the organization that markets it while prior public infrastructure, care work, maintenance, ecological conditions, upstream knowledge, standards, training, and collaborative networks remain less visible. An institutional success can be attributed to formal leadership while informal coordination and repair remain weakly documented. A research output can foreground named authors while technical, administrative, community, or data-

generating contributions are represented only partially. These examples differ substantively, yet they share an epistemic structure in which outcome visibility exceeds visibility of distributed generative conditions.

Justice-sensitive generative attribution therefore requires the contribution profile introduced in Section 5.13 to remain open to distributed and enabling contributions. It should distinguish direct production, enabling infrastructure, maintenance, reproduction of capacity, coordination, constraint removal, preservation, and downstream recirculation where these are evidenced. It should also preserve uncertainty where contribution cannot be disaggregated reliably. A broad attributional map can be more honest than a precise but unsupported allocation of shares.

Definition 5.147 (Justice-sensitive generative attribution)**.** *Justice-sensitive generative attribution* is the practice of attributing generative contribution in a manner that actively examines visibility asymmetries, evidential-capacity differences, classification effects, and background conditions that can systematically obscure or overstate particular contributors, while retaining the causal and evidential standards required for the underlying generative claim.

Definition 5.147 is intentionally epistemic before it becomes distributive. Establishing a contribution does not by itself determine compensation, ownership, recognition, liability, or return. Those normative questions require additional principles developed later in the book. The present requirement is that downstream evaluation begins from a contribution map whose omissions and asymmetries have been critically examined.

The same principle applies to blame and harmful generation. Highly visible actors can receive disproportionate causal attribution while background institutions, inherited structures, enabling infrastructures, or distributed incentives receive too little attention. Conversely, structural explanation can become so diffuse that identifiable agency disappears. Justice-sensitive attribution therefore preserves several levels simultaneously: actor contribution, relational configuration, enabling conditions, historical trajectory, and field-level structure where the evidence supports them. This layered account resists both individualized simplification and structure-only abstraction.

Proposition 5.148 (Epistemic-justice constraint on generative attribution)**.** *Where generative contributions are unevenly visible or unequally documentable, warranted attribution should examine whether evidential asymmetries systematically track power, institutional legibility, or access to preservation and representation; conclusions should preserve relevant distributed contributions and uncertainty before later normative claims about recognition, responsibility, return, or remedy are introduced.*

The epistemic-justice perspective developed in this section therefore modifies neither the requirement for evidence nor the chapter's commitment to uncertainty. It changes the questions asked about how evidence becomes available and authoritative. GRE inquiry should ask whose relations are visible, who can define categories, whose testimony receives uptake, which relations fit institutional formats, who can produce durable evidence, how representations remain contestable, and whose generative contributions are liable to disappear from the record. These questions strengthen relational inquiry by exposing systematic conditions under which evi-

dential fields themselves can be asymmetrically organized.

The next section turns to machine-mediated relational knowledge. Machine observation, algorithmic classification, computational inference, and AI-assisted reconstruction intensify many of the epistemic issues identified here because they can expand observational reach while concentrating classificatory and representational capacity in systems that operate at scales difficult for observed actors to inspect or contest. The transition therefore moves from epistemic justice in relational inquiry to the specific architecture of machine-mediated observation, inference, and representational power.

5.19 Machine-Mediated Relational Knowledge

Section 5.18 examined epistemic justice in relational inquiry by asking how visibility, voice, classification, evidential capacity, representation, and attribution are distributed among differently positioned actors. The present section narrows that problem to machine-mediated knowledge. Its role is to specify how computational systems enter the epistemic chain between relational reality, traces, representation, inference, and subsequent action. Its objective is to distinguish machine observation, algorithmic classification, computational inference, machine-generated representation, and AI-assisted reconstruction while identifying the epistemic asymmetries and contestability requirements that arise when these operations are concentrated in technical systems. The section proceeds from observation to classification and inference, then to representation and reconstruction, before examining asymmetry, representational power, and contestability. The method remains epistemically plural: computational output is treated as one mediated source of evidence whose warrant depends on provenance, target specification, model assumptions, boundary and scale, and the relation between machine-produced representations and other forms of evidence.

Machine mediation expands the range, speed, and granularity at which relational traces can be collected and organized. Administrative databases can connect records across institutions; platform logs can record interaction sequences at scales inaccessible to unaided observation; computer vision and remote sensing can generate repeated observations of physical or ecological environments; language models can summarize, classify, and recombine large documentary corpora; and network or statistical models can infer candidate relations that are only partially represented in the raw record. These capacities can materially improve inquiry. They also create additional layers at which categories, missingness, optimization objectives, architecture, training data, access privileges, and institutional purposes can shape what becomes visible as relational knowledge.

The distinction between machine mediation and machine authority is therefore fundamental. A computational system can assist observation or reconstruction without receiving final authority over the relational claim. Conversely, a machine-produced classification can become operationally authoritative even when its epistemic basis remains uncertain, especially when institutions embed it in eligibility, ranking, allocation, monitoring, or enforcement. Section 5.6 developed this

possibility through performative representation. Machine-mediated epistemology must therefore evaluate both whether a system tracks a target relation adequately and how its outputs enter subsequent relations.

Definition 5.149 (Machine-mediated relational knowledge)**.** *Machine-mediated relational knowledge* is relational knowledge whose evidential access, classification, inference, representation, reconstruction, or circulation depends materially on computational systems, such that the system's data-generating conditions, categories, transformations, model assumptions, and operational uses become part of the epistemic conditions of the claim.

Definition 5.149 is deliberately broader than machine learning. A rule-based administrative system, a database query, a sensor network, a statistical model, a graph algorithm, and a generative model can all mediate relational knowledge in different ways. The relevant question is not whether a system is called "AI," but where computational operations enter the evidential chain and how those operations affect what can be warranted.

5.19.1 Machine Observation

Machine observation concerns computationally mediated acquisition of traces that bear on a relational target. The term includes automated sensors, transaction logs, administrative data pipelines, digital interaction records, remote sensing, platform telemetry, and other systems in which observation is produced through technical infrastructure rather than through unaided human perception alone. The World Bank's account of contemporary data systems, for example, explicitly includes administrative, survey, citizen-generated, and machine-generated data within wider data infrastructures (World Bank 2021). For GRE, the epistemic importance of machine observation lies in the way these infrastructures extend observational reach while also fixing particular units, events, intervals, and recording rules.

Section 5.7 treated observation as position-dependent and partial. Machine observation does not remove that condition. It relocates observer position into an engineered observation regime. A platform can observe clicks, messages, transactions, or mobility traces because its architecture has defined which events are recorded and at what resolution. A sensor can repeatedly measure a physical variable while remaining insensitive to relations that do not manifest through its detection channel. An administrative system can observe registered interactions while missing informal obligations or unreported exchange. Machine observation can therefore be extensive and still relationally selective.

Definition 5.150 (Machine observation regime)**.** A *machine observation regime* is the organized combination of instruments, event definitions, sampling rules, recording intervals, data schemas, access conditions, and preprocessing operations through which computational infrastructure converts selected manifestations into machine-readable traces.

The definition makes several sources of uncertainty explicit. First, event ontology matters: the system determines what counts as an interaction, transaction, encounter, exposure, or response. Second, temporal resolution matters: repeated observations at one interval may obscure dynamics occurring at another. Third, miss-

ingness matters: a system can record only actors, locations, devices, or activities that enter its observational infrastructure. Fourth, preprocessing matters: filtering, deduplication, imputation, aggregation, and identity resolution can alter the trace before analysis begins. Fifth, access matters: the institution controlling the infrastructure may observe a relation at a level of granularity unavailable to the people whose behavior generates the traces.

Machine observation should therefore be documented as a trace-production process. A relational claim based on logs or sensor data should identify what the infrastructure was capable of recording, what it systematically excluded, how identities or events were linked, what transformations occurred before analysis, and how the observational window relates to the target relation. Large volume does not remove the need for this account. A very large set of selectively generated traces can support precise estimates of the wrong relational object.

5.19.2 Algorithmic Classification

Machine observation becomes analytically consequential when traces are assigned to categories. Algorithmic classification maps observed or derived features into labels, scores, clusters, rankings, risk classes, similarity groups, or other operational distinctions. The epistemic issue is continuous with the chapter's earlier treatment of statistical and administrative representation. Desrosières shows historically how statistical categories and comparability depend on conventions of classification and coding (Desrosières 1998), while Hacking emphasizes the historical interaction between classificatory practices and the objects or persons classified (Hacking 2002). Algorithmic systems intensify this problem because classification can occur repeatedly, automatically, and at scale.

A classification is not yet a relation. A label such as "high risk," "similar," "coordinated," "fraudulent," "influential," or "vulnerable" may be used to infer a relational position, but the connection between category and relation requires separate warrant. Two actors placed in the same cluster may share measured features without interacting. A recommendation system may classify users as behaviorally similar while remaining agnostic about whether any socially meaningful relation exists between them. A fraud-detection model may flag transactions as related through a learned pattern while the substantive mechanism remains uncertain.

Algorithmic classification also introduces threshold dependence. A continuous score can become a discrete category through an operational cutoff, and that cutoff can affect which relations appear present or consequential. When categories subsequently control access, review, surveillance, or opportunity, classification becomes performative in the sense developed in Section 5.6. The epistemic and performative questions should remain separate: whether a classification is well supported is one issue; what institutional consequences follow from assigning it is another.

Proposition 5.151 (Classification dependence of machine-mediated relational claims)**.** *Where a relational claim depends materially on algorithmic categories, the warrant for that claim depends partly on the evidential adequacy of the category definition, feature construction, threshold or grouping rule, and portability of the classification to the population, period, and relational target under study.*

Proposition 5.151 does not imply that every classification requires a single uniquely correct category system. Several classifications can be useful for different research purposes. The requirement is that the category's purpose and scope remain explicit and that a purpose-specific classification is not silently treated as a complete description of relational reality.

5.19.3 Computationally Inferred Relations

Computational inference moves beyond recorded traces or predefined categories by estimating relations that are incompletely observed. Link-prediction models, latent-variable models, embedding methods, clustering procedures, probabilistic graphical models, sequence models, and related techniques can identify candidate connections, dependencies, similarities, or relational structures. Section 5.15 already distinguished computationally inferred evidence from directly observed relations. The present subsection clarifies the epistemic status of the inferred relation itself.

Definition 5.152 (Computational relational inference)**.** *Computational relational inference* is the model-mediated estimation of a relation, relational property, or relational configuration from observed traces and specified assumptions when the target relation is not completely recorded in the evidential input.

The inferential distance between data and target can vary considerably. Inferring that two registered accounts exchanged messages may require relatively little modeling when the underlying logs are reliable. Inferring that two actors coordinate strategically, share an obligation, occupy analogous institutional positions, or participate in the same latent community requires additional assumptions about how the observed traces map onto the substantive relation. Section 5.2 described this as an inverse problem of manifestation: multiple relational realities can generate similar observed patterns.

Manski's work on identification is relevant because it separates what data identify from conclusions that become available only after stronger assumptions are added (Manski 2008). GRE applies the same discipline to computational relation inference. Model performance on a prediction task does not by itself establish that the inferred latent object corresponds to the substantive relation named by the researcher. A representation can predict interaction successfully while organizing that interaction through dimensions that differ from the researcher's interpretive vocabulary.

For this reason, computationally inferred relations should carry explicit provenance about training or estimation data, target construction, validation conditions, model class, relevant assumptions, error structure, and sensitivity to alternative specifications. External or qualitative evidence can be especially important when the substantive meaning of an inferred relation exceeds what was directly encoded in the training target. The goal is not to subordinate computational inference to human interpretation, but to prevent predictive success from becoming an unexamined bridge between trace and relation.

5.19.4 Machine-Generated Representations

Computational systems increasingly generate representations rather than only classify existing inputs. They produce summaries, captions, labels, rankings, graph layouts, synthetic descriptions, extracted entities, reconstructed timelines, and natural-language accounts of relational configurations. Generative models can further reorganize large corpora into compact representations that appear coherent and immediately usable. These capabilities increase the speed with which relational material can be explored, but they also increase the distance between the original trace and the representation presented to the investigator.

Section 5.5 treated representation as selective mediation. Machine generation adds a transformation process whose output can contain compression, interpolation, omission, normalization, or unsupported completion. Bender and colleagues' discussion of large language models is relevant because fluent linguistic output does not by itself establish grounded understanding or factual adequacy (Bender et al. 2021). Within GRE, the corresponding point is narrower: linguistic or graphical coherence does not establish that the represented relations are evidentially warranted.

Definition 5.153 (Machine-generated representation)**.** A *machine-generated relational representation* is a computationally produced description, visualization, categorization, summary, or structured encoding of relations whose form is generated through model operations rather than being a direct transcription of the underlying evidential record.

Such representations can be epistemically useful when they reduce search cost, reveal patterns, generate candidate comparisons, or make complex relational structures inspectable. Their use nevertheless requires preservation of the path back to source material. A generated summary of correspondence should permit retrieval of the documents that support each consequential relational claim. A generated network description should remain linked to the records and inference rules through which edges were created. A machine-produced historical narrative should distinguish sourced events from model-generated connective language.

The need for source recoverability grows with generative compression. When hundreds or thousands of traces are compressed into a concise narrative, the representation can become easier to circulate than the evidence that produced it. Repetition then gives the generated representation an appearance of stability even when its evidential basis is mixed. GRE therefore treats machine-generated representations as revisable analytical artifacts whose claims should remain decomposable into traceable evidential units where consequences are substantial.

5.19.5 AI-Assisted Relational Reconstruction

AI-assisted relational reconstruction uses computational systems to help assemble partial traces into a candidate account of relations, trajectories, fields, or generative processes. Relevant tasks include entity resolution across archives, extraction of relation mentions from documents, coding of qualitative materials, identification of temporal sequences, comparison of alternative classifications, detection of anomalous patterns, and generation of candidate hypotheses for human examination. These ap-

plications can expand the feasible scope of relational inquiry while also creating new forms of dependency on model behavior.

The epistemic unit should be the reconstruction workflow rather than the model output in isolation. A robust workflow specifies which tasks are delegated to the system, which outputs are independently checked, how disagreements are handled, how evidence is linked to reconstructed relations, and where human interpretation enters. Longino's account of socially organized criticism is useful here because epistemic robustness depends partly on opportunities for critical interaction and uptake of objections (Longino 1990). AI assistance can widen the space of candidate interpretations, yet it can also narrow that space when one model's categories or summaries become the default entry point to the evidence.

Proposition 5.154 (AI-assisted reconstruction)**.** *AI assistance strengthens relational reconstruction when it expands evidential search, comparison, or pattern detection while preserving source provenance, alternative interpretations, uncertainty, and independent routes of criticism; its epistemic contribution weakens when generated representations become difficult to trace back to the evidence or when model outputs silently replace the inferential steps they were intended to assist.*

The proposition supports a division of epistemic labor rather than a general hierarchy between human and machine judgment. Machines may be superior at repeated comparison across large corpora; situated participants may possess forms of access that the corpus does not record; domain experts may identify institutional distinctions that a general model merges; computational models may reveal regularities that established theory overlooked. GRE therefore evaluates contributions task by task and preserves disagreement as evidence about where reconstruction remains unsettled.

AI assistance also changes the economics of hypothesis generation. When candidate relations and explanations can be generated cheaply, the bottleneck shifts toward validation, source checking, discrimination among alternatives, and preservation of negative results. Abundant candidate explanations should therefore increase, rather than relax, the importance of explicit evidential burden. Machine-assisted inquiry becomes epistemically stronger when it makes comparison easier without making acceptance automatic.

5.19.6 Epistemic Asymmetry between Observer and Observed

Machine-mediated inquiry can create unusually large differences between what an observing institution knows about a relation and what observed actors can know about the observing process. A platform can aggregate behavioral histories across millions of interactions while an individual sees only a local interface. An employer can use computational systems to direct, evaluate, and discipline work at scale, a phenomenon documented in the literature on algorithmic management (Kellogg et al. 2020). A lender, insurer, government agency, or marketplace can combine records from multiple sources while the person classified may not know which variables, historical records, proxies, or model transformations contributed to the result.

Burrell's analysis of machine-learning opacity distinguishes secrecy, technical-literacy barriers, and opacity arising from model characteristics and scale (Burrell

2016). This distinction is useful because epistemic asymmetry can arise for different reasons and therefore require different remedies. Contractual secrecy may require disclosure or independent audit. Technical complexity may require explanation, expertise, or tooling. Scale-related opacity may require sampling, monitoring, or structured documentation rather than an expectation that every individual inspect every model operation.

Definition 5.155 (Machine-mediated epistemic asymmetry)**.** *Machine-mediated epistemic asymmetry* is a relational difference in access to the observations, categories, model operations, aggregate patterns, or revision mechanisms through which computational systems produce consequential knowledge about actors or relations.

This asymmetry has several dimensions. *Observational asymmetry* concerns access to traces. *classificatory asymmetry* concerns knowledge of the categories and thresholds applied. *inferential asymmetry* concerns access to the models and assumptions connecting traces to conclusions. *temporal asymmetry* arises when institutions preserve long histories while observed actors cannot reconstruct the same record. *revision asymmetry* concerns who can correct data, categories, or outputs once an error or mismatch is identified.

Asymmetry is not automatically unjust or epistemically defective. Epidemiological surveillance, fraud detection, infrastructure monitoring, or scientific instrumentation can require specialized access. The relevant question is how asymmetry interacts with consequence, error, vulnerability, and opportunities for challenge. Where outputs materially affect actors' opportunities or standing, the burden for provenance and contestability becomes correspondingly stronger.

5.19.7 AI and the Power to Define Relational Reality

The phrase "define relational reality" requires restraint. Computational systems do not acquire ontological authority merely because they classify at scale. The stronger and more defensible claim is that institutions can grant machine-produced representations *operational authority*: the categories, scores, clusters, or inferred relations become inputs to decisions that reorganize subsequent interaction. Section 5.6 showed how representation can become performative, while Section 5.18 showed that classification and representational authority can be distributed unequally.

Historical work on classification and statistical reasoning helps clarify the structure. Desrosières demonstrates that categories and measures are institutionally produced rather than transparent windows onto a preformatted social world (Desrosières 1998). Hacking likewise examines how classificatory practices can participate in the historical constitution of objects of knowledge (Hacking 2002). Machine systems can accelerate and routinize this process because classification is embedded directly in operational infrastructures.

A recommendation system can alter which social or commercial relations become likely to form. A ranking system can change organizational attention. An automated risk score can redirect scrutiny. Algorithmic management can restructure the temporal and informational relation between workers and supervisors (Kellogg et al. 2020). In such cases, the machine-produced representation participates in the generation of the relational reality later observed. The epistemic danger is recursive confirmation:

a classification changes behavior or opportunity, and the resulting trace is then interpreted as further evidence that the original classification captured an underlying stable relation.

Proposition 5.156 (Operational authority of machine representation)**.** *When a machine-produced representation is embedded in consequential allocation, ranking, monitoring, recommendation, or enforcement, its epistemic role cannot be assessed solely by predictive performance; inquiry should also examine how the representation changes the relations that later generate evidence about its apparent validity.*

This proposition does not imply that performative effects invalidate a model. Some systems are intentionally designed to alter outcomes, as in early-warning or safety systems. The requirement is temporal and relational clarity. Researchers should distinguish evidence collected before deployment, effects produced through deployment, adaptation by affected actors, and later data generated within the altered environment. Otherwise, the system can appear to discover a relation that it has partly stabilized or produced.

5.19.8 Contestability of Machine-Mediated Knowledge

Contestability concerns the practical capacity to question, inspect, test, correct, or replace a machine-mediated relational claim. It extends beyond explanation in the narrow sense. A system can provide an intelligible local explanation while leaving the underlying data, category, target definition, institutional purpose, or appeal process fixed. Conversely, complete publication of source code may provide little meaningful contestability to an affected actor if the relevant training data, operational thresholds, or institutional consequences remain inaccessible.

Kroll and colleagues argue that consequential automated systems require accountability mechanisms capable of verifying compliance with relevant standards rather than relying on ordinary assumptions developed for human decision makers (Kroll et al. 2017). Dataset documentation offers a complementary infrastructure: Gebru and colleagues propose recording dataset motivation, composition, collection processes, and recommended uses so that downstream users can evaluate provenance and limitations (Gebru et al. 2021). GRE draws a broader epistemic lesson from these approaches. Contestability should be attached to the whole relational-knowledge pipeline rather than to the final model output alone.

Definition 5.157 (Contestability of machine-mediated relational knowledge)**.** The *contestability of machine-mediated relational knowledge* is the degree to which relevant actors can identify the target claim, recover its evidential and computational provenance, understand the consequential categories and assumptions at an appropriate level, introduce counter-evidence or alternative interpretations, obtain review of material error or mismatch, and preserve the result of that challenge for subsequent revision.

Contestability is therefore layered. *Data contestability* concerns whether records can be inspected and corrected where appropriate. *category contestability* concerns whether the relation between operational labels and substantive concepts can be challenged. *model contestability* concerns assumptions, validation, uncertainty, and sensitivity to alternatives. *decision contestability* concerns how outputs enter conse-

quential action. *historical contestability* concerns whether earlier versions, disputes, and corrections remain preserved so that later re-epistemization is possible.

Proposition 5.158 (Contestability architecture)**.** *For consequential machine-mediated relational claims, a minimally adequate contestability architecture should preserve enough provenance to reconstruct how the claim was produced, specify the target and relevant categories, expose material uncertainty and known limitations, provide a route for qualified counter-evidence or review, and record substantive corrections or unresolved disputes for future revision.*

Proposition 5.158 is intentionally compatible with differentiated access. Privacy, security, trade secrecy, or protection of vulnerable actors can limit complete disclosure. Contestability can therefore involve trusted independent review, secure audit, controlled data access, or representative challenge rather than universal publication of every technical artifact. The epistemic standard concerns the existence of credible routes through which consequential claims can be tested and revised.

Machine-mediated relational knowledge thus intensifies themes developed throughout Chapter 5 without replacing them. Observation remains partial; classification remains historically and institutionally situated; inferred relations remain model-dependent; representations remain mediated; generative attribution remains burdened by mechanism and alternatives; and epistemic justice remains concerned with unequal capacities for visibility, voice, evidence, and correction. Computational systems can expand the reach of inquiry while simultaneously concentrating the infrastructure through which relational reality becomes visible and actionable. GRE therefore treats machine mediation as an epistemic architecture requiring explicit provenance, calibrated confidence, and contestability rather than as an independent source of authority.

The next section turns from machine mediation to revisability. Once relational knowledge is understood as partial, mediated, historically situated, and increasingly produced through human-machine infrastructures, the ability to update relational maps, categories, interpretations, and attributions becomes a constitutive requirement of epistemic adequacy rather than a secondary procedure applied only after error has been discovered.

5.20 Revisability of Relational Knowledge

This section establishes revisability as a constitutive property of relational knowledge in GRE. Its role is to specify how warranted claims can remain usable while the observed relations, manifestation processes, categories, evidential bases, and conditions of inquiry continue to change. The objective is therefore methodological in an epistemic sense: to distinguish several sources of revision and to identify the documentary and interpretive conditions under which revision can be disciplined rather than improvised. The section proceeds through provisional relational maps, updating through new evidence, revision after intervention, historical revision, category revision, reflexive observation, and preservation of alternative interpretations. The discussion treats revision as traceable change in a claim, representation, or attribution under stated reasons and preserved provenance. This orientation is compatible

with traditions that expose scientific claims to criticism and correction (Popper 2002; Longino 1990), while GRE gives the requirement a specifically relational and historical form.

Definition 5.159 (Revisability of relational knowledge)**.** The *revisability of relational knowledge* is the organized capacity to modify, qualify, extend, contract, replace, or retire a relational or generative claim when changes in evidence, intervention, historical conditions, categories, observer relations, or competing interpretations materially alter its warrant, while preserving enough provenance to reconstruct why the earlier and later formulations differed.

Definition 5.159 separates revisability from epistemic instability. A claim can be strongly warranted at a specified time, scale, boundary, and evidential state while remaining revisable under materially changed conditions. Revisability therefore concerns the architecture of knowledge maintenance rather than a presumption that every conclusion is equally fragile. It also differs from routine textual editing. The relevant change is epistemically consequential: the object, representation, evidential basis, inferential relation, or confidence profile has changed sufficiently that the knowledge claim should change with it.

5.20.1 Provisional Relational Maps

Relational inquiry commonly produces maps of actors, relations, fields, boundaries, flows, dependencies, generative pathways, or historical trajectories. Such maps can be indispensable analytical objects while remaining provisional. Provisionality follows from the conditions developed throughout this chapter: observation is partial, boundaries and scales are selected, relation identity is criterion-dependent, higher-order structures are reconstructed, field claims require distributed evidence, and generative attributions carry additional inferential burdens. A relational map should therefore be understood as a warranted representation under stated conditions rather than as a completed inventory of the relevant relational world.

Definition 5.160 (Provisional relational map)**.** A *provisional relational map* is an explicitly bounded and time-indexed representation of identified relations, positions, fields, trajectories, or generative linkages whose evidential basis, representational choices, uncertainty, and conditions of revision are sufficiently documented for later reassessment.

Provisionality has at least four dimensions. *Observational provisionality* concerns incomplete or unequal access to traces. *representational provisionality* concerns the possibility that another formal, linguistic, legal, statistical, or computational representation preserves different aspects of the same target. *historical provisionality* concerns transformation of the relations themselves. *inferential provisionality* concerns the possibility that new evidence changes the relative warrant of competing explanations. These dimensions can vary independently. A network representation, for example, may remain an adequate summary of recorded interactions while later evidence changes the interpretation of what those interactions mean.

A provisional map should therefore carry metadata about its epistemic conditions. At minimum, the map should identify its target, observational window, boundary, scale, relation criteria, principal evidence types, major representation choices, and

known uncertainties. When generative links are included, the map should also distinguish observed association from stronger mechanism-sensitive attribution. This practice allows a map to be used operationally without allowing its graphic or computational completeness to imply stronger warrant than its evidential basis supports.

Proposition 5.161 (Provisional warrant)**.** *A relational representation may support action, comparison, or further inquiry while remaining provisional, provided that the conditions under which its claims are warranted and the conditions under which they should be reconsidered remain explicit.*

Proposition 5.161 matters because a demand for unrevisable certainty would make most relational inquiry unusable, whereas a refusal to stabilize any working representation would prevent cumulative investigation. GRE therefore permits temporary stabilization under documented conditions. The epistemic task is to make the stabilization inspectable and corrigible.

5.20.2 Updating through New Evidence

New evidence can alter relational knowledge in several ways. It may increase confidence in an existing relation, weaken an earlier identification, reveal a previously hidden participant, extend the temporal duration of a relation, narrow its scope, expose an alternative mechanism, or motivate replacement of the earlier interpretation. Updating is consequently broader than adding observations to an unchanged model. The update can affect the data, the representation, the category system, the causal interpretation, or the confidence profile introduced in Section 5.17.

The relevance of evidence is itself mediated by background assumptions, categories, and standards of criticism, a point emphasized in Longino's account of scientific objectivity and critical interaction (Longino 1990). GRE therefore treats updating as an argued relation between an earlier claim state and a later evidential state. The investigator should identify what changed and why the new material bears on the target claim. A newly available administrative record may change confidence in a formal relation without resolving its enacted intensity. New ethnographic evidence may revise interpretation of an interaction while leaving its recorded frequency unchanged. A newly reconstructed historical source may reopen a genealogy without directly altering contemporary observational evidence.

Definition 5.162 (Traceable epistemic update)**.** A *traceable epistemic update* is a documented revision that identifies the prior claim, the new or reinterpreted evidence, the inferential reason for revision, the dimensions of the claim affected, and the resulting change in confidence, scope, representation, or attribution.

The definition supports a versioned understanding of relational knowledge. Earlier formulations need not disappear when they are superseded. Their retention can show which evidence was available at the time, which assumptions governed interpretation, and where later revision entered. This matters especially when a later claim appears obvious only because intervening evidence has changed the epistemic environment.

Updating also requires proportionate response. Minor evidence should rarely trigger wholesale theoretical replacement when a narrower qualification is sufficient.

Conversely, a large volume of confirmatory observations should not protect a claim when new evidence undermines the relation criterion, identifies a systematic observation failure, or reveals that the apparent pattern was produced by the measurement regime itself. The magnitude of revision should therefore correspond to the part of the epistemic architecture that the new evidence actually affects.

Proposition 5.163 (Dimension-matched revision)**.** *When new evidence alters only a specified dimension of a relational claim, revision should ordinarily be concentrated on that dimension unless the dependence structure of the argument shows that wider conclusions also lose warrant.*

This proposition preserves both responsiveness and continuity. It also makes disagreement more diagnosable: researchers can dispute the evidence, the relation between evidence and target, the affected dimension, or the wider dependencies without treating every update as a judgment on the entire research programme.

5.20.3 Revision after Intervention

Intervention creates a distinctive revision problem because the inquiry may change the relational system whose earlier representation it sought to describe. Policy reform, organizational restructuring, legal recognition, platform redesign, resource redistribution, experimental treatment, public disclosure, or governance intervention can alter participants, incentives, opportunities, classifications, and manifestation processes. Evidence gathered after intervention may therefore concern a transformed relational configuration rather than a cleaner observation of the earlier one.

Interventionist accounts of causal explanation use controlled changes and counterfactual contrasts to clarify causal dependence (Woodward 2003). GRE adopts the value of intervention-sensitive reasoning while adding a historical-relational caution: an intervention can become part of the subsequent relational reality. The epistemic task is then twofold. Inquiry may learn about the earlier system from how it responded, while also needing to reconstruct the new system produced through that response.

Definition 5.164 (Intervention-sensitive revision)**.** *Intervention-sensitive revision* is the reassessment of relational knowledge that distinguishes evidence about a pre-intervention configuration from relations, manifestations, or generative pathways produced, suppressed, or reorganized through the intervention itself.

This distinction is especially important when interventions are adaptive. Actors can learn from monitoring, reorganize around a new rule, create substitutes for a constrained pathway, or redirect activity into less visible channels. A short-run post-intervention change can therefore differ from the later stabilized configuration. The relevant temporal horizon should remain explicit, and the revision record should identify which parts of the earlier map persisted, which transformed, and which newly emerged.

Intervention can also expose relations that were previously difficult to observe. Removing a constraint may reveal latent coordination capacity; altering an institutional interface may expose dependencies that had been absorbed by routine practice; changing access conditions may make hidden relations observable. Such evi-

dence can legitimately revise the earlier account, but the reasoning should separate discovery from creation. The intervention may have revealed a pre-existing relation, created a new relation, or done both in different respects.

Proposition 5.165 (Post-intervention relational reassessment)**.** *When an intervention materially changes the conditions under which relations are formed, manifested, or observed, post-intervention evidence should be interpreted through an explicit reassessment of relation identity, manifestation rules, boundary conditions, and temporal horizon before it is used to update claims about the pre-intervention system.*

Proposition 5.165 limits a common inferential shortcut: treating later observations as if they belonged automatically to the same relational object. It also prepares the methodological discussion of intervention in later Parts, where research and application praxis require designs capable of learning from transformation without erasing the distinction between observation and intervention-produced change.

5.20.4 Historical Revision

Historical revision arises when later evidence, later consequences, changed categories, or a transformed interpretive context alters what can be warranted about an earlier relational configuration. Section 5.14 described historical re-epistemization as a disciplined reconstruction of earlier knowledge under later conditions. The present subsection places that process within the broader architecture of revisability.

Historical revision can proceed from newly recovered sources, improved provenance, reinterpretation of previously known records, changed knowledge of surrounding institutions, or recognition that an earlier category concealed distinctions relevant to the historical actors or relations. Hacking's historical ontology emphasizes that concepts and objects of knowledge can acquire historically specific conditions of possibility (Hacking 2002); Ricoeur's hermeneutics likewise treats interpretation as mediated through distance, text, and changing horizons of understanding (Ricoeur 1991). For GRE, these traditions support a practical requirement: later reconstruction should preserve the difference between revision of present knowledge about the past and transformation of the past itself.

Definition 5.166 (Historical epistemic revision)**.** *Historical epistemic revision* is a documented change in the warranted interpretation, classification, boundary, trajectory, or generative attribution of an earlier relational configuration produced by later evidence or later analytical resources, while preserving the temporal location and evidential conditions of the earlier claim.

The preservation clause is essential. An earlier claim may have been reasonable given the records then available even if later evidence substantially revises it. Conversely, a historically influential interpretation can remain important as an object of study after its descriptive warrant has weakened, because institutions or actors may have acted on it. Revision should therefore distinguish at least three objects: the past relational configuration, the earlier representation of that configuration, and the historical effects produced by that representation.

Later consequences also alter salience. An event that appeared minor at the time

can become analytically significant because it entered a long generative trajectory. This later significance does not establish that the event already contained its later outcome or that contemporaries could have known the trajectory. Historical revision should therefore preserve the chapter's earlier distinction between retrospective significance and retrospective determinism.

Versioned historical knowledge is especially important where records are incomplete or politically uneven. Superseded interpretations, disputed classifications, alternative chronologies, and unresolved evidential gaps should remain visible when they materially affect later reconstruction. Such preservation allows future inquiry to distinguish a settled finding from an interpretation that became dominant because competing records disappeared.

5.20.5 Revision of Categories

Relations become knowable through categories: actor types, institutional statuses, transaction classes, legal forms, network edge definitions, risk groups, occupational codes, value categories, and many other classificatory devices. Categories enable comparison and cumulative research, yet they can become misaligned with the relational system. Category revision is therefore a distinct epistemic operation rather than a special case of adding more data.

Historical studies of statistics show that comparability depends on conventions of classification and coding (Desrosières 1998). Hacking likewise examines the historical interaction between classificatory practices and the objects classified (Hacking 2002). Sections 5.5, 5.6, and 5.19 have already shown that categories can mediate and sometimes alter relational reality. A category that once produced useful analytical compression may later obscure differentiation, become strategically gamed, exclude emergent subjects, or acquire performative consequences that change what the category measures.

Definition 5.167 (Relational category revision)**.** *Relational category revision* is the explicit modification of a classificatory scheme used to identify, compare, or represent relational objects when evidence indicates that the existing categories materially distort, omit, overmerge, or misalign with the target relations or their historical transformation.

Category revision can involve splitting an overly broad category, merging distinctions that have ceased to matter for the target, adding a previously unrepresented relational form, changing membership criteria, altering temporal or spatial resolution, or replacing a category whose operational meaning has drifted. These changes affect comparability. A revised category can improve current fit while making historical series less directly comparable. The revision record should therefore retain category definitions and mapping rules between versions where such mappings are defensible.

Category failure should be diagnosed with target-specific evidence. Low predictive performance may indicate category inadequacy in one setting, while ethnographic mismatch, systematic testimonial disagreement, institutional change, high within-category heterogeneity, or emergent strategic behavior may reveal other forms of failure. None supplies a universal threshold. The relevant question is whether the

category continues to preserve distinctions required by the relational claim for which it is used.

Proposition 5.168 (Category-revision discipline)**.** *When a relational category is revised, the revision should document the target problem, the evidence of mismatch, the semantic change, the consequences for comparability, and any effects that the old and new categories may themselves have on subsequent relational behavior.*

This proposition prevents category revision from becoming an invisible preprocessing step. It also allows later inquiry to determine whether an observed change reflects transformation in the relational world, transformation in the classification scheme, or an interaction between the two.

5.20.6 Reflexive Observation

Observation can become reflexive when the process of observing, measuring, publishing, ranking, classifying, or explaining enters the relations under observation and changes their subsequent development. Section 5.6 treated performative representation, and Section 5.19 analyzed machine-mediated recursive classification. Reflexive observation places these phenomena inside the revision process: once an inquiry becomes consequential to its object, later evidence cannot be interpreted as if the observational relation remained external and unchanged.

Research on rankings documents how public measures can alter expectations and organizational behavior through reactivity (Espeland and Sauder 2007). MacKenzie similarly shows how financial models can become incorporated into market practice and participate in reshaping the processes they represent (MacKenzie 2006). These cases differ in mechanism, yet both illustrate a general epistemic possibility relevant to GRE: the observer, representation, or measurement infrastructure can become a participant in the relational configuration.

Definition 5.169 (Reflexive observation)**.** *Reflexive observation* occurs when an observational, classificatory, representational, or explanatory practice becomes known, anticipated, or operationally consequential within the target system and thereby contributes to changes in the relations or manifestations subsequently observed.

Reflexive observation is more specific than ordinary measurement error. A noisy instrument can distort a reading without changing the underlying relation. Reflexivity requires a pathway through which the inquiry or its representation enters the relational process. That pathway can operate through anticipation, strategic adaptation, stigma, prestige, resource allocation, compliance, resistance, imitation, learning, or redesign of institutional routines.

Revision under reflexivity requires temporal segmentation. The investigator should distinguish observations produced before the inquiry became consequential, the period in which actors learned or responded to it, and the later configuration that incorporates those responses. Where possible, the analysis should also compare differently exposed actors or settings. Such strategies cannot fully restore an external observer position, but they can make the observer relation itself part of the evidential account.

Proposition 5.170 (Reflexive monitoring requirement)**.** *When there is credible evi-*

dence that an inquiry, measure, classification, or published representation has become consequential to the target system, subsequent relational claims should include the observer–system relation among the candidate mechanisms shaping the observed configuration.

The proposition also applies to GRE itself. A relational map circulated among institutions, a generative-foreclosure diagnosis used in policy, or an AI-assisted classification adopted operationally can alter the object that subsequent GRE research encounters. Reflexivity therefore links epistemology to research ethics and governance without collapsing those domains into one another.

5.20.7 Preservation of Alternative Interpretations

Revisability depends on more than the ability to overwrite an earlier conclusion. Future revision requires access to the evidential and interpretive alternatives that made earlier judgment non-trivial. If rival explanations, negative findings, disputed categories, uncertainty ranges, or minority interpretations disappear from the research record, later inquiry may inherit an artificially narrowed possibility space. Preservation of alternatives is therefore part of epistemic infrastructure.

Longino's account of objectivity emphasizes the importance of effective criticism and plural perspectives in the production of scientific knowledge (Longino 1990). GRE translates that insight into a preservation requirement. Alternative interpretations need not receive equal weight, and implausible possibilities need not be retained indefinitely as live explanations. The relevant alternatives are those that were materially plausible given the evidence, represented consequential disagreements about category or mechanism, or preserve information needed to understand why a dominant interpretation prevailed.

Definition 5.171 (Alternative-interpretation record)**.** An *alternative-interpretation record* is a preserved account of a materially plausible competing relational or generative interpretation, including its evidential basis, assumptions, boundary and scale, principal objections, current epistemic status, and conditions under which it could regain or lose warrant.

This record can include rejected hypotheses, unresolved anomalies, competing relation criteria, alternative historical periodizations, different boundary specifications, or interpretations supported by evidence that later became inaccessible. Preservation is particularly valuable when disagreement tracks unequal access to records or representational authority. An interpretation can be weakly institutionalized without being evidentially empty, and future evidence can change its status.

Alternative preservation should also record why an interpretation was set aside. A superseded model that failed because its mechanism contradicted evidence is different from one that lost favor because data were unavailable, categories changed, or research priorities shifted. This distinction allows later investigators to avoid rediscovering abandoned paths without understanding the reasons for abandonment.

Proposition 5.172 (Preservation condition for revisability)**.** *Where competing interpretations are materially relevant to a relational or generative claim, a revisable knowl-*

edge system should preserve enough information about serious alternatives and their evidential status to permit later reassessment without reconstructing the earlier controversy solely from the interpretation that became dominant.

The requirement remains proportional. Routine exploratory alternatives need not all become permanent archival objects. Preservation becomes more important when the claim is consequential, uncertainty remains substantial, categories are historically unstable, evidence is difficult to reproduce, or alternative interpretations are linked to differently positioned observers whose access may later disappear.

Revisability therefore completes the chapter's movement from mediated access to disciplined epistemic maintenance. GRE treats relational knowledge as capable of strong warrant while remaining open to revision through new evidence, intervention, historical transformation, category change, reflexive observation, and preserved alternatives. The resulting epistemic stance avoids both premature closure and unrestricted indeterminacy. Claims are stabilized enough to support inquiry and action, yet their conditions of warrant, histories of change, and routes of correction remain visible. The next section consolidates this architecture by stating the principal epistemic commitments that GRE carries forward into methodology.

5.21 Epistemic Commitments of GRE

This section consolidates the epistemic architecture developed across this chapter into a set of commitments that can guide later research design without collapsing epistemology into method. Its role is synthetic: the preceding sections examined manifestation, trace, representation, observation, boundary, scale, relational identity, higher-order structure, fields, generative attribution, historical reconstruction, evidence, uncertainty, epistemic justice, machine mediation, and revisability as distinct problems. The present section states what GRE commits itself to after those problems are taken together. The objective is to make those commitments sufficiently explicit that later empirical, historical, interpretive, formal, and computational work can be assessed against them. The discussion proceeds through partial knowledge, explicit representation, explicit boundary and scale, explicit uncertainty, mechanism-sensitive attribution, evidential pluralism, historical sensitivity, revisability, and epistemic humility. The method is reconstructive rather than additive: each commitment summarizes an epistemic discipline already developed in the chapter and identifies the constraint it places on subsequent inquiry.

Definition 5.173 (Epistemic commitment of GRE)**.** An *epistemic commitment of GRE* is a standing discipline governing how relational and generative claims are formulated, warranted, delimited, represented, challenged, and revised under conditions of mediated access to relational reality.

Definition 5.173 distinguishes an epistemic commitment from a preferred technique. A commitment such as explicit uncertainty can be satisfied through different research methods; conversely, the use of a sophisticated method does not by itself establish that the commitment has been satisfied. This distinction prepares the transition developed in the next section: epistemology specifies what a warranted claim requires, whereas methodology specifies how inquiry can be organized to meet those

requirements.

5.21.1 Partial Knowledge

GRE treats partiality as a normal condition of relational knowledge rather than as an exceptional defect. The argument follows from the architecture already established in this chapter. Manifestation does not transparently disclose relational reality; inverse inference is generally non-unique; traces depend on production and preservation; observation is position-dependent and incomplete; boundaries and scales delimit what enters the analytical field; higher-order structures and relational fields are reconstructed from partial evidence; and generative attribution adds further inferential burdens. A claim can therefore be warranted without being exhaustive.

Partial knowledge has several forms. *Observational partiality* concerns incomplete access to manifestations and traces. *representational partiality* concerns the selective preservation of some target properties over others. *relational partiality* concerns incomplete identification of relevant relations, participants, positions, or higher-order configurations. *historical partiality* concerns uneven preservation of past evidence and changing categories of interpretation. *generative partiality* concerns incomplete knowledge of mechanisms, mediating conditions, distributed contributors, delayed effects, or unrealized possibilities. These forms can coexist while differing in degree.

Definition 5.174 (Bounded epistemic warrant)**.** *Bounded epistemic warrant* is support for a claim whose target, evidential basis, boundary, scale, temporal horizon, representation, and principal uncertainties are stated with enough precision that the claim can be used without implying knowledge beyond those conditions.

Bounded warrant permits GRE to make substantive claims while preserving the difference between local adequacy and epistemic completeness. A reconstruction of a labor relation, for example, can be well supported within a specified institution and period even when informal dependencies outside the observed boundary remain incompletely known. A field model can be useful for a defined target while leaving some relations latent. A generative attribution can identify a strongly supported contribution without exhausting every contributing condition.

Partiality therefore changes the grammar of strong claims. Strength comes from fit between evidence and target, explicit scope, discrimination among alternatives, and preserved uncertainty. It does not require a declaration that all relevant relations have been observed or that every competing explanation has been eliminated. This commitment protects GRE from converting the breadth of its relational vocabulary into an assumption of total relational visibility.

Proposition 5.175 (Partial knowledge and substantive inquiry)**.** *Partial knowledge can support substantive relational and generative claims when the limits of access are characterized and the claimed warrant remains proportionate to the evidence available within those limits.*

Proposition 5.175 also places a burden on claims of absence. As Section 5.4 established, non-observation becomes evidence of absence only under sufficiently specified conditions of observability. Partial knowledge therefore does not merely counsel modest wording; it changes how positive, negative, and comparative claims are

warranted.

5.21.2 Explicit Representation

The second commitment concerns the visibility of representation. Section 5.5 distinguished relation, trace, symbolization, and representation, while Section 5.6 showed that representations can enter subsequent relational processes. GRE therefore treats representations as analytically consequential choices rather than transparent containers for already given reality.

An explicit representation identifies what is represented, which properties are preserved, which are compressed or omitted, what categories and symbols are used, and what inferential work the representation is expected to perform. The requirement applies to prose categories as much as to formal models. Terms such as "dependency," "trust," "capital," "value," "field," or "constraint" already organize observation and comparison; a network diagram, regression specification, legal category, archival code, ethnographic typology, or machine-generated embedding adds further representational commitments.

Definition 5.176 (Representation declaration)**.** A *representation declaration* is an explicit account of the target, representational form, principal selection or compression choices, relation between represented features and the underlying claim, and known conditions under which the representation can become misleading.

The purpose of a representation declaration is not to demand exhaustive philosophical commentary for every variable or diagram. Its function is proportional disclosure. A highly consequential classification requires more explanation than a conventional formatting choice. A representation that materially affects relational identification, comparison, causal attribution, or operational decisions requires enough documentation for readers to understand what the representation contributes to the inference.

Explicitness is especially important when formal precision exceeds epistemic precision. A numerical score can be reported to several decimal places while the mapping from the score to the relational target remains contestable. An algorithm can produce stable clusters while the substantive relation represented by those clusters remains uncertain. A legal category can be formally definite while incompletely describing enacted relations. GRE therefore distinguishes precision of representation from adequacy of representation.

The commitment also includes contestability. When a representation materially shapes what can be seen, classified, compared, or acted upon, affected interpretations should remain examinable against alternative representational choices where feasible. This follows from Sections 5.18 and 5.19: representational authority can be unequally distributed, and machine-generated representations can acquire operational power beyond their evidential warrant. Explicit representation creates the documentary basis on which such authority can be evaluated.

5.21.3 Explicit Boundary and Scale

Relational claims depend on what is included in the analytical field and at what level or resolution relations are reconstructed. Section 5.8 showed that boundaries are neither purely arbitrary analytical conveniences nor automatically given by the object. Some boundaries are institutionally, legally, materially, or organizationally consequential; others are research selections; many combine both properties. Scale similarly affects which relations, variations, and generative processes become visible.

GRE therefore requires boundary and scale to become part of the claim rather than remaining hidden in the research setup. A statement about a firm, household, platform, market, neighborhood, national economy, supply network, or historical period tacitly establishes inclusion and exclusion rules. The interpretation of a relation can change when external dependencies are included, when a local process is examined across a wider field, or when a long-run trajectory is reconstructed from observations that appeared stable at a shorter horizon.

Definition 5.177 (Scope specification)**.** A *scope specification* identifies the boundary, scale, temporal window, relevant level of aggregation or resolution, and principal cross-boundary or cross-scale dependencies under which a relational or generative claim is asserted.

Scope specification serves at least three epistemic functions. First, it prevents local findings from acquiring an unearned universal range. Second, it makes cross-study disagreement more diagnosable: two studies may reach different conclusions because they study different relational neighborhoods or temporal scales rather than because one is methodologically defective. Third, it reveals when the research boundary excludes a mechanism necessary to explain the observed outcome.

Explicit scope does not imply that a single correct scale exists. Some relations are most intelligible at one level; others are produced through interactions across levels. Cross-scale claims therefore require evidence for the bridge by which local and distributed processes are connected. The commitment is to expose the scale logic of the argument and to avoid treating a convenient unit of observation as an ontologically privileged unit of explanation.

Proposition 5.178 (Scope-indexed warrant)**.** *The warrant of a relational claim is indexed to the boundary, scale, and temporal horizon under which the relevant evidence and inferential relations hold; portability beyond that scope requires additional justification.*

5.21.4 Explicit Uncertainty

The fourth commitment follows from Section 5.17. GRE treats uncertainty as structured information about the state of an inquiry. Uncertainty can concern relational existence, manifestation, generative attribution, boundary choice, scale, temporal persistence, model specification, or the relative support of competing explanations. Compressing these dimensions into a single confidence statement can obscure where the argument is strong and where it remains vulnerable.

An uncertainty statement should therefore identify the dimension to which uncertainty belongs. A relation may be well evidenced while its mechanism remains

uncertain. A mechanism may be plausible while the magnitude or temporal reach of its effect remains weakly identified. A historical trajectory may be strongly reconstructed over one interval while continuity across an archival gap remains uncertain. A computational model may predict reliably while its relational interpretation remains contested. These are different epistemic states and should be reported differently.

Definition 5.179 (Uncertainty disclosure)**.** An *uncertainty disclosure* identifies the principal dimensions of a claim whose warrant remains incomplete, contested, model-dependent, boundary-sensitive, scale-sensitive, temporally limited, or dependent on unresolved alternatives, together with the evidence that could materially change that assessment where such evidence can be specified.

Explicit uncertainty supports comparison and revision. It allows later evidence to address the uncertain part of a claim without requiring wholesale reassessment of everything already supported. It also reduces the risk that technical sophistication masks unresolved inferential assumptions. A simulation, causal model, or machine-learning system can quantify one source of uncertainty while leaving classification, representation, boundary, or historical uncertainty largely outside the formal calculation.

GRE consequently favors profiled confidence over rhetorical certainty. This orientation permits strong localized conclusions where the evidence supports them and visible restraint where the evidential architecture remains incomplete. Uncertainty is therefore neither a disclaimer appended to an otherwise finished argument nor a reason to suspend inquiry indefinitely. It is part of the content of the claim.

5.21.5 Mechanism-Sensitive Attribution

Generative claims create a stronger epistemic burden than claims that a relation exists or covaries with an outcome. Sections 5.12 and 5.13 distinguished generative effects from ordinary state differences and developed a plural architecture for attribution involving mechanisms, counterfactual dependence, multiple causation, distributed generation, delayed effects, branching pathways, and emergence. GRE therefore commits to mechanism-sensitive attribution without making one mechanism template a universal criterion.

Mechanism sensitivity asks how the attributed contribution is carried, enabled, mediated, reproduced, or transformed through the relevant relations. In some cases the mechanism can be specified through organizational rules, legal obligations, material flows, incentives, communication pathways, or institutional procedures. In other cases the contribution is distributed across a configuration, making a single linear mechanism an inadequate description. The epistemic requirement is to identify the structure of dependence that makes the generative claim stronger than observed association.

Proposition 5.180 (Mechanism-sensitive generative attribution)**.** *A generative attribution gains warrant when evidence identifies a credible pathway or dependency structure linking the candidate relation or configuration to the target effect, while relevant alternative explanations, boundary conditions, temporal ordering, and distributed contributions are examined in forms appropriate to the case.*

This proposition deliberately allows different combinations of evidence. Interventionist evidence can be powerful where meaningful interventions are possible. Historical sequence can identify enabling conditions or branching processes that cannot be experimentally recreated. Ethnographic or documentary evidence can reveal mechanisms hidden from aggregate data. Longitudinal or computational analysis can identify temporal dependencies or distributed patterns requiring further interpretation. The commitment therefore links mechanism sensitivity to evidential pluralism rather than to methodological monism.

Mechanism-sensitive attribution also requires restraint in normative interpretation. A relation can generate an effect without that effect being desirable, just, efficient, or valuable. Conversely, a desirable outcome does not establish the mechanism that produced it. GRE keeps causal-generative attribution distinct from normative evaluation so that later analyses of value, power, justice, capture, return, and governance can build on rather than substitute for the epistemic argument.

5.21.6 Evidential Pluralism

Sections 5.15 and 5.16 established that relational and generative claims can draw on documentary, administrative, legal, behavioral, testimonial, ethnographic, network, longitudinal, historical, formal, and computational evidence. These evidence forms differ in what they record, how they are produced, whose position they encode, what they systematically omit, and how directly they bear on the target. GRE therefore commits to evidential pluralism in the sense of target-relative complementarity rather than indiscriminate accumulation.

Definition 5.181 (Evidential pluralism in GRE)**.** *Evidential pluralism in GRE* is the disciplined use and comparison of heterogeneous evidence forms according to the relational or generative property each can support, their trace-production conditions, characteristic omissions or distortions, and the way convergence or disagreement among them affects the target claim.

Pluralism does not imply that every research project should use every method or that every evidence type receives equal weight. A legal document can strongly evidence formal obligation while weakly evidencing enacted intensity. Behavioral data can reveal patterned interaction while underdetermining meaning. Testimony can provide access to experience or interpretation unavailable in administrative records while remaining situated and potentially contested. Network data can reveal recorded ties while depending on how edges were defined and observed. Computational inference can extend analytical reach while adding model and category dependence.

The epistemic task is therefore to match evidence to claim. Heterogeneous evidence becomes especially valuable when distinct trace-production processes converge on the same relational proposition or when disagreement reveals that apparently identical measures refer to different dimensions of the relation. Evidential pluralism also protects against systematic blindness produced by a single archive, administrative regime, platform, expert vocabulary, or machine classification system.

This commitment has a justice dimension without collapsing evidential standards into representational inclusion. Section 5.18 showed that actors differ in their ca-

pacity to create durable records, institutional categories, expert interpretations, and machine-readable traces. Evidential pluralism can widen the space of epistemic participation, while warrant still depends on what each source can support and how conflicts among sources are adjudicated.

5.21.7 Historical Sensitivity

GRE treats relations, categories, manifestation processes, evidential infrastructures, and standards of interpretation as historically situated. Section 5.14 developed relational trajectories, generative trajectories, path dependence, genealogical reconstruction, historically constrained counterfactuals, and historical re-epistemization. Historical sensitivity therefore concerns more than adding chronological background to a contemporary analysis.

A historically sensitive relational claim asks whether the relation itself persisted, whether its participants or constitutive rules changed, whether the same manifestation carried the same significance at different times, whether evidence was preserved under comparable conditions, and whether present categories distort earlier forms. A historically sensitive generative claim additionally asks whether the mechanism, opportunity structure, and feasible alternatives changed across the trajectory.

Definition 5.182 (Historical index of a relational claim)**.** The *historical index of a relational claim* specifies the period, trajectory, category regime, evidential conditions, and relevant path-dependent or transformative processes under which the claim is warranted.

Historical sensitivity also limits retrospective determinism. Later consequences can change the significance attributed to earlier events without proving that those consequences were already inevitable or fully contained in the earlier configuration. Historical counterfactuals should therefore be constrained by possibilities evidenced for the period rather than by alternatives that became available only later.

This commitment has implications for concepts used throughout GRE. Terms such as capital, market, household, labor, ownership, value, organization, expertise, and technology may preserve partial continuity across periods while their relational constitution changes. The framework should therefore remain capable of tracing continuity and transformation together. Historical sensitivity prevents a stable label from being mistaken for an unchanged relation.

5.21.8 Revisability

The eighth commitment synthesizes Section 5.20. GRE treats relational knowledge as revisable because new evidence can emerge, interventions can transform the object, historical conditions can change, categories can fail, observation can become reflexive, and previously weak alternatives can acquire stronger support. Revisability is consequently part of responsible stabilization rather than its opposite.

A revisable claim preserves enough provenance for later investigators to reconstruct how its warrant was established. This includes the evidence available at the time, category definitions, boundary and scale choices, major representational decisions, uncertainty profile, competing interpretations, and reasons for selecting the

working conclusion. Versioning is therefore epistemic infrastructure. When a claim changes, the change should be traceable to the dimension that changed.

Definition 5.183 (Revision architecture)**.** A *revision architecture* is the set of documentary, procedural, and interpretive practices through which a relational or generative claim can be reassessed, updated, qualified, replaced, or retired while preserving the provenance of earlier formulations and the reasons for change.

Revisability includes contestability. A claim that cannot be meaningfully challenged because its data, categories, model assumptions, representational choices, or inferential path are inaccessible has a weaker revision architecture even when its current performance appears strong. This point is particularly important for machine-mediated inquiry, where analytical capability can expand faster than human capacity to reconstruct every internal operation. Contestability can therefore be supported through provenance, documentation, comparative testing, alternative representations, appeal procedures, or other mechanisms appropriate to the domain, without requiring that every technical process be reducible to a simple human-readable explanation.

Revisability also supports cumulative inquiry. Earlier claims can remain useful even when later work narrows their scope or revises their categories. Preservation of serious alternative interpretations allows future researchers to distinguish evidence that genuinely resolved a disagreement from conditions that merely made one interpretation institutionally dominant. GRE therefore treats the history of its own knowledge claims as part of the material needed for future research.

5.21.9 Epistemic Humility

The final commitment concerns the relation between theoretical ambition and epistemic limitation. GRE is intentionally ambitious in analytical scope: it seeks to study heterogeneous relations, distributed fields, generative processes, historical trajectories, multiple forms of value, power over relational and conversion structures, and transformations of future possibilities. Such breadth can create a temptation to treat the relational vocabulary as if it offered a privileged view from which the system can be comprehensively known. The epistemology developed in this chapter rejects that inference.

Definition 5.184 (Epistemic humility in GRE)**.** *Epistemic humility in GRE* is the disciplined refusal to infer epistemic mastery from theoretical scope, formal sophistication, computational capacity, evidential volume, institutional authority, or temporary explanatory success, together with the positive practice of stating what is known, how it is known, where its warrant ends, and what could revise it.

Epistemic humility differs from generalized skepticism. It permits strong claims where evidence, scope, mechanism, and alternatives support them. It also permits action under incomplete knowledge. Its function is to prevent a successful analytical framework from erasing the mediations through which its own claims are produced. Ontological suspension remains relevant here: GRE can investigate relational reality rigorously without converting analytical usefulness into a final metaphysical settlement.

Humility also has an institutional dimension. Analysts, experts, organizations, and computational systems can occupy positions that make their representations unusually consequential. The resulting authority does not automatically track epistemic adequacy. Sections 5.18 and 5.19 therefore make contestability, provenance, unequal evidence-production capacity, and representational authority part of the epistemic architecture. Humility requires institutional arrangements capable of receiving correction, especially from positions whose evidence is weakly represented by dominant recording systems.

The commitments developed in this section can now be stated together.

Proposition 5.185 (Minimum epistemic commitments of GRE)**.** *A GRE inquiry that advances relational or generative knowledge should ordinarily make visible, in forms proportionate to the claim and research context:*

1. *the partial character and evidential reach of the knowledge claim;*
2. *the principal representational choices through which the target is rendered;*
3. *the boundary, scale, and temporal scope under which the claim is asserted;*
4. *the principal dimensions of uncertainty and live competing explanations;*
5. *the mechanism or dependency structure supporting stronger generative attribution where such attribution is made;*
6. *the relation between heterogeneous evidence forms and the target they support;*
7. *the historical conditions under which relations, categories, evidence, and mechanisms are interpreted;*
8. *the provenance and contestability required for later revision; and*
9. *the limits beyond which the inquiry does not claim epistemic mastery.*

Proposition 5.185 is intentionally methodological only in the broad sense of disciplining inquiry. It does not select a research technique. The same commitment can be satisfied differently in archival research, ethnography, survey analysis, network analysis, causal inference, formal modeling, computational simulation, or mixed research designs. The proposition therefore completes the epistemic synthesis while leaving the design problem open.

GRE can remain ambitious under these commitments because ambition concerns the range and depth of questions that inquiry is prepared to pursue, whereas epistemic mastery concerns an unwarranted claim to complete, final, or position-independent knowledge. The framework can investigate distributed generativity, historical transformation, heterogeneous value, and complex relational fields while continuing to expose its boundaries, mediations, uncertainties, and revision conditions. This combination of analytical reach and disciplined limitation provides the immediate basis for the transition from epistemology to methodology developed in the next section.

5.22 From Epistemology to Methodology

This section closes the epistemic argument of this chapter by translating the chapter's commitments into requirements for subsequent research design. Its role is tran-

sitional: the preceding sections established what must be made explicit before GRE can claim warranted knowledge of relations, fields, trajectories, and generative effects; the next Part must determine how inquiry can be organized so that those epistemic requirements are practically addressed. The objective here is therefore neither to prescribe a universal research procedure nor to introduce a new methodological canon. It is to identify the bridge between epistemic warrant and research practice. The discussion proceeds from the difference between knowing relations and studying relations, to epistemic requirements for design, claim-sensitive method selection, the additional burden associated with generative claims, and the transition toward relational methodology. The method is architectural: each subsection converts an epistemic commitment already developed in this chapter into a design question that later methodological chapters can answer with domain-appropriate techniques.

Definition 5.186 (Epistemic design translation)**.** An *epistemic design translation* is the process of converting a condition of warranted knowledge into an explicit requirement for research design, evidence production, analysis, documentation, or revision.

Definition 5.186 establishes the limited function of this section. Epistemology identifies what would make a claim defensible; methodology organizes inquiry so that evidence and analysis capable of supporting, qualifying, or revising that claim can be produced. The relation is therefore constraining without being mechanically deductive. A commitment to explicit boundary and scale does not determine one technique, yet it does require the design to identify the relevant inclusion rules, levels of analysis, and conditions of cross-scale inference. A commitment to revisability does not select one empirical method, yet it does require provenance, versioning, preserved alternatives, and procedures through which later evidence can alter earlier claims.

5.22.1 Knowing Relations and Studying Relations

Knowledge of a relation and the practical study of that relation belong to different analytical levels. The first concerns warrant: what supports the claim that a relation exists, persists, changes, or contributes generatively to a target outcome. The second concerns research organization: how observations are obtained, how evidence is produced or recovered, how participants and archives are accessed, how representations are constructed, how comparison is performed, and how alternative explanations are evaluated. The chapter has concentrated on the first level while repeatedly exposing its dependence on the second.

The distinction matters because epistemic adequacy cannot be inferred directly from the label of a method. An interview may provide strong evidence concerning lived dependency, weak evidence concerning population prevalence, and indirect evidence concerning institutional structure. A network dataset may represent a recorded interaction pattern with considerable precision while leaving the substantive meaning of an edge uncertain. An archival series can support reconstruction of institutional categories and historical sequences while preserving systematic silences. A computational model can clarify consistency, sensitivity, or possible dynamics without independently establishing that its represented relations correspond to the empirical world. Method names therefore provide limited information until the target claim and evidential pathway are specified.

Conversely, the same epistemic target can often be approached through different research practices. A relation of dependence may be reconstructed through contractual records, administrative data, longitudinal behavior, testimony, ethnography, historical comparison, or combinations of these materials. Each route reveals some aspects of the target and obscures others. The methodological problem is consequently one of fit between a claim, the traces through which that claim may become accessible, and the procedures capable of recovering and interpreting those traces.

Definition 5.187 (Relational study design)**.** A *relational study design* is an organized set of procedures for identifying, observing, reconstructing, comparing, representing, and revising claims about specified relations under explicit conditions of access, boundary, scale, temporality, and uncertainty.

The definition treats research design as more than a sequence of techniques. It includes the conditions through which a relation becomes researchable. Access arrangements, category construction, sampling rules, temporal windows, field boundaries, recording systems, legal classifications, machine infrastructures, and researcher position can all affect what becomes visible. Sections 5.7, 5.8, 5.18, and 5.19 established that such conditions can shape both evidence and the object represented by that evidence. Studying relations therefore requires methodological attention to the production conditions of knowledge itself.

The distinction between knowing and studying also protects GRE from a common shortcut: moving directly from an epistemic ideal to a preferred technique. A commitment to evidential pluralism, for example, does not imply that every project should use mixed methods. It means that no evidential form receives unconditional authority and that the selection of evidence should be justified relative to the claim. A narrowly designed study can be epistemically strong when its claim is correspondingly narrow and its evidential fit is clear. A methodologically elaborate project can remain epistemically weak when the relation between evidence and target is poorly specified.

Proposition 5.188 (Claim–study distinction)**.** *The epistemic strength of a relational claim depends on the fit between the target, the evidence generated or recovered by the study, and the inferential pathway connecting them; it cannot be determined from the nominal sophistication or plurality of methods alone.*

Proposition 5.188 provides the first bridge into methodology. The next methodological chapters must therefore ask how research practices produce evidence of different kinds, which claims those practices can support, and how their characteristic blind spots can be made visible.

5.22.2 Epistemic Requirements for Research Design

The epistemic commitments consolidated in Section 5.21 become design requirements when inquiry begins to specify an object, field site, archive, dataset, model, comparison, or intervention. These requirements do not form a universal checklist whose every item must receive equal attention. Their relevance and burden vary with the strength and consequence of the intended claim. They nevertheless provide a common architecture for asking whether a design can generate evidence proportionate to its epistemic ambitions.

Partial knowledge becomes a requirement to characterize access conditions and likely blind spots. A design should identify what can be observed directly, what must be inferred, what remains latent or hidden, and which absences are interpretable. Explicit representation becomes a requirement to document how relations are encoded in concepts, categories, variables, graphs, narratives, legal forms, or computational objects. Boundary and scale commitments become requirements to state the domain of inclusion and the level at which claims are expected to hold. Uncertainty becomes a requirement to preserve dimensions of doubt rather than compress them prematurely into a single confidence statement.

Mechanism-sensitive attribution becomes a requirement to collect or reconstruct evidence capable of discriminating among plausible generative pathways when stronger causal or generative claims are intended. Evidential pluralism becomes a requirement to justify why a particular evidence form is suitable for the target and, where consequential uncertainty remains, whether complementary evidence could materially improve discrimination. Historical sensitivity becomes a requirement to reconstruct the categories, opportunity structures, institutions, and trace-production systems relevant to the period rather than projecting contemporary classifications backward without qualification. Revisability becomes a requirement for provenance, versioning, preserved assumptions, and explicit triggers for revision. Epistemic humility becomes a requirement to state the limits of portability, generalization, and authority.

These translations can be summarized through the notion of an epistemic design requirement.

Definition 5.189 (Epistemic design requirement)**.** An *epistemic design requirement* is a research-design condition introduced because failure to satisfy it would materially weaken the warrant, scope control, interpretability, contestability, or revisability of the intended claim.

The definition makes proportionality central. A study of a narrowly bounded documentary relation may require relatively modest procedures for cross-scale inference, while a claim concerning distributed generative transformation across institutions requires considerably stronger boundary, temporal, and mechanism design. The burden should therefore rise with inferential depth, scope, and consequence.

Research design also involves prioritization. Some epistemic problems can be reduced by obtaining more observations or recovering missing records. Others arise from category ambiguity, strategic concealment, historical discontinuity, observer effects, or underdetermination among relational explanations. Additional data can sometimes leave these problems intact. The appropriate response may require interpretive reconstruction, comparative design, historical analysis, participant engagement, category revision, sensitivity analysis, or preservation of competing explanations. Methodology therefore begins by diagnosing the type of epistemic limitation before selecting the procedure intended to address it.

Proposition 5.190 (Design proportionality)**.** *The methodological burden of a GRE study should be proportionate to the inferential distance, scope, temporal reach, and practical consequence of the claims it intends to support.*

Proposition 5.190 prevents two symmetrical distortions. One is methodological

minimalism applied to claims whose generative, historical, or cross-scale scope exceeds the evidence produced by the design. The other is unnecessary methodological expansion in studies whose claims are deliberately local and modest. GRE methodology should be demanding where the claim requires it and economical where additional complexity would not materially improve warrant.

The design stage should therefore make explicit at least four elements: the intended epistemic target; the principal evidence pathway; the major conditions under which that pathway can fail; and the procedures through which those failures will be detected, bounded, or preserved as uncertainty. Later chapters can operationalize these elements differently across qualitative, historical, quantitative, formal, computational, and mixed research practices.

5.22.3 Relational Identification and Method Selection

Method selection follows from the structure of the relational claim rather than from allegiance to a disciplinary technique. The first methodological question is therefore not which method GRE prefers, but what kind of relation the study seeks to identify and which properties of that relation matter for the research problem. A relation may be legal, material, behavioral, symbolic, institutional, affective, informational, ecological, spatial, computational, or composite. Its evidential traces can differ accordingly.

Relational identification usually contains several separable tasks. The study may need to identify the relevant relata; determine whether the relation is direct, mediated, nested, collective, multilayer, or field-like; specify the temporal criterion under which the relation is treated as persistent; reconstruct its boundary and scale; characterize its directionality or symmetry; and determine whether observed manifestations are sufficient to distinguish it from plausible alternatives. The appropriate methods depend on which of these tasks carry the main uncertainty.

A study concerned with formal legal relations may require close analysis of legal texts, institutional procedure, and enacted practice because formal validity and relational realization can diverge. A study concerned with informal care or dependency may require testimony, observation, and contextual interpretation because administrative traces can remain sparse. A study concerned with network structure may require relational data and explicit edge semantics, while a study concerned with historical persistence may require longitudinal or archival reconstruction. A study concerned with a relational field may require evidence that local positions derive meaning or constraint from distributed organization rather than merely from pairwise density.

Definition 5.191 (Claim–method fit)**.** *Claim–method fit* is the degree to which a research procedure can generate, recover, or interpret evidence that bears directly on the properties required to identify and delimit the intended relational claim.

Claim–method fit is therefore property-specific. A method can fit one component of a claim while remaining weak for another. Longitudinal administrative data can support persistence and sequence, yet offer limited access to unrecorded meaning. Ethnographic observation can clarify relational enactment and category mismatch, yet require additional design for population-level prevalence. Formal models can ex-

pose structural consequences of assumptions while requiring independent evidence for empirical correspondence. Method selection should make such asymmetries explicit rather than allowing the prestige or familiarity of a method to substitute for evidential fit.

This orientation also clarifies the role of methodological pluralism. Pluralism does not require the accumulation of methods for its own sake. It permits the research design to combine methods when distinct properties of the claim require different forms of access. Complementarity is strongest when each method addresses a known weakness in another evidential pathway or when heterogeneous evidence provides independent support for a relational reconstruction. Redundancy without additional discrimination can increase workload without materially increasing warrant.

A further implication concerns sequencing. Method selection can be iterative. Early qualitative or historical inquiry can reveal categories that later support structured measurement; computational exploration can identify patterns requiring interpretive reconstruction; formal analysis can expose assumptions whose empirical plausibility must then be examined; surprising field observations can trigger revision of a sampling frame or relational boundary. GRE therefore permits research designs in which identification and method selection co-evolve as evidence clarifies the object under study.

Proposition 5.192 (Relational method selection)**.** *Method selection in relational inquiry should be justified by the properties required to identify, delimit, compare, or reconstruct the target relation, together with the characteristic access conditions and failure modes of the proposed evidential pathway.*

Proposition 5.192 prepares the more detailed relational methodologies developed later. Those methodologies can organize concrete procedures around relational identification without treating one technique as the defining method of GRE.

5.22.4 Generative Claims and Methodological Burden

Generative claims place a heavier methodological burden on inquiry because they extend beyond relational identification toward claims about contribution to emergence, transformation, persistence, suppression, capacity formation, structural change, or alteration of future possibilities. Sections 5.12, 5.13, and 5.16 established that generativity must be specified relative to a target and supported through evidence connecting a relation or configuration to the claimed effect.

The methodological burden has several layers. First, the underlying relation must be identified with adequate warrant. Second, the target change must itself be evidenced. Third, the design must support an inferential pathway linking the relation to that change. Fourth, materially relevant alternatives, enabling conditions, mediators, and distributed contributors must be considered at a level proportionate to the strength of the attribution. Fifth, delayed and branching effects require temporal design capable of tracing carriers across stages rather than relying exclusively on immediate association.

These layers mean that a generative study may require different forms of evidence at different points in the argument. The existence of a relation may be documented

through contracts or network data; its mechanism may require process evidence; its downstream effect may require longitudinal observation; its historical conditions may require archival reconstruction; its distributed contribution may require comparative or configurational analysis; its transformation of future possibilities may require reconstruction of feasible alternatives rather than observation of realized outcomes alone. No single evidential form receives automatic priority across these tasks.

Definition 5.193 (Generative methodological burden)**.** The *generative methodological burden* is the additional design and evidential work required to move from a warranted claim that a relation or configuration exists to a warranted claim that it contributed to a specified generative effect under stated boundary, scale, temporal, and uncertainty conditions.

The burden is graded. A modest claim that a relation plausibly enabled a capacity can require less evidential discrimination than a claim that the same relation transformed an institutional structure or altered the conditions through which later transformation occurred. The vocabulary of attribution should track this difference. Terms such as association, contribution, mediation, enabling, constraint, co-generation, and stronger generative attribution can express different levels of warranted commitment.

Generative inquiry also increases the importance of negative and unrealized evidence. Foreclosure concerns possibilities that became less accessible; path dependence concerns alternatives whose feasibility changed through sequence; capacity formation concerns what actors or systems became able to do; second-order generative change concerns altered conditions of later transformation. Research design therefore cannot rely only on directly realized outcomes. It may need historical comparison, counterfactual discipline, institutional analysis, process tracing, or formal representation of feasible states, with the evidential status of each construction kept explicit.

The methodological problem is especially demanding where generation is distributed. An outcome can depend on background infrastructure, maintenance, tacit coordination, legal conditions, ecological supports, technical systems, and contributions whose traces are unequally preserved. Section 5.18 showed that unequal evidence-production capacity can distort generative attribution. A methodology adequate to distributed generation should therefore examine whether evidential visibility is itself patterned by power, institutional legibility, or recording infrastructure.

Proposition 5.194 (Escalating burden of generative inference)**.** *As a claim moves from relational identification toward stronger claims about downstream, distributed, historical, structural, or second-order generative effects, the methodological burden ordinarily increases because additional mediating conditions, alternative pathways, temporal carriers, and boundary assumptions become relevant to warrant.*

Proposition 5.194 supplies the principal reason for maintaining a distinction between methodologies of relational inquiry and methodologies of generative relational inquiry. The two remain connected: generative inquiry presupposes relational identification. Their methodological burdens differ because the latter adds a further

inferential layer concerning transformation through time.

5.22.5 Transition to Relational Methodology

The epistemic work of this chapter establishes the conditions under which GRE can move responsibly from manifestation and trace toward claims about relations and generative processes. The next Part must convert those conditions into research praxis and concrete methodological architectures. The transition therefore begins with a change in question. The chapter has asked what warrants a relational or generative claim. Subsequent chapters ask how inquiry should be organized when researchers must produce, recover, interpret, compare, formalize, and revise the evidence needed for such warrant.

The first consequence is that methodology must remain relationally reflexive. Research is conducted through relations: between researchers and participants, analysts and institutions, observers and instruments, archives and classification systems, computational systems and datasets, funders and research agendas, disciplines and objects of study. These relations can shape access, categories, recording, interpretation, and the practical effects of published representations. The epistemic concerns developed in Sections 5.6, 5.7, 5.18, 5.19, and 5.20 therefore become problems of research praxis as well as abstract epistemology.

The second consequence is methodological pluralism with explicit division of labor. Historical and interpretive inquiry can recover categories, meanings, trajectories, and institutional transformations that sparse contemporary datasets cannot preserve. Qualitative inquiry can examine enacted relations, observer position, category mismatch, and weakly institutionalized experience. Quantitative inquiry can estimate distributions, comparisons, temporal patterns, and conditional associations where measurement is appropriate. Formal and computational inquiry can clarify structural implications, generate counterfactual scenarios, test sensitivity, and represent complex relational configurations. Their value depends on the target and their relation to evidence; none receives automatic jurisdiction over the others.

The third consequence is that methodology must preserve the distinction between relational and generative questions. Relational methodology concerns how relations are identified, reconstructed, represented, compared, and situated within boundaries and fields. Generative relational methodology adds the study of how such relations contribute to the production or transformation of capacities, relations, structures, constraints, values, trajectories, and future possibilities. Integrated designs can combine the two, yet their inferential steps should remain visible so that evidence for relational existence is not mistaken for evidence of generative effect.

The fourth consequence is that research design itself becomes revisable. If categories change, access conditions shift, interventions transform the field, new evidence appears, or machine-mediated observation alters what can be seen, then the design may require modification. A methodology aligned with Section 5.20 therefore includes procedures for documenting such revision rather than treating the initial research plan as epistemically privileged simply because it came first.

These consequences can be consolidated into one transition principle.

Proposition 5.195 (Epistemology-to-methodology transition)**.** *GRE methodology should organize research practices so that the evidential, representational, historical, relational, generative, justice-sensitive, and revisability requirements established in this chapter become explicit design problems rather than implicit assumptions of analysis.*

Proposition 5.195 marks the endpoint of the chapter's argument. Ontological suspension in the preceding chapter prevented analytical representations from being mistaken for final ontology. The present chapter has added a corresponding epistemic discipline: manifestations, traces, representations, observations, models, and historical records provide mediated and partial access whose warrant depends on boundary, scale, evidence, attribution, uncertainty, justice, provenance, and revisability. The methodological chapters that follow can now proceed without requiring epistemic certainty and without treating technical procedure as a substitute for epistemic justification.

The resulting research programme begins from a demanding but workable position. GRE may study complex relational systems under incomplete knowledge; it may combine heterogeneous evidence; it may use historical, interpretive, quantitative, formal, and computational resources; and it may advance generative explanations where the evidential burden is met. At the same time, each design remains answerable to the limits of its access and representation. Methodology therefore becomes the practical organization of disciplined inquiry under the epistemic conditions established here.

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Programme Charter

Standards Programme Charter

Governance Working Draft

Draft version 0.1

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WORKING DRAFT FOR REVIEW

This document is not adopted. Its requirement language expresses proposals for review and rehearsal. Preparation of this text does not establish programme governance, approve a formal standards project, or certify substantive truth, legal validity, or institutional legitimacy.

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1 Purpose, status, and application

Responsible editor: `UNASSIGNED`. Canonical source: `governance/standards_programme_charter.tex`. Intended readers are founding participants, programme administrators, reviewers and affected people.

This Charter proposes the mission, authority, participation model, and accountability of the Generativity Standards Program. It is a governance publication, not a technical Standard. Its requirements are proposed conditions for operating the programme after recorded adoption. No office, membership, delegation, institutional partnership, or publication authority is created by this draft.

CH-001 The programme shall identify this document as a Governance Working Draft until a founding adoption record identifies the adopting persons, their actual authority over programme resources and publications, the edition adopted, its effective date, and the scope of that authority.

CH-002 An adoption record shall distinguish the programme's own publication authority from any claim to represent a profession, institution, community, jurisdiction, or international constituency. Each representation claim shall identify its actual mandate and limits.

Informative note. The proposed launch model is open individual participation with appointed, accountable decision functions. It does not presume national delegation, institutional membership, international recognition, accreditation, or a legally incorporated body. The older Markdown charter remains a historical outline.

2 Mission and public purpose

The programme develops epistemic and practical infrastructure for warranted recognition, assessment and revision of factual claims, and preservation of consequential generative trajectories. Its motivation is symbolic crisis: instability among representations, their referents, institutional classifications, and practical trust. The purpose includes the conditions under which people can examine grounds, challenge interpretations, revise action, and preserve or reopen future possibilities.

Generativity records can concern what happened, how it became knowable, and how categories and decisions affected later relations. Preserving an output alone can omit contributions, alternatives, constraints, losses, and changes in capacity. More records, stronger authentication, and institutional acceptance do not themselves establish truth, justice, or beneficial generativity.

CH-003 Each proposed programme work item shall identify the recognition or practical problem it addresses, its intended beneficiaries and affected interests, its anticipated contribution to the mission, and the evidence by which that contribution will be evaluated.

CH-004 Programme evaluations shall distinguish demonstrated improvements in recording, interpretation, contestation, or practical response from broader claims about restored trust, justice, or future generative capacity. A broader claim shall identify its evidence and limitations.

CH-005 The programme shall examine its own classification, recording, decision, and publication practices as potential sources of exclusion, dependency, and concentrated authority. Findings and corrective decisions shall enter the programme's maintained issue record.

3 Scope and boundaries

The portfolio covers recording, preservation, exchange, presentation, assessment, contestation, revision, and accountable institutional use of generativity-related records. It includes conceptual work, practical procedures, technical implementation, and distinct policy inquiry.

CH-006 Programme publications shall distinguish metamodel, record ontology, epistemic representation, normative assessment, jurisprudential status, institutional governance, political economy, and technical implementation wherever a requirement or claim depends on more than one of these layers.

CH-007 The programme shall preserve the distinction between theoretical GR concepts and scoped operational requirements. Intentional narrowing, operationalization, or departure shall identify its foundation sources, alternatives, rationale, and recorded architectural decision.

CH-008 Programme publications and public claims shall not present technical conformance, authentic provenance, a programme decision, or a recorded institutional finding as sufficient proof of factual truth, ethical legitimacy, legal validity, or international endorsement.

CH-009 The programme shall identify jurisdictional and institutional authority separately whenever a proposal concerns legal duties, rights, admissibility, liability, or public power. Unresolved applicability shall remain explicit.

Informative note. The six candidate record classes are operational recording concepts. This Charter neither declares them exhaustive constituents of reality nor selects a compulsory mathematical semantics or software platform. Legal and policy research can proceed without pretending that programme publications enact law.

4 Publication authority and work sequence

CH-010 Each publication shall declare its class, maturity, version, responsible editor, and decision authority. Specifications, adopted Standards, policy proposals, governance documents, Technical Reports, and manuals shall retain their distinct authority.

CH-011 The programme shall reserve the designation adopted Standard for an edition approved under its operative development procedure. A draft, schema, prototype, protocol, or technically normative Specification shall not acquire that designation through technical completion alone.

CH-012 Standards-track work shall begin with a stated normative problem, scope, terminology, intended requirements, conformance subjects, and relevant constraints. A dependent Specification work item shall identify the reusable technical need that motivates it. Draft requirements and Specifications may co-evolve through pilots and review.

CH-013 A policy proposal shall identify its intended institution or class of institutions, mandate assumptions, institutional alternatives, expected effects, safeguards, and evaluation approach. Its recommendations shall not amend technical conformance requirements outside the standards-development procedure.

CH-014 Formal work-item approval shall depend on the governance launch conditions in this Charter and Directives Part 1. Preliminary source research, draft preparation, synthetic examples, and technical exploration shall retain their preliminary status while those conditions remain unmet.

5 Participation and fair consideration

CH-015 The programme shall provide a documented route for interested individuals to contribute proposals and comments and to receive reasoned dispositions. Employment, institutional sponsorship, a proprietary tool account, payment, or travel shall not be a prerequisite for submitting a relevant comment.

CH-016 The participant register shall distinguish participation in an individual capacity from authorized institutional representation. It shall record relevant affiliations, interests, assigned roles, and any limits on a representation mandate, subject to justified protection of sensitive information.

CH-017 For each work item, the coordinator shall identify affected interests, reviewer competence needed, known participation gaps, outreach undertaken, and feasible measures for language, disability, time-zone, connectivity, and resource barriers. Unfilled gaps shall remain visible in progression decisions.

CH-018 The programme shall provide an asynchronous contribution route and a human-readable account of proposed substantive changes. A contribution requiring assistance with format shall be assessed for its substance after proportionate assistance or an accessible alternative has been offered.

CH-019 Funding, institutional affiliation, authorship volume, technical access, or control of repository credentials shall not by itself confer decision rights or priority in comment disposition. The decision authority shall assess whether concentrated interests or unpaid-work burdens materially limit fair consideration.

CH-020 Any restriction on participation shall state the conduct or process reason, its scope, duration or review trigger, responsible decision maker, and available challenge route. Restrictions shall not be imposed solely because a participant disputes a proposal or authoritative interpretation.

Informative note. Participation does not imply agreement, authorship, ownership, or authority to speak for others. Consultation with one participant does not establish consent of an entire community. Funded support and declared expertise can improve participation; their influence remains inspectable.

6 Governance functions and accountable appointments

The following functions constitute the proposed minimum organization. They are functions to staff, not assertions that bodies already exist.

Founding authority — UNASSIGNED. Records the basis on which the launch package is adopted and establishes bounded appointments.

Programme decision authority — UNASSIGNED. Authorizes scoped work, assesses progression and adoption evidence, appoints accountable officers, and maintains the programme mandate.

Coordinator and records custodian — UNASSIGNED. Maintains notices, role and work registers, decision evidence, protected access arrangements, and continuity information.

Technical committee convenor — UNASSIGNED. Coordinates work and multidisciplinary review within the committee mandate.

Editors and work-item leads — UNASSIGNED. Prepare drafts, trace requirements, and resolve comments under recorded decisions.

Neutral procedural reviewer — UNASSIGNED. Reviews challenged procedure without participation in the disputed decision or a material conflict.

Ethics contact and alternate — UNASSIGNED. Receive protected reports and arrange conflict-sensitive consideration under the ethics policy.

Maintenance owner — UNASSIGNED. Coordinates review, corrections, revisions, withdrawal, and continuity for assigned publications.

For coordination with Directives Part 1, the programme decision authority is the governance authority; the coordinator and records custodian performs the Secretariat function; and the neutral procedural reviewer performs the independent appeal-review function. A review chair is an explicitly assigned function for a particular review, not an additional standing body. The appointment record identifies the responsible release owner and maintenance owner.

CH-021 An appointment shall identify the person, appointing authority, accepted mandate, decision limits, relevant interests, start date, term or review date, alternate or vacancy arrangement, and removal or replacement procedure. An office shall not be treated as staffed until acceptance is recorded.

CH-022 The programme decision authority shall publish reasons for appointments, renewals, and removals at a level compatible with necessary protection. A challenged appointment or removal shall have access to neutral procedural review under Directives Part 1.

CH-023 Where one person holds multiple functions, each decision record shall identify the capacity exercised and any resulting conflict. A person shall not conduct the neutral review of their own challenged decision.

CH-024 The programme shall not delegate a decision to an automated system. AI-assisted drafting, summarization, analysis, or validation shall retain an accountable human role responsible for checking the resulting material and recording consequential use.

CH-025 The programme shall not exercise a delegated function while its required responsible role is vacant or recused without an authorized substitute. Unaffected preliminary work may continue with its status declared.

7 Decision procedure and governance launch

Directives Part 1 specifies stages, notice and review periods, comment handling, consensus assessment, decision evidence, appeals, and maintenance. Directives Part 2 specifies drafting and publication structure. This Charter defines their mandate and does not duplicate numerical rules.

CH-026 Each consequential progression, adoption, mandate, or appointment decision shall identify the operative procedure, authority, evidence considered, interests and recusals, alternatives, material objections, reasons, consequences, and review route.

CH-027 A claim of consensus shall include evidence that relevant concerns were considered and that remaining substantial objections received reasoned treatment. Silence, elapsed time, a vote total, or lack of a funded alternative shall not alone establish consensus.

CH-028 Before formal work-item initiation, the governance launch record shall identify the adopted Charter and Directives, committee mandate, ethics and contribution arrangements, public-review route, maintenance and records arrangements, accepted appointments, and an available neutral procedural review route. It shall include the results and dispositions of a governance rehearsal.

CH-029 If neutral review is unavailable for a consequential contested decision, the programme shall defer that disputed progression or adoption decision and record the capacity gap. The programme shall continue research and drafting that do not depend on the contested authority.

CH-030 An amendment to governance shall follow the change and review procedure in Directives Part 1, state its effective date and transition arrangements, and preserve the prior edition. A procedure shall not be changed retrospectively solely to validate a disputed decision.

8 Resources, records, and external relations

CH-031 The programme shall maintain an inspectable record of material funding, in-kind support, decision-related conditions, and control of essential infrastructure. Restricted details shall have a stated reason for restriction and an accountable reviewer.

CH-032 A funding or hosting arrangement shall not authorize a sponsor to suppress relevant criticism, require adoption of its preferred technical solution, or bypass review. Material changes in support shall trigger a capacity and continuity assessment.

CH-033 The records custodian shall maintain access to publication status, version history, work scopes, decision reasons, comment dispositions, and correction notices. Protection or deletion of underlying sensitive records shall retain a non-sensitive account of the action and its authority where permitted.

CH-034 An external liaison, pilot, endorsement, submission, or agreement shall identify who is authorized to act, its purpose and limits, and any external institution's actual assent. Participation in the programme shall not be represented as institutional endorsement.

CH-035 The programme decision authority shall review mission performance, participation gaps, concentrated influence, conflicts, unresolved appeals, review capacity, and maintenance resources at least annually with the programme account required by Directives Part 1 and after a material institutional change. The review shall record remedial actions, owners, and follow-up.

9 Founding procedure and decision eligibility

The founding instrument records an explicit commitment by persons with actual authority over identified programme resources or publication functions. It does not derive authority from a draft claiming to be already adopted. The following procedure is the proposed condition for declaring the programme launched.

CH-036 Before founding adoption, the prospective founding signatories shall identify their actual capacities and proposed commitments, publish the exact governance package within cleared rights, identify proposed appointments and decision-eligibility criteria, and announce a founding review that applies the public-review, comment-disposition, reply, and material-change periods in draft Directives Part 1 as explicit conditions of that founding process.

CH-037 The founding signatories shall execute an adoption instrument only after review dispositions, a governance rehearsal, accepted minimum appointments, and independent assessment of the founding process are recorded. The instrument shall identify each signatory's express agreement, scope of commitment, dissent, outstanding limits, and the exact texts adopted. A person or institution shall not be bound or represented by a signature that lacks actual authority.

CH-038 The founding instrument shall identify the first programme decision authority, its delegated limits, appointment and succession route, and review date. Founding adoption shall not itself approve GR/NWIP-001 or any technical Standard. Subsequent formal adoption and maintenance decisions shall use the applicable ballot and review rules of operative Directives Part 1, distinguishing substantive maintenance from editorial correction and confirmation.

CH-039 Before constituting a decision roster, the programme decision authority shall publish the proposed decision scope, nominations route, closing date, competence or affected-perspective criteria, expected review commitment, and conflict rules. Eligible individuals shall have an accepted bounded role, disclosed relevant interests, agreed applicable conduct terms, and a recorded capacity for the particular decision. Institutional representation shall require an identified mandate.

CH-040 Selection to or exclusion from a decision roster shall have recorded reasons against the announced criteria and an available procedural challenge. The authority shall assess concentrated interests and missing perspectives before fixing the roster. A roster shall not change during a ballot except through the correction and restart rules of Directives Part 1.

CH-041 An appointment renewal or proposed removal shall receive a recorded grounds statement and an opportunity for the affected person and relevant participants to respond before a final decision. A non-conflicted authority shall decide the matter within its mandate and provide access to neutral procedural review. Urgent temporary protective measures shall follow the ethics policy and emergency procedure, with a stated review point.

Informative note. The founding instrument uses express agreement by the actual signatories because it establishes their own programme commitments. Later technical adoption uses the separately proposed ballot rules. The requirement for review and available independent capacity prevents the initial signature from being represented as an already completed standards process.

10 Evidence for adoption and continuing review

The adoption dossier provides a clause-to-evidence index. For CH-001–CH-002, CH-021–CH-030, and CH-036–CH-041, evidence includes the founding instrument, accepted role register, decision records, rehearsal record, and neutral-review arrangement. For CH-015–CH-020 and CH-031–CH-035, it includes tested contribution routes, participation and funding records, protection rules, maintenance arrangements, and documented gaps. Mission and scope clauses are checked against an actual proposed work item and its intended claims.

Informative note. A paper declaration of independence or accessibility is insufficient evidence that a reviewer is available or a route works. Rehearsal can expose these defects without asserting that an external institution has participated. Adoption establishes local governance authority only within the recorded mandate.

11 Informative sources and proposed choices

Source and interpretation. Programme Brief, version 0.2; comprehensive development plan, version 0.1; cross-domain programme; foundation traceability map, particularly FT-01 and FT-06. Local paths: `PROGRAMME_BRIEF.md` and `docs/planning/`. These explain the mission and candidate operational direction.

Source and interpretation. Foundation manuscripts: FM-001, `GRE_Chapter_01.pdf`, section 1.14.2–1.14.5, pp. 79–83; FM-003, `GRE_Chapter_03.pdf`, section 3.12, pp. 129–132; FM-005, `GRE_Chapter_05_Complete_First_Draft.pdf`, section 5.18, pp. 150–153. Files are in `foundation_manuscripts/`. These ground the orientation to representational instability, revisable action, and unequal evidential capacities; they do not enact these governance clauses.

Source and interpretation. WTO, Principles for the Development of International Standards, Guides and Recommendations, official presentation of the 2000 TBT Committee decision, consulted 2026-09-22: https://www.wto.org/english/tratop_e/tbt_e/principles_standards_tbt_e.htm. Its treatment of transparency, participation, impartial consideration, relevance, coherence, and resource barriers informs process design. Local requirements and organization are programme proposals, not a claim of WTO recognition.

The selected draft direction uses individual contribution and bounded appointments, with separation of authoring, decision authority, and neutral review. Alternatives include institutional membership or a hybrid representative model. The launch choice reduces administrative assumptions while leaving representation and concentrated influence visible. Transition to a different membership model needs a recorded Charter revision; it does not occur through informal growth.

OPEN. Founding authority, organizational form, actual appointments, neutral reviewer capacity, operating resources, and public/protected contact routes remain OPEN. The text supplies reviewable rules; it does not fill those roles.

OPEN. The scope of public distribution rights and the operative contribution terms remain OPEN under the Ethics, Conflict-of-Interest, and Contribution Rights Policy. Drafting and internal review remain possible within actual permissions.

GENERATIVITY STANDARDS PROGRAM

Directives Part 1

Procedures for Development and Maintenance

Governance Working Draft

Draft version 0.1

22 September 2026

WORKING DRAFT FOR REVIEW

This document is not adopted. Its requirement language expresses proposals for review and rehearsal. Preparation of this text does not establish programme governance, approve a formal standards project, or certify substantive truth, legal validity, or institutional legitimacy.

Publication class, scope, dependencies and unresolved decisions are stated in the document. No ISO, IEC or IEEE affiliation or endorsement is claimed.

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1 Status, scope, and authority

This document proposes an executable development procedure for the Generativity Standards Program. Its clauses govern the programme only after explicit governance adoption. It is a **PROVISIONAL Governance Working Draft**, not an adopted Standard, an approved project, or evidence that a committee exists. Its numbered requirements are proposed requirements. A rehearsal can test them without making them operative.

Responsible editor: `UNASSIGNED`. Canonical source: `governance/directives_part_1.tex`. Intended readers are founding participants, procedural administrators, editors, reviewers, affected people, and prospective implementers of the development procedure. The assessed subject is a particular project-development or maintenance procedure and its records, not the substantive truth of a resulting Standard.

The procedure supports inspectable, revisable recognition and practical action by preserving grounds, alternatives, objections, decisions, and subsequent changes in standards development itself. It does not determine the truth of recorded claims, settle GR theory by vote, or confer external legal authority.

D1-001 The programme shall apply the adopted Charter for decision authority and appointments, these Directives for development procedure, Directives Part 2 for drafting, and the adopted Ethics, Conflict-of-Interest, and Contribution Rights Policy for conduct, conflicts, and rights. A conflict between these instruments shall be referred to the governance authority and resolved before a dependent decision proceeds.

D1-002 Every procedural decision shall identify its accountable decision maker, operative authority and procedure versions, input document versions, grounds, outcome, date, and review or appeal route. Drafting, a repository merge, an ADR, or successful compilation shall not constitute governance adoption or Standard approval.

D1-003 An organizational function without an appointed holder and recorded mandate shall remain `UNASSIGNED`. Formal project initiation and adoption shall remain pending while required authority or an independent appeal route is unavailable. Preliminary research, drafting, and synthetic rehearsals may continue with explicit status labels.

2 Terms used in this procedure

Governance authority The body or bounded transitional authority constituted by the adopted Charter; its mandate determines which decisions it can take.

Technical committee An actually constituted committee with a bounded project mandate; not a label that itself establishes authority.

Substantive change A change that could alter scope, meaning, duties, permissions, conformance outcomes, interoperability, protection, or practical consequences.

Substantive objection A reasoned concern about technical adequacy, evidence, scope, procedure, rights, participation, harm, or feasibility relevant to the proposed decision.

Consensus assessment A documented assessment of participation, consideration of concerns, remaining disagreement, and grounds for progression. It is distinct from a ballot tally.

Eligible participant A person assigned decision rights under the Charter and recorded for the specific decision; authorship, payment, or attendance alone does not confer those rights.

Calendar day A day counted using the closing time and time zone stated in the notice. A notice states an exact closing timestamp.

3 Founding, responsibilities, and participation

D1-004 Before formal standards-project approval, the founding adoption record shall identify the founding basis, adopted governance texts and versions, participants and capacities, decision method, dissent, transitional limits, review date, and replacement route. Governance adoption shall follow the founding procedure recorded under the Charter, rather than assume that these draft Directives have already authorized themselves.

D1-005 The governance authority shall assign oversight, project progression, public-review administration, release, maintenance, conflict handling, and independent appeal functions. The assignment register shall identify holders, terms, delegated limits, substitutes, and contact routes. Combined roles shall be disclosed; an interested decision maker shall not determine their own procedural appeal.

D1-006 The Secretariat shall maintain an accessible work programme and participation route. A project notice shall identify the problem, scope, current status, available documents, contribution terms, comment routes, decision roles, and intended review dates. Public comment shall not require voting membership or endorsement of the proposal.

D1-007 The review chair shall document outreach to affected interests and relevant expertise, participation barriers, affiliations relevant to dominance, and remaining gaps. The chair shall provide an asynchronous contribution route and record requested accessibility or language accommodations and the response. Lack of response shall not be recorded as consent.

D1-008 Before a formal decision, the chair shall confirm current conflict declarations and apply the adopted recusal procedure. The record shall identify recusals and their effect on eligibility and quorum without disclosing protected details unnecessarily. If conflicts prevent a valid decision or impartial review, progression shall be deferred.

Informative note. Participant eligibility and appointment belong to the Charter; conduct and contribution permissions belong to the Ethics, Conflict-of-Interest, and Contribution Rights Policy. These Directives do not grant membership, impose a license, or establish a legal entity.

4 Project initiation and scope control

D1-009 A New Work Item Proposal shall identify purpose, intended users and affected people, publication class, bounded deliverables, exclusions, proposed conformance subjects, alternatives to new standardization, source basis, dependencies, review expertise, pilot evidence, resource needs, and prospective maintenance responsibility.

D1-010 The proposal shall explain how the work addresses warranted recognition or generative trajectory and identify epistemic assumptions, ethical impacts, legal and institutional boundaries, public-policy implications, accessibility, protection needs, and distribution of recording and implementation burdens. A claimed institutional mandate shall identify its source and limits.

D1-011 The technical committee shall begin with the normative problem and assessment needs. A dependent Specification proposal shall identify the draft requirements requiring reusable

technical infrastructure, the implementation alternatives, and intended tests. A protocol proposal shall additionally identify actors, interactions, states, transitions, outcomes, failure handling, and authority boundaries.

D1-012 The authorized project decision maker shall record accept, revise, defer, or reject, with reasons, scope, assigned responsibilities, dependencies, and review milestones. A coordinated proposal shall retain a separate bounded scope and progression record for each deliverable. A technical dependency shall not acquire Standard status through inclusion in a proposal.

D1-013 A proposed expansion beyond approved scope shall receive impact review and an explicit scope decision before dependent progression. A Specification intended for promotion to a Standard shall enter an explicit standards-track proposal and the applicable review stages; technical stability alone shall not authorize promotion.

5 Stages and progression evidence

The following codes are the programme's local lifecycle. They retain the repository's grouping of review, revision, and withdrawal under stage 90. Specifications have separately declared maturity; stage 60 is reserved here for adopted Standards.

Stage	Local status	Evidence for progression
00	Preliminary	Need, preliminary sources, alternatives, and draft NWIP; no project authority presumed.
10	Proposal	Approved bounded scope, capacity, assignments, dependencies, and review plan.
20	Working Draft	Candidate clauses, source and decision traceability, assessment methods, and example or pilot design.
30	Committee Draft	Integrated requirements, review findings and dispositions, pilot evidence and limitations, proposed public-review package.
40	Public Review Draft	Versioned notice, accessible draft, comments and responses, material-change review, and remaining objections.
50	Final Approval Draft	Frozen approval package, consensus assessment, valid ballot, procedural checks, and appeal handling.
60	Published Standard	Recorded adoption and release authorization, verified publication package, maintenance owner and next review date.
90	Review / revision / withdrawal	Issue and impact evidence; recorded confirmation, correction, amendment, revision, supersession, or withdrawal.

D1-014 Each progression decision shall state the current and proposed stage, evaluate the relevant evidence, identify remaining limitations, and record approval, return for revision, deferral, or closure. A stage label shall not substitute for the decision record. No Standard shall skip public review or final approval by claiming that a prototype or pilot already establishes acceptance.

D1-015 The editor shall retain versioned drafts, a requirement-to-source and assessment map, an issue register, and substantive decision records identifying alternatives, selected direction, rationale, and affected artifacts. GR interpretation shall use relevant foundation manuscripts

and preserve unresolved source differences; operational narrowing affecting architecture shall have an ADR.

D1-016 At committee review, named reviewers shall evaluate epistemic adequacy, practical usability, ethical and distributional effects, accessibility, preservation and protection, legal/institutional boundaries, and technical feasibility within declared competence. Missing expertise or evidence shall be reported and resolved, or the scope narrowed, before unsupported requirements advance.

D1-017 Pilot reports shall identify the tested versions, cases and negative cases, methods, participants' roles, failures, burdens, limitations, and resulting changes. Synthetic or author-operated tests shall be labelled accordingly. External institutional participation, access authority, independent validation, and legal validity shall not be inferred from a synthetic rehearsal.

6 Public review and comment disposition

D1-018 Before opening public review, the chair shall freeze a uniquely identified draft and publish its scope, class, maturity, change summary, dependencies, known limitations, review questions, exact opening and closing times, submission routes, and intended treatment of commenter information. Required supporting material shall be accessible to reviewers under workable terms.

D1-019 Public review shall remain open for at least 60 calendar days. The chair shall record outreach, access interruptions, and accommodation needs; a material access failure shall receive an extension sufficient to restore meaningful opportunity, with reasons and revised closing time published.

D1-020 The Secretariat shall accept comments in an accessible free-text route as well as any structured template. It shall assign a stable identifier, record the affected version or topic, requested change if supplied, receipt date, and disclosure preference, and acknowledge receipt within seven calendar days. A comment shall not be rejected solely for lacking technical drafting expertise.

D1-021 The Secretariat shall offer a protected route for justified confidential submissions and explain its access limits. The chair shall arrange competent consideration and publish a safe summary of the issue and disposition where possible. If essential grounds cannot be exposed sufficiently for fair review, the chair shall record the limitation and defer or narrow the affected decision.

D1-022 The responsible review group shall give every in-scope comment a disposition of accepted, accepted with modification, not accepted, or deferred, with reasons and links to affected clauses or issues. Out-of-scope and duplicate comments shall retain identifiers and a reason or linked disposition. Deferral shall identify an owner, next action, and why the unresolved issue does not invalidate proposed progression.

D1-023 The chair shall target initial dispositions within 30 calendar days after review closes. If that target cannot be met, the chair shall publish reasons, interim status, and a new target before it expires. A target extension shall not deem comments resolved. Commenters shall receive disposition notice and at least 30 calendar days to reply before final approval.

D1-024 The chair shall assess each reply and record remaining disagreement. Late comments shall be logged with reasons for current-cycle consideration or later referral; a newly identified

material safety, rights, or validity defect shall receive assessment before adoption regardless of receipt date.

D1-025 A substantive post-review change shall undergo public re-review for at least 30 calendar days, showing the changed text, reasons, effects, and affected dependencies. The chair shall notify previous commenters and newly affected interests. A change that substantially alters the purpose, affected constituency, or conformance subject shall receive renewed scope approval and a full 60-day review.

D1-026 Re-review shall permit comments on changed material and its consequences for unchanged clauses. Further substantive changes shall repeat the applicable review. Editorial changes shall be logged with a reason why meaning and conformance remain unchanged.

7 Consensus, ballots, and final approval

D1-027 Before recommending progression, the chair shall produce a consensus assessment identifying participation and gaps, objections, attempts at resolution, evidence and alternatives considered, remaining dissent, and reasons for the recommendation. Numerical approval shall not establish substantive truth or by itself dispose of an objection.

D1-028 A sustained substantive objection shall receive reasoned consideration and an opportunity for reply. It shall not automatically confer a veto. Unresolved defects in mandatory procedure, decision authority, rights to participate, or required evidence shall prevent progression until remedied. Other remaining disagreement shall be visible in the approval package and assessed by the authorized decision maker.

D1-029 For adoption, substantive maintenance decisions, and other decisions assigned a formal ballot by the Charter, the Secretariat shall circulate a frozen package and proposed resolution for at least 30 calendar days. It shall state eligible participants, recusals, closing time, threshold calculation, ballot options, and challenge route. Ballots shall be approve, disapprove, or abstain; nonresponse shall be recorded separately.

D1-030 The eligible non-recused roster shall be fixed before ballot opening. Each eligible person shall have one ballot in their declared capacity; proxies and duplicate capacities shall not count. Eligibility corrections or later recusals shall be recorded. A change materially affecting the electorate, quorum, or result shall require a new ballot; membership shall not be manipulated to obtain a desired outcome.

D1-031 Let N be the number of eligible non-recused participants, R valid returned ballots including abstentions, Y approvals, and D disapprovals. A ballot shall meet quorum only if $R \geq \lceil 2N/3 \rceil$. Approval shall also require at least three substantive ballots, $Y + D \geq 3$, and $Y \geq \lceil 2(Y + D)/3 \rceil$. Abstentions shall count for returned-ballot quorum but not the substantive-ballot minimum or approval denominator; nonresponses shall count for neither.

D1-032 The result shall include the frozen roster count, recusals, returned ballots, approvals, disapprovals, abstentions, nonresponses, calculation, minority grounds, and decision. Failure of quorum or threshold shall return the matter for further work or deferral, without deemed approval. A substantive change during ballot shall return to the applicable review stage.

D1-033 Final approval shall require a procedurally valid ballot, reasoned consensus assessment, completed dispositions and reply periods, resolved blocking findings, compatible normative dependencies, rights clearance, maintenance assignment, and an authorized adoption record.

The Secretariat shall publish accessible decision notice, notify participants and commenters, and record when the appeal period starts. Release shall await that period and resolution of any appeal affecting adoption or publication.

OPEN. All numerical values in this draft are local proposals requiring author and participant review before governance adoption. They are not ISO/IEEE rules. A valid three-person ballot does not itself demonstrate stakeholder breadth or independent review capacity; Annex A identifies these participation-risk choices for explicit review.

8 Procedural appeals and separate complaint routes

D1-034 A participant, commenter, or person directly affected by a programme decision may lodge a procedural appeal identifying the decision, alleged procedural failure, available evidence, and requested remedy. Membership or payment shall not be a condition. The ordinary filing period shall be 30 calendar days after accessible notice of the decision; lack of effective notice or newly discovered concealed procedural failure shall permit a reasoned extension by the independent reviewer.

D1-035 The Secretariat shall acknowledge an appeal within seven calendar days and refer it to an appointed reviewer independent of the disputed decision. The reviewer shall disclose relevant involvement and interests, consider conflict objections, and record independence. The decision's author, a materially interested participant, or a person deciding a related complaint about their own conduct shall not determine the appeal.

D1-036 The reviewer shall state scope, admissibility reasons, record access arrangements, and timetable; provide the appellant and responsible decision maker a meaningful opportunity to reply; and issue a reasoned determination. An initial determination shall be targeted within 30 calendar days of receipt, with reasoned extensions and updated dates notified before expiry. No response or elapsed time shall constitute rejection.

D1-037 An appeal concerning adoption, public-review exclusion, or authority shall pause the affected publication decision. Other appeals shall receive a recorded decision on whether a stay is necessary to prevent prejudice. If no independent reviewer is available, consequential contested progression shall remain pending while unaffected work continues.

D1-038 The reviewer may uphold the process, require disclosure or correction of records, set aside a procedurally defective decision, or remit the matter for renewed participation, review, or ballot. The reviewer shall not substitute a ruling on factual truth, external legal entitlement, or technical merit for procedural review. The accountable body shall record implementation of the remedy before renewed progression.

D1-039 Technical reconsideration, conduct complaints, record-specific access or correction requests, and external legal remedies shall have distinguishable routes. Misrouted submissions shall receive assisted referral rather than silent rejection. Protected conduct handling shall follow the adopted ethics policy; disagreement alone shall not be treated as misconduct. Internal review shall not be presented as replacing external rights or remedies.

9 Publication and release integrity

D1-040 The release owner shall verify that the exact publication package implements the approved text and decision. The package shall identify edition, date, class, maturity, adoption authority, conformance scope, dependencies, licenses or permissions, known limitations, maintenance contact, next review date, and superseded publications where applicable.

D1-041 The release manifest shall identify authoritative source files, rendered publications, schemas or fixtures where included, their versions and integrity checks, build instructions and tool versions, and the approval record. A reviewer other than the final editor shall compare the rendered output with the approved source for omitted, altered, or unreadable requirements and record the result.

D1-042 The release owner shall resolve source/build discrepancies before release. Source corrections affecting meaning shall return to substantive review; a rebuild shall not silently change an adopted requirement. Public notices shall distinguish an adopted Standard, a Specification, an informative publication, and a policy recommendation and shall not claim ungranted endorsement or certification.

10 Maintenance, review, and withdrawal

D1-043 Every release shall have an assigned maintenance owner, issue intake route, and next review date. The default review interval shall be two years, shortened by a recorded risk-based decision. Loss of ownership, serious defects, changed dependencies, inaccessible implementation rights, or evidence of material exclusion or harm shall trigger earlier review. An overdue review shall be publicly marked and escalated; silence shall not confirm continued suitability.

D1-044 The maintenance owner shall log reported issues, classify their effect, identify affected versions and dependencies, and publish disposition or investigation status. A correction request shall not be rejected merely because the reported behavior matches the current text.

D1-045 A corrigendum shall correct an error without introducing a new obligation, altering intended meaning, or changing a valid conformance outcome. It shall identify the affected text, corrected text, justification, reviewer, and authorization. If semantic effect is uncertain, the change shall use the amendment or revision route. Historical publications shall remain identifiable rather than silently overwritten.

D1-046 An amendment shall make a bounded substantive change to a named edition; a revision shall issue a consolidated new edition. Both shall receive scope approval, assessment of dependent artifacts and users, appropriate pilots, committee and public review, and final approval under these Directives. An incompatible change shall include migration, coexistence, and deprecation information without claiming lossless conversion absent evidence.

D1-047 Periodic review shall invite evidence from users and affected parties and record confirmation, correction, amendment, revision, supersession, or withdrawal with reasons. Confirmation shall require a maintenance report and an authorized decision; it shall not erase known limitations.

D1-048 Proposed withdrawal or supersession shall receive a public notice of reasons, dependencies, transition consequences, and alternatives for at least 60 calendar days, followed by comment disposition, reply, and formal approval. Withdrawn editions shall remain identifiable

with status and date; withdrawal shall not retroactively change what a past conformance claim asserted. Necessary protection of underlying records shall follow D1-052, D1-053, and EIP-039.

11 Emergency safeguards and continuity

D1-049 An authorized governance or release holder may issue a time-limited warning or suspend programme distribution or programme recommendations for new use where a documented serious protection, rights, or integrity risk requires immediate action. The action shall state evidence, scope, authority, duration, contact, affected users, and safe public reasons. It shall remain within programme authority and shall not create or amend normative requirements or purport to invalidate external legal decisions.

D1-050 Emergency action shall receive independent review within seven calendar days and expire within 30 calendar days unless the governance authority records a justified extension, next review date, and remedy plan. Unavailable independent capacity shall not authorize emergency adoption. Permanent amendment or withdrawal shall follow the ordinary procedure; protective handling of unlawfully or improperly disclosed material remains governed by the applicable policy and context.

D1-051 A vacant role shall trigger recorded reassignment within the Charter's mandate or deferral of dependent decisions. A temporary substitute shall meet the same conflict and independence conditions. Emergency procedure shall not be used to avoid consultation because ordinary development is late or under-resourced.

12 Records, transparency, and external liaison

D1-052 The Secretariat shall preserve linked proposal, draft, comment, disposition, decision, ballot-result, appeal-outcome, release, and maintenance records. Public readers shall be able to follow the grounds and changes of a decision without mandatory access to private correspondence. Record corrections shall retain the prior account and correction relationship where lawful and appropriate.

D1-053 A records schedule shall state purpose, custodian, access category, retention period or trigger, restriction review, and authorized disposition for each record category. Public publication history and safe decision reasons shall be retained durably; sensitive submissions and personal data shall not be retained indefinitely by default. A restriction or deletion shall preserve a safe explanation when permitted, without revealing protected existence or identity.

D1-054 The governance authority shall publish an annual account of active work, decisions, unresolved objections, participation gaps, funding influence, overdue maintenance, and procedural incidents at a level that protects affected people. The account shall distinguish claimed representation from evidenced participation.

D1-055 External liaison shall have an explicit mandate identifying purpose, authorized speaker, commitments permitted, and reporting duties. A policy proposal shall identify its intended institution and review route and remain recommendatory. Liaison, use of external sources, and informal participation shall not imply affiliation, institutional endorsement, or adoption of another body's procedures.

12.1 Publication routes outside Standard adoption

D1-056 Before external release of a Specification or informative publication, the responsible authority shall approve a work-item review plan identifying publication class, maturity criteria, release authority, reviewers and needed competence, public-comment arrangements and period with rationale, objection disposition, appeal route, maintenance responsibility and rights clearance. The release record shall identify fulfillment and remaining limitations. Drafting alone shall not constitute that approval.

D1-057 A Specification release containing technical conformance requirements shall use the technical review, public review, disposition, ballot and appeal rules in this Part, while retaining Specification status and its declared maturity. Its release shall not use stage 60 or imply Standard adoption. Promotion shall require an explicit Standard work-item and adoption decision with review of changed scope, requirements and prior evidence.

D1-058 A Policy or Institutional Proposal shall receive a separate mandate-specific release decision identifying its intended addressee, institutional and affected-interest review, public-comment opportunity, considered alternatives and unresolved objections. Its review plan shall preserve a reasoned disposition and the procedural appeal route in this Part. An informative report or manual shall likewise identify its review and release decision without claiming technical Standard conformance authority.

A Proposed defaults and alternatives (informative)

These choices make the draft exercisable; they remain **PROVISIONAL** until explicit governance adoption. A future change to operative thresholds or minimum periods needs governance amendment and does not apply retrospectively to an open ballot or review.

Proposed default	Purpose	Alternative and evidence needed
60-day public review; 30-day material re-review	Allow asynchronous participation while enabling bounded iteration.	Longer multilingual review or shorter narrow review; test notice reach, access, and actual response burden. Shortening minima needs prior governance amendment.
30-day disposition target and reply period; seven-day acknowledgement	Make receipt and delay visible while preserving substantive consideration.	Different service targets; test volunteer capacity and accessibility needs. A target is not an automatic closure rule.
30-day ballot and appeal periods	Give participants time to read a fixed package and challenge process.	Longer periods for complex work; test availability and remedy effectiveness.
Two-thirds returned-ballot quorum; three substantive votes; two-thirds approval	Prevent adoption based on one affirmative vote and abstentions; require substantial expressed support.	Larger minimum electorate or stakeholder balance conditions. Three voters do not demonstrate constituency breadth; assess actual participation and available competence.

Proposed default	Purpose	Alternative and evidence needed
Two-year maintenance review	Require periodic attention without continuous reballoting.	Annual or longer scope-specific review; evaluate dependency change, harms, issue volume, and maintenance resources.
Seven-day emergency review; 30-day expiry	Limit exceptional authority and expose delays.	Shorter periods for urgent privacy incidents; test reviewer availability and restoration of ordinary review.

B Governance rehearsal evidence (informative)

A useful rehearsal records actors as fictional or unassigned, uses identified draft versions, and leaves a complete decision trail. It is not actual public review, proof of representativeness, or governance adoption.

Assessment uses an evidence register with a row for each applicable D1 identifier, the procedure or decision assessed, required record location, reviewer, result (fulfilled, not fulfilled, not assessed, or not applicable), and unresolved action. A not-applicable result identifies the absent trigger. Document inspection assesses notices, disclosures, reasons, and manifests; arithmetic recalculation assesses ballot results; observed exercises assess intake, recusal, reply, appeal, and restoration behavior. Independent procedural review assesses contested fairness and authority. Missing records or unperformed procedures are not counted as fulfillment.

1. Process a bounded NWIP through accept, revise, and defer alternatives. Identify an infrastructure need without presuming a Specification or Standard already exists.
2. Receive an accessible free-text comment, a protected submission, and a sustained minority objection. Show acknowledgement, reasoned disposition, reply, and safe publication.
3. Re-review a material change and demonstrate why a change of constituency restarts full review. Preserve unsuccessful alternatives and source uncertainty.
4. Recalculate a ballot after recusal: with five eligible people, four returns meet quorum; two approvals, one disapproval, and one abstention satisfy the approval threshold. Repeat with two returns and show deferral.
5. Test three returns consisting of one approval and two abstentions. Record failure of the three-substantive-vote minimum even though returned-ballot quorum can be met.
6. Appeal exclusion from review; document independent appointment, conflict challenge, stay, reply, remedy, and renewed decision. Repeat with no independent reviewer and show pending progression.
7. Compare approved source and rendered output, detect an omitted requirement, and prevent release. Distinguish typographic correction from a changed conformance result.
8. Simulate maintenance, incompatible revision, withdrawal, an urgent warning, and role vacancy. Demonstrate that an emergency cannot adopt a Standard.

The rehearsal report records failures, required staffing, elapsed effort, participation and confidentiality barriers, revised clauses, and remaining questions before the founding participants assess readiness.

C Source and tailoring record (informative)

The programme's Brief and comprehensive plan supply the mission and local lifecycle. The comparative planning study supplies the alternatives examined. This draft proposes its own procedures and values; it does not claim ISO, IEEE, or WTO conformity, accreditation, or international representativeness.

Source and interpretation. ISO, *International harmonized stage codes*, official webpage checked 22 September 2026, https://www.iso.org/stage-codes.html. The source distinguishes publication, review, and withdrawal; this programme retains its existing local stage 90 grouping. No ISO substage deadlines or voting rules are imported.

Source and interpretation. IEEE SA, *Standards Board Operations Manual*, clause 5, official webpage checked 22 September 2026, https://standards.ieee.org/about/policies/opman/sect5/. Its separation of project supervision, review, and appeals informs comparison. The programme's staffing, deadlines, eligibility, and remedies above are new local proposals, not statements of IEEE requirements.

Source and interpretation. WTO, *Principles for the Development of International Standards, Guides and Recommendations*, official presentation of the 2000 TBT Committee decision, checked 22 September 2026, https://www.wto.org/english/tratop_e/tbt_e/principles_standards_tbt_e.htm. Its process principles inform scrutiny of transparency, participation, relevance, and coherence; no determination of legal status under the TBT Agreement is made.

OPEN. The comparative study records an access gap for the full ISO/IEC Directives Part 1:2026 and Part 2 amendment text. This draft makes no clause-level claim about those unverified texts. Founding authority, actual appointments, contribution terms, neutral review availability, and numerical defaults need explicit resolution before governance adoption.

GENERATIVITY STANDARDS PROGRAM

Directives Part 2

Structure and Drafting Rules

Governance Working Draft

Draft version 0.1

22 September 2026

WORKING DRAFT FOR REVIEW

This document is not adopted. Its requirement language expresses proposals for review and rehearsal. Preparation of this text does not establish programme governance, approve a formal standards project, or certify substantive truth, legal validity, or institutional legitimacy.

Publication class, scope, dependencies and unresolved decisions are stated in the document. No ISO, IEC or IEEE affiliation or endorsement is claimed.

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1 Scope and standing

Responsible editor: `UNASSIGNED`. Canonical source: `governance/directives_part_2.tex`. Intended readers are publication editors, reviewers and implementers preparing assessment artifacts.

This draft defines proposed rules for preparing, reviewing and maintaining programme publications and their associated machine-readable artifacts. Its conformance subject is a publication package: the declared source document, rendered edition, references, associated artifacts and assessment material. A package can be reviewed against this draft without claiming adopted-Standard status.

The rules become operative only through a recorded governance adoption under the Charter and Directives Part 1. The present exercise is a drafting rehearsal. Requirements use *shall*; recommendations use *should*; permissions use *may*; *can* describes possibility or capability. An unresolved choice is not concealed inside an operative requirement.

D2-001 A publication shall identify its code or other identifier, title, publication class, maturity status, version, responsible editor or unassigned responsibility, and source location near its beginning.

D2-002 A draft shall state that it is not adopted and shall distinguish authoring progress from formally authorized project status. A publication shall not imply ISO, IEC, IEEE or governmental authority without a documented basis.

Informative note. The source files in this initial package are preparatory Working Drafts. The repository's existing numbers remain project-family identifiers; creating a PDF does not advance a document to stage 60.

2 Publication architecture and authority

2.1 Classes and intended readers

D2-003 An editor shall assign one principal publication class and state its intended readers, use and authority. A Standard, Specification, Technical Report, Manual, governance document and Policy or Institutional Proposal shall not be treated as interchangeable classes.

D2-004 A protocol description shall identify its containing publication class. Protocol behavior shall be distinguished from the institutional authority and procedure under which that behavior is used.

D2-005 A Policy or Institutional Proposal shall distinguish factual background, interpretation, objectives, options, mandate, implementation implications and unresolved questions. It shall not create technical conformance obligations through an unapproved policy recommendation.

2.2 Document components

A Standards-track or Specification draft normally contains a foreword or standing statement, scope, normative references if any, terminology, requirements, conformance, informative examples, source rationale, and known open issues. The extent depends on the actual subject; empty headings are not evidence of completeness.

D2-006 The scope shall identify the subject of conformance, intended use, relevant environment and exclusions. A claim of conformance shall be assessable within that stated boundary.

D2-007 Normative and informative material shall be distinguishable at clause, annex or artifact level. Notes, examples and informative annexes shall not introduce additional requirements.

D2-008 Every table, figure, annex and associated artifact shall have a stated role and, where interpretation depends on it, a stated authority status. A normative requirement represented in a diagram shall also have an identifiable textual formulation.

3 Requirements and recommendations

3.1 Form of a provision

D2-009 A requirement shall identify the responsible actor or object, the applicable condition, the required behavior or property, and an outcome or evidence by which fulfillment can be assessed.

D2-010 A requirement shall use a stable identifier independent of its displayed section number. An identifier shall not be reassigned to a different obligation after circulation; a withdrawn identifier shall remain traceable.

D2-011 A requirement shall not combine independent obligations whose applicability or assessment differs so materially that one result would conceal another. Related obligations can be grouped when their joint assessment is explicit.

D2-012 Terms such as adequate, appropriate, trustworthy or significant shall have a scoped criterion, declared decision responsibility or assessment procedure when they determine conformance. A broad aspiration alone shall not be presented as a testable requirement.

D2-013 A permission shall not override a requirement implicitly. Exceptions shall identify the affected obligation, conditions, authority, required record and any limitation on the resulting conformance claim.

D2-014 The editor shall distinguish mandatory conditions, recommendations, permissions and capability statements consistently. A recommendation's non-fulfillment shall not be reported as failure of a requirement.

3.2 Conditions, absence and proportionality

D2-015 A conditional requirement shall state its trigger and how applicability is determined. A result of not applicable shall include its reason; it shall not substitute for unavailable evidence or an unperformed assessment.

D2-016 When complete information is not realistically available, a recording requirement shall specify whether a justified unknown, limitation or restricted disclosure satisfies the obligation. It shall not require invented content to complete a mandatory field.

Informative note. A requirement can demand a declaration of uncertainty without demanding a resolved historical fact. Proportionality concerns the recording obligation; it does not make unsupported substantive claims better supported.

4 Terminology, sources and GR interpretation

D2-017 An operational definition shall state its scope and shall not imply that it exhausts a broader philosophical concept. A definition imported or adapted from a source shall identify that source, edition and the nature of the adaptation.

D2-018 For a substantive GR definition, the editor shall record the relevant foundation passage, alternatives, unresolved differences and the rationale for operational use. A material narrowing or departure shall have an Architecture Decision Record before the definition is stabilized for adoption.

D2-019 An operational definition of Entity, State, Event, Process, Relation or Property shall address admissibility, identity, temporal behavior, allowed relations, required and optional information, examples, counterexamples and unresolved edge cases. A declaration that an item remains provisional shall identify the missing decisions.

D2-020 The editor shall not equate a formal state with an archival State, a mechanism with a Process, or formal change with an Event without an explicit argument and scoped decision. The six record roles shall not be presented as exhaustive constituents of reality.

D2-021 A draft shall distinguish occurrence claims, observations, evidence assessments, interpretations, normative evaluations, legal assertions and institutional determinations wherever conflation would strengthen a claim beyond its grounds or authority.

D2-022 An external reference used to support a normative or scholarly claim shall be verified against an identified primary source. Inaccessible text, uncertain edition, incomplete review and unverified compatibility shall be identified rather than reconstructed as fact.

5 References and dependencies

D2-023 A normative reference shall identify the exact document and edition required to apply a requirement, the part relied on and a means of obtaining it. Informative motivation shall be listed separately from normative dependencies.

D2-024 A draft depending on another draft shall identify the dependency's version and status and the consequences of a change. It shall not imply the dependency has already been adopted.

D2-025 Before approval for publication, the editor shall produce a dependency review identifying incompatible versions, unavailable dependencies, circular requirements and licensing or access constraints material to implementation.

D2-026 A claim of equivalence, compatibility or interoperability with another model shall identify its direction, scope, tested cases, unsupported distinctions and known loss. Matching terminology alone shall not justify that claim.

Informative note. Core documents can co-evolve without circular authority: vocabulary supplies terms; recording and epistemic documents supply complementary requirements; a package declaration pins both drafts for an experimental assessment.

6 Conformance clauses and profiles

D2-027 The conformance clause shall distinguish the assessed subject, publication edition, profile, applicable requirements, assessment method, assessor and result. It shall distinguish a record, producer, protocol participant, presentation, archive and organizational procedure when their obligations differ.

D2-028 Each requirement shall have at least one stated assessment method and evidence expectation. Structural checks, protocol tests, human interpretation and procedural review shall have separately identifiable results.

D2-029 A conformance report shall distinguish fulfilled, not fulfilled, not assessed and not applicable results. A missing assessment shall not be counted as fulfillment.

D2-030 A profile shall state its parent requirements, additions, permitted restrictions, exclusions and intended users. It shall not silently weaken a parent requirement while claiming unqualified parent conformance.

D2-031 A draft shall state the limits of its conformance claims, including the distinction between record structure and factual truth, between source authentication and evidential warrant, and between technical conformance and legal or ethical judgment.

D2-032 An automated check shall identify the constraints it actually assesses. A passing automated result shall not be presented as evidence of a human or institutional action that the check did not observe.

7 Protocol and machine-readable artifacts

D2-033 A protocol Specification shall define its participants, inputs, preconditions, state transitions, observable outputs, effects, refusal and failure cases, recovery behavior, version assumptions and authorization boundaries.

D2-034 An artifact package shall identify the relationship between its prose requirements and its schemas, examples, vocabularies, test fixtures and executable components. Conflicts shall have a documented resolution rule that does not silently amend an approved requirement.

D2-035 Examples intended to be valid shall identify the supported profile and expected result. Negative examples shall identify the intended defect. Synthetic evidence shall be labelled as synthetic.

D2-036 A schema, API or encoding choice shall be traceable to a stated requirement or interoperability need. Implementation convenience alone shall not be described as a philosophical necessity or universal institutional rule.

D2-037 Executable validation or rendering shall not silently retrieve unpinned remote resources, disclose protected input or substitute a current external vocabulary for the edition declared in the package. Any required external processing shall be explicit.

8 Presentation, accessibility and legal context

D2-038 A publication shall use headings, table labels, link text and readable typography that expose its structure. Essential meaning shall not depend solely on color, visual position or a diagram.

D2-039 An editor shall provide a usable source or alternative reading representation and identify known accessibility limitations of the rendered document. Successful PDF compilation alone shall not establish accessibility conformance.

D2-040 A legal or institutional assertion used in a requirement shall identify the context, asserted source of authority and scope. A proposed model rule or policy option shall be labelled as such rather than described as generally applicable law.

D2-041 The editor shall record cross-domain review findings relevant to scope, including epistemic, ethical, legal, institutional, political-economy, archival, security and accessibility questions. Unavailable competence or unresolved material objections shall remain visible in progression records.

9 Versioning and publication production

D2-042 Each circulated edition shall identify its canonical source and rendered artifacts. Changes to proposed requirements shall be traceable through the change record, with superseded reasoning retained subject to justified access and retention rules.

D2-043 A release candidate shall be built from the declared source revision, with build instructions, required tooling and an artifact manifest sufficient to reproduce and compare its substantive content.

D2-044 The release check shall detect broken internal references, duplicate requirement identifiers, missing glyphs, visibly clipped material, mismatched status labels and disagreement between declared source and generated artifact. Unresolved defects shall be reported with their effect on use.

D2-045 An editorial correction shall not silently change the substance of a requirement. A substantive change to an adopted normative edition shall use the amendment or revision procedure in Directives Part 1, including affected-artifact and compatibility review. A draft change shall follow the change-control and re-review rules applicable to its current stage. Changes to a released Specification shall follow its declared maintenance procedure and promotion shall require a separate decision.

Informative note. Byte-identical PDF reproduction is not assumed: timestamps and compiler versions can change bytes. The initial build manifest records source and PDF hashes, compiler results and review warnings so each reviewed artifact is identifiable.

10 Assessment of a publication package

The editor prepares an assessment register with one row for each applicable D2 requirement: identifier, evidence location, result, reviewer and unresolved action. Examples of evidence

include the source front matter, dependency inventory, requirement-to-case matrix, source-to-definition map, compilation report and page inspection.

A review against this draft is described as an experimental drafting assessment. It is not ISO/IEEE conformance, accreditation, accessibility certification or adoption of a programme Standard.

11 Informative source basis and drafting decisions

The programme's AGENTS instructions, publication taxonomy, source manifest, comprehensive plan and accepted ADR-0002 provide the local basis. The proposed publication-source architecture and bounded technical drafting are recorded in ADR-0004.

Source and interpretation. ISO's public house-style and foreword guidance were consulted for distinctions among requirements, recommendations, permissions, possibilities and conformity assessment: https://www.iso.org/ISO-house-style.html and https://www.iso.org/foreword-supplementary-information.html. IEEE's public Operations Manual clause 6 was consulted for the distinction among normative and informative materials: https://standards.ieee.org/about/policies/opman/sect6/. Checked 22 September 2026. These sources inform independently written programme proposals; their procedures are not adopted by citation.

The initial production choice is canonical TeX source beside existing project documents, a shared presentation preamble and LuaLaTeX rendering through an explicit manifest. Markdown remains navigation and historical context. Alternative authoring systems remain possible after a recorded maintenance decision.

OPEN. The licence terms, founding adoption, actual editor appointments, minimum accessibility target and final profile terminology remain to be decided. This draft does not grant publication rights to third-party material.

OPEN. Full ISO/IEC Part 1:2026 and Part 2:2021 with its 2026 amendment were not available in the earlier comparison. No clause-level conformity with those editions is asserted here.

GR/TC 1

GR/TC 1 Charter: Generativity Records and Infrastructure

Governance Working Draft

Draft version 0.1

22 September 2026

WORKING DRAFT FOR REVIEW

This document is not adopted. Its requirement language expresses proposals for review and rehearsal. Preparation of this text does not establish programme governance, approve a formal standards project, or certify substantive truth, legal validity, or institutional legitimacy.

Publication class, scope, dependencies and unresolved decisions are stated in the document. No ISO, IEC or IEEE affiliation or endorsement is claimed.

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1 Status and committee mandate

Responsible editor: `UNASSIGNED`. Canonical source: `governance/technical_committee_charter.tex`. Intended readers are committee participants, editors, domain reviewers and the programme decision authority.

This draft defines the proposed remit, responsibilities, and evidence obligations of GR/TC 1. It is a governance document; it does not constitute the committee, approve a work item, or adopt a technical Standard. The programme Charter and Directives supply decision authority and procedure.

TC-001 The committee shall become active only through a recorded mandate under the adopted programme Charter. The mandate shall identify its convenor, responsible decision authority, participating capacities, accepted work items, review resources, and mandate review date.

TC-002 The committee shall develop coordinated recording and practical procedures that support warranted, contestable, revisable recognition and preservation of consequential generative trajectories. Each accepted work item shall state its contribution to this purpose and the limits of its expected effects.

TC-003 Committee work shall distinguish changes in the situation under inquiry, changes in evidence and judgment, and changes in categories or methods of recognition. A technical representation connecting these histories shall preserve their distinguishable meaning.

2 Scope and exclusions

The proposed scope includes source-grounded vocabulary, recording requirements, epistemic representation, evidence and interpretation, contestation, revision, accountable institutional use, information models, exchange, presentation, preservation, access, and conformance assessment.

TC-004 The committee shall retain the distinctions between theoretical metamodel, operational record ontology, epistemic representation, normative assessment, jurisprudential status, institutional governance, political economy, and implementation when defining scopes or allocating work.

TC-005 The committee shall not claim authority to certify substantive historical truth, resolve a complete metaphysics, determine legal rights across jurisdictions, endorse a political choice on technical grounds alone, or mandate unrestricted disclosure of recorded material.

TC-006 The committee shall preserve existing publication identifiers when refining scopes. A proposal to change a publication's class, merge or divide its scope, or introduce a new identifier shall record the reason, dependencies, alternatives, and authorizing decision before the change is treated as operative.

Informative note. Protocols describe actors, interactions, states, transitions, outcomes, and failures within a Specification or adopted Standard. Protocol is not a separate publication-authority class. The committee can investigate category-theoretic semantics in Technical Reports without making them a user-facing ontology.

3 Work-item authorization and coordination

TC-007 A work-item proposal shall identify purpose, scope and exclusions, conformance subjects, affected interests, foundation sources and tensions, existing alternatives, related publications, anticipated Specifications, reviewer competence, practical evidence, and maintenance ownership.

TC-008 The committee shall record work-item dependencies and allocate requirements to their responsible publication before producing a normative technical binding. A shared requirement shall have one authoritative location, with versioned references from dependent work.

TC-009 Editors shall begin with the normative or procedural need and create a Specification proposal when reusable infrastructure is required to satisfy or assess it. A prototype shall not silently determine a theoretical definition or institutional obligation.

TC-010 A proposed substantive scope expansion shall return to the responsible decision authority with its consequences for participation, sources, dependencies, review, and resources. Work outside the authorized scope shall remain exploratory pending a decision.

Informative note. GR/NWIP-001, Generativity Recording and Presentation Infrastructure, is the candidate first coordinated work item. Its current draft does not itself authorize formal committee drafting. Preliminary drafts and synthetic exercises provide evidence for that decision.

4 Functions, work groups, and capacity

The proposed committee convenor, editors, domain reviewers, affected-participant contacts, implementation reviewers, and maintenance owners are **UNASSIGNED**. A single coordinated group can initially perform several tasks, subject to declared competence and conflicts. The six working groups named in the historical outline remain possible allocations; their names do not establish active bodies.

TC-011 For each active deliverable, the committee shall record an accepted editor or lead, a maintenance contact, required review competence, available reviewers, and unfilled roles. Multiple roles held by one person shall be declared.

TC-012 A new working group shall have a bounded scope, actual willing participants, an accountable lead, dependencies, intended outputs, and review or closure conditions. Its formation shall not imply autonomous adoption authority.

TC-013 A reviewer shall identify the domain and scope of their assessment, relevant competence or situated knowledge, interests, material limitations, and whether they contributed to the material reviewed. A self-review shall not be labelled independent.

TC-014 Where required expertise or affected perspectives are unavailable, the committee shall record the gap and its material effect on progression. It shall narrow claims, seek additional review, or defer the affected decision when the gap prevents a justified assessment.

5 Conceptual sources and operational decisions

TC-015 Before introducing or materially changing a GR definition, notation, ontology class, or compatibility claim, the responsible editor shall examine the relevant foundation manuscripts

and record exact source locations, terminology, scope, historical differences, and the proposed operational translation.

TC-016 The committee shall preserve unresolved foundation differences rather than harmonizing them silently. A material operational narrowing or departure shall be recorded through an architectural decision with alternatives, rationale, affected publications, and remaining uncertainty.

TC-017 A candidate record-class definition shall identify its definition, admissibility conditions, identity criterion, temporal behavior, permitted relations, required and optional metadata, examples, counterexamples, and unresolved edge cases, or explicitly identify which elements remain under development.

TC-018 An external compatibility or reuse proposal shall identify the exact source and edition, verified relevant provisions, mapping assumptions, exclusions, and evidence needed to support the claimed relationship. Similar terminology shall not alone establish equivalence.

6 Multidisciplinary review

TC-019 At work-item scoping, before a real pilot, and before publication progression, the committee shall maintain a review dossier covering applicable epistemic, ethical, jurisprudential, institutional, political-economic, archival, privacy/security, accessibility, and technical questions. Each domain shall have findings or an explicit justified statement of non-applicability or unassessed scope.

TC-020 The review dossier shall identify evidence, reviewers and their capacities, affected perspectives, conflicts, alternative designs, findings, dispositions, owners of corrective action, and residual limitations. A metadata field or completed checklist shall not by itself count as domain assessment.

The following review questions guide implementation of TC-019. They are informative prompts, not additional undeclared conformance requirements.

Epistemic. Can a reader distinguish a trace, observation, claim, inference, counterevidence, institutional finding, and a changed method? Are uncertainty and absent or restricted evidence intelligible?

Ethical. Who is exposed or excluded, who bears recording and contestation work, which values conflict, and what refusal, correction, or repair is feasible?

Jurisprudential. Which forum, rule, authority, and procedural status are asserted? Is the text descriptive analysis, a model rule, a policy option, or an implemented institutional procedure?

Institutional and policy. Who can decide, give reasons, reconsider, implement a remedy, and monitor consequences? Which mandate and policy alternatives remain open?

Political economy. Who controls evidence, categories, infrastructure, access, and migration? How do costs, contributions, dependency, and benefits differ among participants?

Archival and protection. What is preserved, omitted, restricted, revised, transferred, or destroyed? Can a later user understand an authorized historical view without exposing protected material?

Technical and human use. Can independent users implement the required behavior and understand the presentation? Are failures, conflicts, unsupported features, accessibility, and feasible human alternatives addressed?

TC-021 A legal or institutional profile shall state its jurisdiction or forum, target action, relevant sources and status, claimed authority, temporal scope, unresolved conflicts, and reviewing competence. Generic technical conformance shall not replace assessment of actual applicability.

TC-022 A policy proposal arising from committee work shall follow the separate policy-publication route and compare plausible institutional options, including existing infrastructure or deferral when relevant. The committee shall not present participation in technical review as assent to a policy recommendation.

7 Pilots, assessment, and failure evidence

TC-023 Before a pilot begins, its record shall identify the case and baseline, questions and success criteria, participants and actual authority, material and access permissions, resource burden, anticipated harms, challenge and correction routes, stop conditions, and responsible reviewers. Synthetic cases shall be labelled synthetic.

TC-024 The initial coordinated demonstration shall exercise a claim and its grounds, a consequential relation or contribution, an alternative or challenge, a reasoned response, a historical revision, a protected or unavailable record, and a presentation that makes their distinct status understandable.

TC-025 Pilot findings shall report failed tasks, missing or conflicting evidence, excluded participants, unmet assumptions, and burdens alongside successful behavior. The committee shall trace each material finding to a requirement change, retained decision with reasons, further inquiry, or scope limitation.

TC-026 A conformance proposal shall identify the assessed subject, edition, profile, applicable requirements, methods, evidence, unresolved findings, and limits of the resulting claim. Syntax checks, semantic interoperability, procedural compliance, usability, and substantive warrant shall receive distinguishable results.

TC-027 The committee shall substantiate an interoperability claim with independent implementation or exchange evidence appropriate to the claim. A single internally consistent prototype shall be reported as such.

8 Progression, maintenance, and accountability

TC-028 For each requested progression decision, the convenor shall assemble the current draft, requirement and source trace, comment dispositions, unresolved objections, multidisciplinary findings, pilot or other assessment evidence, rights-clearance status, and maintenance proposal. The programme decision authority shall apply Directives Part 1.

TC-029 The committee shall retain a link from a corrected or superseded requirement to the prior text, reason, decision, affected dependencies, and migration consequence. Historical decisions shall remain distinguishable from the current authoritative edition.

TC-030 The committee shall submit scope, participation, resource, and outstanding-risk information at its mandate review and when material conditions change. An inactive or unstaffed work item shall receive an explicit status and continuity disposition.

9 Review evidence and informative sources

Committee readiness is assessed against accepted appointments, a scoped work item, a requirements/dependency register, a source trace, a review dossier, and a rehearsal record. Technical publication readiness remains a separate decision. A reviewer can select a material requirement and follow it from the problem and source through alternatives, draft, assessment, comments, and disposition.

Source and interpretation. Programme Charter and Directives Parts 1 and 2, companion Governance Working Drafts, version 0.1. These are proposed internal dependencies pending coordinated adoption. Their adopted edition identifiers must be fixed in the committee mandate.

Source and interpretation. Local planning basis: `docs/planning/comprehensive_development_plan.md`, `docs/planning/cross_domain_programme.md`, `docs/planning/protocol_specification_plan.md`, and `docs/planning/foundation_traceability.md`. The committee responsibilities are new operational proposals derived from that programme plan.

Source and interpretation. Foundation orientation: FM-001, Chapter 1, section 1.14, pp. 79–83; FM-003, Chapter 3, section 3.12, pp. 129–132; FM-005, Chapter 5, section 5.18, pp. 150–153. Exact files and version uncertainties are recorded in `foundation_manuscripts/MANIFEST.md`. Operational obligations in this Charter do not purport to exhaust the manuscripts' theoretical concepts.

The draft selects one coordinated committee with declared review functions. Alternatives include immediate formation of six standing groups or independent domain committees. The selected direction keeps shared dependencies visible and avoids claiming staffing or independence that has not been demonstrated. Additional groups remain available when actual work and capacity justify them.

OPEN. Committee constitution, membership register, reviewers, formal work-item approval, and live pilot partners remain OPEN. The first case can be rehearsed using synthetic material and appropriately shareable programme history without implying external consent.

OPEN. Property/Attribute terminology, Chapter 3 version precedence, and the relationship between fixed-carrier formalism and broader emergence remain OPEN source questions. The committee mandate does not resolve them.

GENERATIVITY STANDARDS PROGRAM

Ethics and IP Policy

Ethics, Conflict-of-Interest, and Contribution Rights Policy

Governance Working Draft

Draft version 0.1

22 September 2026

WORKING DRAFT FOR REVIEW

This document is not adopted. Its requirement language expresses proposals for review and rehearsal. Preparation of this text does not establish programme governance, approve a formal standards project, or certify substantive truth, legal validity, or institutional legitimacy.

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1 Purpose, status, and distinct responsibilities

Responsible editor: UNASSIGNED. Canonical source: governance/ethics_ip_policy.tex. Intended readers are contributors, affected people, ethics and rights reviewers, and programme administrators.

This governance draft addresses conduct in programme development, conflicts affecting decisions, impacts of the infrastructure being developed, and the rights needed to receive, revise, preserve, and publish contributions. These are connected responsibilities with different review questions. Ethical acceptability, evidential adequacy, and permission to reuse material are not interchangeable.

No copyright transfer, licence, patent undertaking, contract, or institutional legal mandate is created by this draft. Operative contribution and publication terms require a recorded choice, authority to offer them, and acceptance where required. Programme-internal conduct remedies do not determine legal liability or replace external remedies.

EIP-001 The programme shall identify the adopted edition, effective scope, responsible ethics contact and alternate, protected reporting route, decision authority, and neutral-review route before treating this policy as operational. Until then it shall retain Governance Working Draft status.

EIP-002 The programme shall assess conduct, conflicts, substantive impacts, and contribution rights through distinguishable findings. A favorable finding in one area shall not be represented as clearance in another.

2 Respectful participation and evidential integrity

EIP-003 Participants acting in programme roles shall not engage in harassment, threats, retaliation, discriminatory exclusion, or coercive disclosure of protected information. Critical disagreement about sources, methods, policy, and requirements shall remain eligible for reasoned consideration.

EIP-004 A participant presenting a factual or source-based claim shall distinguish observation, quotation, interpretation, inference, and proposal where that distinction affects review. Known material errors, fabricated evidence, or falsely attributed sources shall not be retained as support after discovery without correction or explicit disputed status.

EIP-005 Editors shall preserve attribution of material contributions and competing positions within actual permissions and protection needs. Authorship, acknowledgement, evidential reliability, ownership, and decision authority shall remain distinct.

EIP-006 A participant using AI assistance for a material draft, analysis, evidence synthesis, or disposition proposal shall identify the consequential assistance and the responsible human reviewer in the development record. The reviewer shall verify material sources and conclusions before relying on them.

EIP-007 Participants shall not submit protected, confidential, or third-party material to a tool or service without an established basis for that disclosure. Uncertainty about such a basis shall be resolved before the disclosure.

Informative note. The AI-use record can be proportionate: task, material sources, consequential transformations, and human checking can be sufficient without preserving every prompt or exposing protected inputs. AI use alone does not establish either error or authorship entitlement.

3 Interests, influence, and recusal

EIP-008 Before accepting a decision or review role and when relevant circumstances change, a participant shall disclose interests that could materially affect, or reasonably call into question, their impartial performance of that role. The disclosure shall include relevant financial, employment, funding, authorship, institutional, personal, and infrastructural-control interests.

EIP-009 The responsible coordinator shall record a conflict assessment, its author, the affected decision, the disclosed interest, protection limits, and the selected management action. Disclosure alone shall not be treated as resolving a conflict.

EIP-010 A person shall not determine the disposition of a complaint against themselves, act as neutral reviewer of their own decision, or independently assess a rights clearance in which they have an unresolved material interest. The alternate route shall be used.

EIP-011 Conflict management shall identify whether disclosure with oversight, separation of roles, partial recusal, replacement, or deferral is required. A recusal shall identify the decision scope and substitute authority without suppressing relevant technical evidence from the recused contributor.

EIP-012 The decision authority shall examine material concentration of funding, affiliation, available unpaid labor, infrastructure access, and agenda control when assessing fair consideration. If the concentration impairs review, it shall record corrective measures and reassess progression.

Informative note. Expertise and experience often arise through involvement. The aim is bounded, inspectable authority and conflict-sensitive review, not automatic exclusion of knowledgeable contributors. A public summary can state the conflict category and management action while protected details remain with a neutral reviewer.

4 Protected reports and fair treatment

EIP-013 The programme shall provide a reporting route to an ethics contact and an alternate independent of a reported person. Its notice shall explain receipt handling, who can access material, limits on confidentiality, possible outcomes, record retention, and the procedural-review route.

EIP-014 A report shall receive acknowledgement, triage, status communication, and a reasoned disposition. The acknowledgement and initial-determination targets, including notified extensions, in D1-035 and D1-036 shall apply to report handling without converting the report into a procedural appeal. Triage shall distinguish immediate protection needs, conduct issues, procedural appeals, substantive technical objections, and record-specific correction or access requests.

EIP-015 A report shall not be rejected solely because its author requests protected handling or lacks a formal role. The reviewer shall record whether limited identity or unavailable evidence constrains investigation and what fair assessment remains possible.

EIP-016 Before an adverse conduct finding, the responsible reviewer shall provide the affected person a sufficient account of the concern and an opportunity to respond, using redaction or a protected intermediary when necessary. Where protection prevents a fair determination, that limitation shall remain explicit.

EIP-017 A temporary protective measure shall identify the immediate risk, authority, limited scope, review point, and route to challenge. It shall be distinguished from a concluded misconduct finding.

EIP-018 A final conduct disposition shall identify the applicable rule, assessed evidence and limits, conflicts and recusals, finding, reasons, proportionate remedy, responsible implementer, and review route. Available programme remedies include correction, facilitated participation, role reassignment, limited access, suspension, or removal under the Charter.

EIP-019 The programme shall monitor agreed remedies and potential retaliation and shall publish a non-sensitive account sufficient to inspect procedural handling. Confidential material shall not be published merely to demonstrate transparency.

EIP-020 If a fair, sufficiently independent review cannot be provided, the programme shall record that limitation, preserve appropriate protections, and defer the affected consequential determination. It shall not represent inability to investigate as proof that a report is false or established.

5 Impacts of proposed standards and pilots

EIP-021 Each work item shall assess whose experiences become visible, who can challenge classifications, who bears recording and review burdens, and who gains control or access through the proposed infrastructure. Assessment shall consider relevant alternatives, evidence, and residual uncertainty.

EIP-022 An impact assessment shall distinguish observed effects, predicted effects, value commitments, and institutional choices. It shall identify material tradeoffs involving recognition, privacy, autonomy, unequal participation, maintenance labor, ecological conditions, and future capacities where relevant to the use case.

EIP-023 Before a real pilot or consequential expansion, the responsible authority shall record its purpose, actual participants and mandate, permitted material, accessible notice and challenge routes, protection measures, monitoring, stop conditions, and capacity to implement correction or repair.

EIP-024 A proposal involving contribution or generativity return shall distinguish descriptive attribution, normative evaluation, and any proposed allocation of benefits or responsibilities. It shall not infer a monetary amount, entitlement, or contractual obligation solely from a generativity record.

EIP-025 A material unresolved ethical or participation finding shall receive a recorded disposition before the affected publication or pilot decision. Completion of a form shall not alone establish that an impact is acceptable or a remedy effective.

6 Contribution intake and rights register

Contribution intake means receiving material for a specified purpose. Publication, redistribution, modification, retention, software implementation, and use of personal information can require different authority. A rights register makes those distinctions visible; it does not establish that an asserted permission is legally effective.

EIP-026 For contributed material proposed for incorporation or distribution, the rights register shall identify the artifact and version, contributor and stated capacity, claimed rights holder, source, intended uses, asserted permission or licence, restrictions, third-party components, evidence of authority, and unresolved questions.

EIP-027 A contribution record shall distinguish permission to examine material from permission to incorporate, edit, redistribute, sublicense, or publish it. Repository access, submission of comments, acknowledgement, or the absence of a licence notice shall not alone be treated as permission for those further uses.

EIP-028 The programme shall keep terms for prose, schemas, software, examples, datasets, and foundation manuscripts separately identifiable. A licence applying to one artifact class shall not be presumed to cover the others.

EIP-029 Foundation manuscripts and third-party sources shall retain their recorded source terms. Incorporating a source in the foundation manifest, citing it, extracting concepts from it, or placing it in the repository shall not be represented as relicensing the source.

EIP-030 Before public distribution of an artifact, the designated rights reviewer shall record that the intended distribution and included material are covered by identified permissions or another reviewed basis. Unclear rights shall block the affected distribution, while drafting and review within established permissions may continue.

EIP-031 Where an intended use exceeds available permission, the editor shall obtain suitable permission, replace or remove the material, narrow the use, or retain the affected artifact as restricted. The disposition shall preserve the source and reason without exposing restricted content.

EIP-032 A change in contribution or publication terms shall identify the artifacts and versions affected, authority for the change, contributor acceptance needed, and transition treatment. A new licence shall not be represented as retrospectively covering existing contributions without an established basis.

7 Selecting terms without presumed commitments

The following options identify distinct review questions. They are not an operative licence offer.

Document prose. Compare access to adopted text, quotation, redistribution, translation, derivative versions, attribution, and protection against misleading modified editions.

Schemas and code. Compare implementation, modification, distribution, dependency compatibility, notices, patent-related provisions, and long-term maintenance under the actual selected terms.

Examples and datasets. Examine source rights separately from privacy, confidentiality, consent, representational authority, cultural restrictions, and permitted reuse. Synthetic labels do not excuse copying protected source material.

Foundation corpus. Preserve manuscript-specific authority, authorship, and version history; choose any future distribution arrangements explicitly with the relevant rights holder.

EIP-033 Before offering contribution terms or choosing publication licences, the programme shall record its organizational and jurisdictional context, intended rights and obligations, artifact classes, alternatives, implementation consequences, and review by a person competent for the relevant rights questions.

EIP-034 The programme shall make operative contribution terms available before requesting assent to them and shall retain the accepted version and scope. A record of assent shall not assert that the contributor holds rights that remain unverified.

8 Patent and essential-rights concerns

This draft selects disclosure and issue handling as interim governance controls. It adopts no royalty policy, mandatory patent licence, representation of patent validity, or external standards body's assurance mechanism.

EIP-035 A participant aware of a potentially material rights obstacle to implementing a proposed requirement shall report the known concern and its basis to the designated rights contact. The report shall distinguish actual knowledge, an asserted claim, and unresolved inference; it shall not be presented as a legal determination.

EIP-036 The programme shall record a material implementation-rights concern, affected requirements, available public information, review competence needed, feasible alternatives, and its disposition before approving an implementation claim that depends on the concern.

EIP-037 No programme participant shall make a licensing promise, patent assurance, rights waiver, or financial commitment on behalf of another person or institution without documented authority. A declaration under another organization's process shall not be represented as a programme agreement without review of its actual scope.

EIP-038 Where implementation rights remain materially unresolved, the responsible decision authority shall narrow the claim, select a reviewed alternative, or defer the affected normative adoption. An empty concerns register shall not be described as proof that implementation is free of third-party rights.

9 Records, review, and evidence

EIP-039 Ethics, conflict, and rights records shall identify an accountable custodian, access rules, retention or review basis, correction route, and treatment of protected information. Public decision evidence shall avoid unnecessary disclosure while making authority, procedure, and unresolved limits inspectable.

EIP-040 The programme shall review this policy with the governance review cycle and after a material complaint, rights dispute, change of legal or organizational context, or change in

publication arrangements. A revision shall preserve the prior edition and unresolved cases' transition treatment.

The adoption dossier includes tested public and protected contact routes, accepted ethics/alternate/rights roles, conflict and contribution-register examples, a synthetic recusal and complaint exercise, a rights-clearance exercise, and a report of remaining gaps. A useful rehearsal includes a contributor who disputes a draft, an editor funded by an affected implementer, and a manuscript available for reading but lacking established redistribution permission. The exercise checks separate dispositions for the objection, the conflict, and the proposed source use.

10 Informative sources and rationale

Source and interpretation. Foundation orientation: FM-005, `GRE_Chapter_05_Complete_First_Draft.pdf`, section 5.18, pp. 150–153, distinguishes opportunities for epistemic visibility and contestation from evidential adequacy and examines risks of intensified visibility. FM-001, `GRE_Chapter_01.pdf`, section 1.14, pp. 79–83, connects verification infrastructure to practical reliance and concentrated power. These theoretical sources inform questions; the policy clauses are programme proposals.

Source and interpretation. Local basis: `docs/planning/cross_domain_programme.md`, sections 3.4–3.7; `docs/planning/standards_development_comparison.md`, sections 3 and 8. These planning texts preserve unresolved contribution-policy and organizational choices.

Source and interpretation. IEEE SA Standards Board Operations Manual, official online clause 6, consulted 2026-09-22: `https://standards.ieee.org/about/policies/opman/sect6/`. Its separate treatment of contributions, patent matters, and open-source artifacts informs the separation of rights questions here. No IEEE contribution agreement, assurance, or platform policy is adopted by this draft. The comparative study records the available 2026 PDF edition; the online clause is cited only for the stated comparison.

Source and interpretation. ISO Standards and Patents, official resource page, consulted 2026-09-22: `https://www.iso.org/iso-standards-and-patents.html`. The page links common patent-policy resources and declaration mechanisms. The programme uses this as a comparison source, not as evidence of permission to implement a particular technology or as an adopted patent policy.

The draft selects granular contribution and clearance records over a presumed repository-wide licence. The alternatives are adoption of specified terms by artifact class or individually negotiated permissions; a future choice can combine them. Granularity permits useful drafting now while exposing exactly which public distribution or implementation claims still need a decision.

OPEN. Operative contribution agreement, publication licences, patent policy, organizational/legal context, qualified rights review, named ethics contact and alternate, and protected reporting infrastructure remain OPEN. This text creates none of those commitments by implication.

OPEN. Jurisdiction-specific duties, external remedies, and legal validity of a permission or retention decision require context-specific primary sources and qualified review. The draft defines programme process requirements without determining those questions.

GENERATIVITY STANDARDS PROGRAM

GR-100

Foundations and Vocabulary

Standards-track Working Draft

Draft version 0.1

22 September 2026

WORKING DRAFT FOR REVIEW

This document is not adopted. Its requirement language expresses proposals for review and rehearsal. Preparation of this text does not establish programme governance, approve a formal standards project, or certify substantive truth, legal validity, or institutional legitimacy.

Publication class, scope, dependencies and unresolved decisions are stated in the document. No ISO, IEC or IEEE affiliation or endorsement is claimed.

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Maturity: PREPARATORY; PROVISIONAL. This is an authoring draft for examination of proposed requirements. It is not an adopted Standard, a formally initiated standards project, or evidence of approval of GR/NWIP-001. Formal initiation depends on the governance launch decisions. The word "shall" expresses a candidate requirement within this draft, without conferring programme adoption or legal authority.

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1 Purpose and scope

This document supplies a bounded operational vocabulary for recording and examining claims about generative histories. It addresses a practical problem: a record can accurately preserve an assertion while the assertion is mistaken, an authentic document can contain an unsupported inference, and a later correction can conceal the historical consequences of an earlier judgment. Inspectable practice requires distinctions among what is claimed to have happened, how it became accessible, what was recorded, what was inferred, and how the account was used.

The scope includes vocabulary use, the separation of levels of description, identity and temporal distinctions, and a candidate description of six record roles. It does not define truth, a complete metaphysics, a universal theory of evidence, legal validity, a universal generativity score, or a machine-readable schema. Domain methods can provide stronger criteria within a declared scope.

GR-110 develops trajectory recording requirements. GR-200 develops the epistemic record package. GR-120 and associated Specifications are intended to resolve technical representation after requirements and cases expose a reusable need. GR-210 is intended to address assessment and contestation procedures. References to these publications identify coordinated draft work; none is an adopted normative dependency.

2 Reading conventions and conformance subject

Sections 3–5 contain operational definitions and candidate vocabulary-use requirements. Section 6 contains informative examples. Sections 7–9 contain candidate assessment methods, informative source traces, and unresolved issues. “Shall” denotes a requirement, “should” a recommendation, “may” permission, and “can” capability or possibility. Notes, examples, source descriptions, and open issues do not add requirements.

The conformance subject is a *declared vocabulary application*: a named and versioned document, record package, profile, or implementation description that uses the terms in this draft. Vocabulary assessment checks what the subject claims and distinguishes. It does not establish that its account of a target is true, that a system implements every future family member, or that an institution has acted legitimately.

V100-001 A vocabulary application shall identify this document and version, its own boundary and version, the terms it uses, and any local extensions or narrower domain meanings. It shall describe departures explicitly and shall not claim unqualified GR-100 vocabulary conformity for a conflicting use of a defined term.

An application can use only a subset of the vocabulary. Using the term “Event,” for example, does not require adding an Entity, Process, or Property record solely to fill a catalogue. A field’s spelling alone does not establish its semantic role.

3 Operational vocabulary

3.1 Reality, manifestation, and representation

Target. That about which a claim is made. A target can be a situation, participant, occurrence, relation, condition, possibility, record, or another claim. Its identification can remain partial

or contested. A target reference is an act of reference; it does not establish existence or identity.

Manifestation. For recording purposes, an identified way in which a difference becomes available to encounter, registration, measurement, expression, or classification under specified conditions. This is a limited operational use informed by FM-004; it does not exhaust that manuscript's account of manifestation.

Representation. A description or arrangement of signs used to describe, classify, model, or otherwise stand for a target. Representations can themselves become targets of inquiry and participants in later action.

Record. An identified retained representation, together with the context needed to interpret its declared recording purpose. A record can contain several claims, and several records can concern one target. Retention need not mean public disclosure or indefinite preservation.

Record package. A declared collection of records and contextual references presented together for a specified purpose and version. A package can contain protected components and a restricted or public view. A view's limitations are part of its declared scope.

The foundation's ontological, relational, and manifestational registers concern different analytical questions. They are not exclusive categories of objects or a mandatory temporal sequence. A practice can operate before its recognition, and a classification can subsequently change the practice. This document does not require every target to receive a philosophical register label.

V100-002 A vocabulary application shall distinguish a represented target, an identified manifestation or trace, a retained record, and a claim wherever it uses those roles. It shall not treat a record identifier, representation, or manifestation as establishing the existence, complete nature, or identity of its target solely by being recorded.

3.2 Claim, observation, inference, and judgment

Claim. An attributed assertion with identifiable content and target, expressed under a stated scope. The assertion can concern an occurrence, a possibility, an interpretation, a value judgment, or institutional or legal status. Recording it does not endorse it. Several parties can assert the same content with different grounds.

Attribution. A recorded association between a claim or activity and the person, institution, system, or source represented as originating or performing it. Attribution can be pseudonymous, unknown, disputed, or mediated through another source.

Observation. A situated activity of attending to or registering a manifestation through a stated method. An observation report is a claim about that activity or its result; "direct" does not mean free of mediation or interpretation.

Inference. A step that relates identified premises or material to a conclusion under a stated method or reasoning. An inferred claim has a different epistemic role from the claim that its premises were recorded.

Interpretation. An attributed assignment of meaning, classification, or significance within a stated context. Interpretation can participate in observation and inference; these terms do not partition human or machine activities into exclusive kinds.

Judgment. An attributed assessment or determination made using identified grounds and criteria. A judgment can assess evidential warrant, ethical acceptability, legal status, or institutional action. These functions carry different bases of authority.

Assessment. A recorded examination of a specified question using identified criteria and material, with a result and limitations. In GR-200 an evidence assessment concerns a claim-relative evidential role. A syntax check concerns a different assessment target.

Uncertainty. Specified unresolved limitations or alternatives affecting a claim's content, identification, observation, method, interpretation, timing, boundary, or warrant. An uncertainty description is itself attributed and scoped. A numerical quantity is one possible representation, not a mandatory universal measure.

V100-003 A vocabulary application shall distinguish assertion, observation report, inference, interpretation, and assessment where those functions occur. Where one item performs several functions, it shall identify the functions and their scopes rather than infer one function's warrant from another.

3.3 Trace, evidence, and provenance

Trace. Material, behavior, testimony, inscription, or another manifestation identified as a remainder or consequence relevant to a target inquiry. The proposed connection to its generative conditions is a claim with its own grounds; calling an item a trace does not establish the proposed origin.

Evidence. A role assigned to identified material in assessing a specified claim, with an account of relevance, reliability, and alternative explanation. The material can support, challenge, limit, or fail to discriminate the claim. Evidence is not an intrinsic status permanently attached to a file or person.

Evidential warrant. The grounds offered for accepting, qualifying, or rejecting a specified claim under stated methods, assumptions, and scope. This draft records those grounds without imposing one universal sufficiency rule.

Provenance. A recorded account of origins, attribution, derivation, custody, or transformations of an identified item. Provenance can be incomplete or disputed. Provenance of a claim's expression differs from evidence for the claim's content.

Authenticity assessment. An assessment of whether an item is what it is represented to be, within a specified question and method. Authenticity of an utterance or document does not establish truth of its substantive claims.

Missingness. A stated condition in which information sought for a recording purpose is absent or unavailable. Not observed, not recorded, lost, withheld, unknown, inapplicable, and disputed describe different conditions and are not interchangeable with a zero, false value, or non-occurrence claim.

V100-004 A vocabulary application shall represent an evidential role relative to an identified claim. It shall keep provenance or authenticity results, evidential assessments, technical conformance, institutional acceptance, and normative or legal judgments distinguishable. It shall not describe success in one of these assessments as success in another without a separately stated argument.

3.4 Identity, time, and history

Record reference. A designation sufficient to distinguish a record or a particular version within a declared context. A reference scheme does not itself determine the identity of the represented target.

Identity criterion. A stated basis for treating two appearances or descriptions as concerning the same target within an inquiry. Identity claims can be contested and criterion-dependent. Similar behavior, equal content, shared names, and common descendants do not alone establish target identity.

Lineage. A directed account of derivation, succession, or continuation. Lineage can branch or merge. Its use does not automatically assert that predecessors and successors are one identical target.

Target time. The time or interval a claim concerns, including an explicitly unknown or uncertain temporal location.

Observation time. The time at which an observation or acquisition is represented as occurring. It can differ from target time and recording time.

Recording time. The time at which a record or identified version was made or entered into a recording context. It does not automatically date the target occurrence.

Assessment time. The time of a stated assessment or judgment, distinct from the time to which that judgment applies.

Descriptive regime. The declared categories, definitions, methods, scales, or boundary choices used to describe a target within an inquiry. This is an operational term; it does not require a fixed family of regimes or a particular mathematical construction.

Revision. An identified change to a representation, claim, assessment, or descriptive regime, with its relationship to an earlier formulation and the stated reason. Revision of an account of the past does not itself change the past occurrence.

Trajectory. A scoped account linking conditions, occurrences, continuations, alternatives, and consequences over a declared temporal or ordering frame. A reconstructed trajectory can remain partial and contested; it need not be a single fully ordered sequence.

V100-005 A vocabulary application shall distinguish record reference, target identity, and lineage. A stated identification of targets across appearances shall identify its criterion and the scope in which it is used. Unresolved identity shall remain expressible without forced merger.

V100-006 A vocabulary application shall distinguish target, observation, recording, and assessment times wherever it uses them. It shall preserve uncertainty about time or order rather than derive occurrence order solely from record entry order.

V100-007 An application that represents revision shall distinguish change in the target situation, change in evidence or assessment, and change in the descriptive regime. It shall allow more than one reason to apply and shall not silently replace the earlier formulation with a later one. Where earlier content cannot be retained or disclosed, it shall identify the resulting limit on historical reconstruction.

These are three linked histories rather than three mutually exclusive event types. Publication of a revised classification can change a target situation as well as its description. A later assertion that the earlier situation differed is an epistemic revision; it does not backdate the physical act of correction.

3.5 Generativity and practical consequences

Generativity-related claim. In this operational vocabulary, a claim about how relations, conditions, or activity generate, sustain, transform, restrict, or destroy subsequent states,

capacities, relations, distinctions, or possibilities. This defines the programme's recording subject; it is not a comprehensive definition of GR generativity.

Generative condition. A condition claimed to enable, constrain, or shape a specified trajectory or possibility. Its role needs attribution and grounds; contemporaneous presence alone does not establish contribution.

Possibility claim. A scoped claim that a continuation was or is available, feasible, blocked, lost, or conjectured under identified conditions. An unchosen proposal differs from an evidenced feasible alternative, and each differs from a later imagined counterfactual.

Contribution. An attributed participation or influence in a specified trajectory or outcome. Contribution, credit, causal responsibility, entitlement, and legal liability remain distinct questions.

Practical uptake. An identified use of a representation or judgment in action, classification, allocation, or institutional decision. Its consequences can become new recording targets.

Generativity return. A research and recording topic concerning claimed return pathways through which generated effects alter conditions of further generation. Its operational measurement, evaluative meaning, and any allocation rule remain **OPEN**; no universal quantity or entitlement is defined here.

V100-008 An application using generativity-related terms shall identify the claimed change or continuation, affected target or participants, relevant conditions, and scope. It shall distinguish a generative attribution from a value judgment and shall not infer beneficialness, entitlement, or legitimacy from the term "generative" alone.

4 Six candidate operational record roles

4.1 Status and shared use rule

These role descriptions are standards-specific proposals, informed by FM-007 and earlier programme vocabulary. They describe how a target is represented for an inquiry. They neither exhaust reality nor require exclusive schema classes. The term Property is retained from the programme; FM-007 uses Attribute. No equivalence between them is asserted.

In the descriptions below, *minimum metadata* means the information required when the role is applied under V100-009. An explicit unknown or restriction with reason can satisfy the obligation to state an unavailable contextual value; it does not satisfy an independent requirement to establish a factual claim. Common metadata means record reference and version, role, described target, recording responsibility and time, and links to the relevant claims and their epistemic context. Referenced context can be shared across a package without duplication.

V100-009 An application of a six-role description shall identify the applied role, its admissibility and identity criteria, the common metadata, and the role's minimum metadata below. It shall disclose unresolved boundaries and use the temporal meaning associated with the role. Missing information shall retain its stated reason rather than be converted to a substantive negative claim.

V100-010 An application shall allow a target to be described through more than one applicable record role without treating role overlap as evidence of inconsistency. A restriction in an application profile shall state its recording purpose and information limits. A Relation whose own identity, state, properties, or history matters to the declared inquiry shall remain independently referenceable.

4.2 Entity

Definition and admissibility. A record role for a focal subject tracked across appearances under a declared continuity criterion. Admissible when the inquiry needs cross-context or cross-time reference; use does not require an unchanging substance.

Identity. The stated reidentification criterion and evidence determine the claim of continuity. A database key identifies a record, not automatically the represented subject. A disputed criterion can remain unresolved.

Temporal behavior. Properties, membership, and relations can change while continuity is asserted. Formation, dissolution, replacement, or uncertain duration can be recorded separately.

Relations to other roles. Participation in Events and Processes; possession of described States or Properties; participation in Relations; lineage links to other Entity descriptions. These are candidate meaningful links, not an exhaustive edge schema.

Minimum metadata. Focal subject and appearances in scope; continuity criterion; temporal scope; attributed identity judgment or unresolved status.

Optional metadata. Names, identifiers assigned by other systems, formation history, known predecessors and successors.

Example and counterexample. An association tracked across a change of premises under a stated organizational continuity criterion. Two unrelated associations sharing a name are not thereby one Entity.

OPEN edge. A split into two successors can preserve lineage while leaving continuity with the predecessor disputed.

4.3 State

Definition and admissibility. A record role for a scoped description of conditions of a target at a stated time or interval. Admissible when the question concerns those conditions rather than an exhaustive inventory of reality.

Identity. Same target, temporal scope, and descriptive regime identify the intended condition description; record versions and conflicting accounts remain distinct. Equality of observed values alone does not establish equality of target conditions.

Temporal behavior. A condition can persist over an interval or be known only at an observation time. Persistence between observations requires a claim. Predictive sufficiency is relative to specified questions and continuations.

Relations to other roles. Conditions of Entities or Relations; preconditions and results of Events; intermediate descriptions in Processes; values articulated through Properties.

Minimum metadata. Target; time or interval; description boundary and regime; conditions described; observation or inferential basis.

Optional metadata. Supported queries, omitted conditions, comparison horizon, warranted persistence interval.

Example and counterexample. A committee's recorded membership on a given date. A timestamped snapshot alone does not establish every member's continuing participation throughout a month.

OPEN edge. A reduced state adequate for a current report can omit historical memory needed for a later operation.

4.4 Event

Definition and admissibility. A record role for an individuated happening or attempted happening under a declared occurrence criterion. Hypothetical, planned, or reconstructed events remain admissible as explicitly qualified targets of claims.

Identity. An occurrence criterion distinguishes event tokens; a description can refer to one event in several records. Repetition of the same operation or outcome does not merge occurrences.

Temporal behavior. Duration, boundaries, sequence, or overlap can be exact, interval-based, partial, or unknown. Failure or interruption does not imply non-occurrence of an attempt.

Relations to other roles. Participants represented as Entities or Relations; changes between States; steps of Processes; Properties of the occurrence.

Minimum metadata. Proposed happening; occurrence and individuation criteria; claimed actuality or modality, such as occurred, attempted, planned, hypothetical, or unresolved; separate epistemic basis, such as reported, observed, or retrospectively inferred; temporal scope; participating targets where known. A retrospectively inferred event can be claimed to have actually occurred.

Optional metadata. Place, before/after conditions, attempted purpose, completion status, links to repeated occurrences.

Example and counterexample. Two separately evidenced permission issuances with the same final status. A formula for the effect of an issuance does not establish that either occurred.

OPEN edge. Different temporal resolutions can treat one prolonged happening as an Event, Process, or several Events; the segmentation rationale matters.

4.5 Process

Definition and admissibility. A record role for activity linked by a declared ordering and criterion of unity. Admissible for goal-directed, recurrent, interrupted, branching, or otherwise connected activity; achievement of an intended endpoint is not required.

Identity. The stated grouping and boundary criterion individuates the process. Equal endpoints or equal modeled composite effects do not establish the same process history.

Temporal behavior. Ordering can be partial; duration and completion can be uncertain. Alternative possible paths remain distinct from the reconstructed actual path.

Relations to other roles. Comprises or links Events and intermediate States; involves Entities and Relations; has scoped Properties; connects to dependent Processes.

Minimum metadata. Unity and boundary criterion; activity in scope; supported ordering; claimed actuality or modality, distinguished from its observational or reconstructive basis; time scope and completion/continuation status.

Optional metadata. Intended purpose, branches, interruptions, excluded steps, retained intermediate conditions.

Example and counterexample. A proposal–revision–authorization sequence with a recorded failed earlier attempt. A factorization of an outcome into mathematically possible operations is not evidence of that history.

OPEN edge. Overlapping practices can belong to several processes; no universal segmentation rule is proposed.

4.6 Relation

Definition and admissibility. A record role for an identified connection, arrangement, or dependence among specified targets or conditions within a stated context. Admissible when its incidence, formation, continuity, or effects are relevant. Potential efficacy requires a further claim.

Identity. A stated criterion distinguishes a continuing arrangement from a renewed or separate one. Equal participants and equal current effects do not alone establish the same relation.

Temporal behavior. Formation, persistence, dormancy, change of terms, and ending are separately attributable. A relation can change while participants remain identified.

Relations to other roles. Participants can be targets described by any relevant role, including other Relations; Events can form or change it; Processes describe its history; States and Properties describe its conditions.

Minimum metadata. Relation reference; participant or condition references with roles; context; relation criterion and temporal scope; stated identity basis.

Optional metadata. Formation history, dependency claims, terms, changing states, prospective effect comparisons.

Example and counterexample. Two separately identified agreements between the same parties, each with its own renewal history. Co-occurrence in a table alone does not establish cooperation, trust, or dependence.

OPEN edge. Uncertain or changing participants can prevent a complete incidence description without eliminating the recorded relation claim.

4.7 Property

Definition and admissibility. Provisionally, a record role for an attributed characteristic or value of a specified subject under a stated definition, time, and context. Admissible when the meaning and subject of the attribution are explicit. This operational use does not resolve the broader Property/Attribute relationship.

Identity. A property assertion is distinguished by subject, characteristic definition, contextual and temporal scope, attribution, and version. A type of characteristic differs from a particular assignment of its value.

Temporal behavior. A value can change with the subject; a later correction can instead revise knowledge of an earlier value. The two histories remain distinguishable.

Relations to other roles. Describes a target represented through any role; measurement or classification can be linked to an Event or Process; multiple conflicting assignments can concern one subject.

Minimum metadata. Subject; characteristic definition; value or explicit missingness state; time and context; method or attribution; scale and unit when used.

Optional metadata. Measurement uncertainty, valid domain, derivation, calibration reference, alternatives.

Example and counterexample. A reported resource quantity for an organization at a specified time. A numbered nominal category is not a measurement permitting arithmetic solely because its code is numeric.

OPEN edge. FM-007's Attribute has explicit domain, interpretation, scale, and definedness conditions. Equivalence to Property, separation, or renaming needs source comparison and a recorded decision.

5 Boundaries between layers

V100-011 A vocabulary application shall distinguish operational record roles from metamodel concepts. It shall not identify a formal carrier state with a record State, a mechanism with a Process, or formal change with an Event without an explicit scoped mapping and argument.

V100-012 A vocabulary application shall keep descriptive, epistemic, evaluative, legal, institutional, and technical assertions distinguishable by their stated question and grounds. It shall not represent technical conformance as automatically creating factual truth, rights, duties, liability, admissibility, jurisdiction, or institutional authority.

The same dossier can connect these assertions. For example, an institutional decision can cite an evidential assessment and an asserted rule, while each remains separately attributable and open to the appropriate form of review. This is separation of questions and authority, not a requirement for independent databases.

6 Worked distinction tests (informative)

1. A clerk records that a request arrived late. A timestamp proves that a record was entered at a time; whether the request itself arrived late requires identifying the timing source, applicable deadline, and inference. The record, target event, and deadline assessment remain distinguishable.
2. A later witness report changes the assessment of the arrival time. That is a revision of the account. A later extension of the deadline changes a governing condition. A new definition of "arrival" changes the descriptive or institutional rule. One dossier can contain all three histories without conflating them.
3. Two administrations reuse an office name. An application follows their records under the same catalogue heading while recording replacement and disputed institutional continuity. Shared cataloguing does not decide Entity identity.
4. A new procedure reduces review time and makes some participants unable to contest an error. A generativity record can preserve both the increased processing capacity and the restricted capacity for correction; an ethical judgment states its own affected parties and criteria.

7 Candidate conformance evidence

Each row identifies a review method, not an already executed test. An assessor examines the declared subject and reports pass, fail, or not applicable for each requirement, with an evidence

locator. Not applicable requires an absent trigger, not an inconvenient result. A review cannot establish the correctness of an external fact merely from compliant vocabulary.

Requirement	Evidence and discriminating check
V100-001	Declaration names version, boundary, terms, extensions. Compare a local "fact" label against its stated meaning; detect an undisclosed conflicting use.
V100-002	Trace a target, manifestation, record, and claim in the subject. An authentic but incorrect report remains representable.
V100-003	Inspect a summary combining observation and inference. Recover which content was registered and which was inferred, by whom.
V100-004	Inspect one material item used differently for two claims. A successful authenticity check does not become a truth result.
V100-005	Inspect a merger, split, or disputed identification. Recover identity criterion and directed lineage without an automatic merger of targets.
V100-006	Inspect a late-entered report. Target time, observation time, recording time, and review time remain distinguishable or explicitly unknown.
V100-007	Compare target change, corrected report, and changed category. Prior meaning and reasons remain recoverable to the declared retention/access extent.
V100-008	Inspect a generative attribution. Scope and affected targets are present; description of expanded capacity is separate from its evaluation.
V100-009	For each applied role, locate admissibility, identity, temporal meaning, and required metadata; inspect a missing value's explicit reason.
V100-010	Inspect a relation with changing terms and an event analyzed as a process. Relevant identity/history and overlapping views remain expressible.
V100-011	Inspect any metamodel mapping. Identify additional premises; absence of a mapping means the conditional check is not applicable.
V100-012	Compare event report, institutional determination, legal assertion, ethical judgment, and technical check. Their distinct grounds remain visible.

8 Foundation trace and drafting rationale (informative)

Page numbers below are one-based pages in the supplied PDFs. FM identifiers are those in `foundation_manuscripts/MANIFEST.md`. The definitions here are operational proposals rather than quotations or claims that the manuscripts prescribe this recording model.

Source	Preserved distinction and draft application
FM-004, §4.2, pp. 11–14; §4.6, pp. 43–45	Registers answer different questions; manifestation is broader than representation, and recognition need not precede relational reality. Basis for V100-002; no exclusive philosophical register schema.
FM-005, §5.4, pp. 28–31	Trace, target relation, and evidence differ; evidential force is target-relative. Basis for V100-003/004 and GR-200 evidence-role requirements.

Source	Preserved distinction and draft application
FM-005, §5.17, pp. 141–142	Uncertainty concerns several dimensions and need not have one scalar measure. Basis for the uncertainty definition and GR-200.
FM-005, §5.20, pp. 168–174	New evidence, intervention, historical revision, and category revision differ. Basis for V100-006/007; three linked histories are an operational organizing proposal.
FM-007, p. 2; §7, pp. 26–29; §8, pp. 32–33	Roles overlap; identity criterion, lineage, participant incidence, and relation continuity require distinct information. Basis for V100-005/009/010 and Entity/Relation proposals.
FM-007, §9, pp. 37–38, 43; §12, pp. 56–57	Occurrence differs from effect; histories differ from endpoints and possible factorizations. Basis for Event/Process proposals.
FM-007, §10, pp. 43–44; §11, pp. 52–53, 56	Attribute domain/scale and State sufficiency are scoped. Basis for Property/State proposals, with Property/Attribute unresolved.
FM-003, §3.10.9, p. 115; §3.13, pp. 141–142	Generativity has no fixed normative sign; effects vary across subjects and time. Basis for V100-008, without a universal measure. Both Chapter 3 variants remain independently preserved.

The main alternatives were a complete philosophical definition, an exclusive six-class schema, or a limited operational vocabulary. This draft selects the third provisionally because initial cases need distinguishable claims and histories before a technical model can be justified. A programme decision record accompanies this drafting choice; adoption and technical realization remain separate decisions.

9 Open issues and next evidence

- **OPEN — Property/Attribute.** Compare FM-007 with sustained programme usage and test conflicting value assignments, undefined values, and nominal scales before deciding equivalence, separation, or a terminology change.
- **OPEN — Claim representation.** Compare independently identified claims, attributed assertions within records, and hybrids using disagreement, revision, restricted access, and round-trip examples. This draft requires distinguishability, not a seventh ontology class.
- **OPEN — Role overlap and profiles.** Test overlapping Event/Process and Entity/Relation descriptions. No exclusive schema typing or full cross-role relation vocabulary has been adopted.
- **OPEN — Identity.** Domain-specific criteria and disputed linkage need examples beyond names and administrative identifiers; branching continuity does not have a universal resolution.
- **OPEN — Generativity and return.** Test possibility, foreclosure, contribution, and return pathways without presuming a universal metric or a normative entitlement.
- **OPEN — Source chronology.** Chapter 3 editorial precedence remains unresolved. This draft cites particular passages without declaring one variant authoritative over the other.

GENERATIVITY STANDARDS PROGRAM

GR-110

Generativity Recording Requirements

Standards-track Working Draft

Draft version 0.1

22 September 2026

WORKING DRAFT FOR REVIEW

This document is not adopted. Its requirement language expresses proposals for review and rehearsal. Preparation of this text does not establish programme governance, approve a formal standards project, or certify substantive truth, legal validity, or institutional legitimacy.

Publication class, scope, dependencies and unresolved decisions are stated in the document. No ISO, IEC or IEEE affiliation or endorsement is claimed.

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1 Scope and standing

Responsible editor: `UNASSIGNED`. Canonical source: `standards/GR-110-recording-requirements/GR-110.tex`. Intended readers are recording practitioners, record custodians, affected participants and assessors.

This document proposes requirements for a bounded generativity record package and for the practice that produces and maintains it. A package is an identified collection assembled for a stated inquiry or practical purpose, with an inventory, scope, responsible recording practice, attributed claims and a history relevant to that purpose.

The objective is to preserve enough information to examine what is represented, how it became known, how judgments changed and how earlier relations contributed to later capacities, constraints or possibilities. Completeness of reality, exhaustive personal surveillance and a uniquely recoverable history are outside scope.

This is preparatory authoring, not a formally initiated or adopted Standard. Proposed requirements are available for synthetic assessment while programme governance is developed. Full GR-120/130/140/150/160/400 documents and a common technical schema are not prerequisites for this draft's manual assessment.

2 Draft dependencies and terminology

For the bounded assessment in this edition, GR-100 Working Draft 0.1 supplies operational terms and GR-200 Working Draft 0.1 supplies the epistemic requirements invoked below. Both dependencies are drafts, not adopted Standards. A change to either dependency requires review of affected results.

A *material claim* in this document is an assertion relied on to explain a consequential relation, generative effect, decision, classification, assessment or revision within the declared purpose. The package's selection rationale identifies such reliance. Importance is purpose-relative; the label does not establish truth.

A *recording practice* comprises the responsible people or organization, methods and custody arrangements used to assemble and maintain a package. Technical capture can be one component. A *generative account* is an attributed account of how conditions or relations enabled, maintained, transformed or constrained subsequent capacities, relations or possibilities. It remains subject to evidential assessment.

3 Purpose, boundary and responsible practice

R110-001 A package shall identify its purpose, intended users, subject matter, boundary, relevant time horizon, recording practice and package version.

R110-002 The recording practice shall state the selection criteria for included material and identify known omissions material to the purpose, including unavailable perspectives, uncollected information and limits of reconstruction.

R110-003 The package shall distinguish an inventory of retained records from an assertion that the underlying history is complete. The existence of a record shall not be used as proof of its represented content.

R110-004 The recording practice shall assign responsibility for capture, assessment, custody, access decisions and correction, recording combined roles and relevant conflicts. An automated component shall not substitute for an unassigned responsibility.

4 Epistemic and identity requirements

R110-005 The package shall identify its material claims and assessments as a bounded epistemic record package assessed against GR-200 Working Draft 0.1, including that draft's package-level obligations. It shall identify the assessed claim set, dependency versions, applicable requirements, evidence, exceptions and results; a claim-level check alone shall not establish fulfillment of the package dependency.

R110-006 Each retained record and version shall be distinguishable within the package, and a reference shall identify its intended target sufficiently for the declared use. A record identifier shall not itself establish identity of the represented person, event or relation.

R110-007 A continuity or identity judgment material to the trajectory shall identify its criterion, responsible source, supporting grounds and known dispute. Merger, succession and common labels shall not silently be treated as identity.

R110-008 The package shall distinguish the represented occurrence or validity time from observation, recording and later assessment times when their difference is relevant. Uncertain intervals and unsupported ordering shall remain explicit.

R110-009 Represented observations, actions, relations, states and properties shall retain the information needed to distinguish their operational roles. A relation with a material history, status or properties of its own shall be identifiable as a recordable subject.

Informative note. These provisions do not mandate a database type hierarchy. A source, a claim about it and an assessment can be represented in different technical forms if the distinctions survive the declared uses. Property remains programme terminology pending the Attribute/Property decision.

5 Recording generative trajectories

5.1 Conditions, contributions and consequences

R110-010 For each generative account, the package shall identify the target capacity, relation, constraint, distinction or possibility; the relevant actors or configuration; the comparison or earlier condition; and the temporal and contextual scope.

R110-011 The account shall state how the proposed enabling, maintaining, transforming or constraining contribution connects earlier conditions to the target, with grounds, method and limitations. Temporal precedence or a diagram edge alone shall not be presented as establishing that connection.

R110-012 An account shall distinguish the asserted occurrence or modality of an effect, such as realized, intended, possible, unrealized or disputed, from its epistemic basis, such as observed, reported, inferred or reconstructed. A realized past effect can be retrospectively inferred. The recording practice shall not manufacture an observed outcome where follow-up evidence is absent.

R110-013 Material participants and contributions shall be attributed with their basis and uncertainty. The recording practice shall provide a means to record disputed, collective, indirect or unknown contribution without forcing attribution to one actor.

R110-014 When an enabling encounter, decision or judgment is material to the account, the package shall identify its represented role, relevant conditions and the claim connecting it to subsequent developments.

5.2 Alternatives, changes in distinctions and loss

R110-015 A recorded alternative shall state whether it was considered at the time, inferred retrospectively, modeled or merely proposed, and identify the grounds for any claim of feasibility. Recorded alternatives shall not be presented as exhaustive or equally feasible without supporting grounds.

R110-016 A material change in categories, available distinctions or methods shall identify the earlier and later formulation, the reason for change and its effect on interpretation. A new description shall not automatically be represented as a newly existing underlying object.

R110-017 Known maintenance, depletion, restriction, exclusion or loss material to the declared generative account shall be recorded alongside creation or expansion, or have an explicit collection or protection limitation under R110-002 and R110-026. The account shall distinguish descriptive effects from their evaluation for particular people or values.

R110-018 Where generativity return is assessed or proposed, the package shall identify the asserted concept, intended recipients, scope, grounds and evaluative basis. Where it is not assessed, that limitation shall be stated without inventing a quantity or entitlement.

Informative note. A stable laboratory collaboration can maintain capabilities despite little immediate output. A successful output can coexist with the loss of a contributor's access. Neither observation alone establishes whether the arrangement was just.

6 Decisions, practical uptake and revision

R110-019 When a represented claim or classification informs a decision within scope, the package shall identify the claim version relied on, the decision, the asserted decision authority, its stated grounds and known subsequent response.

R110-020 A revision shall identify its actor or responsible source, time, target, reason and affected records, distinguishing a change in the represented situation, evidence or interpretation, and descriptive regime. More than one reason can apply.

R110-021 The recording practice shall preserve the intelligible relationship between earlier and later accounts, subject to stated retention and access rules. It shall not retrospectively present earlier actors as possessing evidence or categories first available later.

R110-022 A correction shall identify dependent records or presentations known to the practice, actions taken to correct them and any limits on propagation. The practice shall not assert that uncontrolled external copies were corrected or deleted without evidence.

R110-023 The practice shall provide a declared route for questions, contested attribution and correction requests, identify the responsible recipient and maintain permitted request/disposition records. Availability of the route shall not imply a legal entitlement or a promise of agreement.

Informative note. GR-210 Working Draft 0.1 supplies a complementary procedure for receiving, examining and disposing of such cases. It is not made a blanket dependency of every record package: a claim about a GR-210 procedure needs its own assessment.

7 Protection, custody and absence

R110-024 The recording practice shall declare the purpose and authority basis for collecting, retaining, accessing and disclosing material within the package, including the applicable policy or institutional context and unresolved constraints. It shall limit collected detail to that justified by the declared purpose.

R110-025 Access and retention decisions shall distinguish content, metadata, derived views and audit traces. Preservation of history shall not automatically require public disclosure or indefinite retention of sensitive material.

R110-026 Where material is unavailable, the package shall distinguish known non-collection, loss, destruction, restriction and an unknown reason to the extent that doing so is supported and permitted. It shall not disclose a protected fact merely to label an absence.

R110-027 A transfer, migration or custody change performed by the practice shall identify the source and destination versions or custodians, its authority, relevant transformation and known information loss. Unsupported finer distinctions shall not be invented during conversion.

R110-028 An authorized correction, restriction, retention or disposal action shall have a scoped disposition and an accountable executor. The practice shall record permitted evidence of its result and known limitations without retaining prohibited content solely to prove deletion.

8 Presentation and reviewability

R110-029 A presentation supplied as part of the assessed practice shall identify its source package/version and disclose material selection, reconstruction, uncertainty, disagreement and restriction within the permitted audience. It shall distinguish an attributed claim, an assessment and an institutional determination.

R110-030 A public or reduced view shall not imply that it contains the entire retained package. A validation or provenance result shall state what was checked and shall not be presented as certification of substantive truth or normative legitimacy.

R110-031 The practice shall provide enough accessible explanation for intended users to locate the grounds of a material claim and the relevant review route. A practical assessment shall record observed comprehension barriers and the alternatives or limitations offered.

9 Conformance and experimental assessment

9.1 Separate subjects

Two subjects are distinguished: the *package* and the *recording practice*. Package assessment examines the retained representation. Practice assessment additionally examines responsibility, selection, protection, action and user-facing behavior. A practice claim identifies at least one package or scenario through which behavior was examined.

This edition defines no reduced package profile. A package-only assessment reports a documentary subset and its limits; it is a partial assessment, not overall fulfillment of GR-110. An obligation to perform an action remains not assessed when only its documentation was examined. Not applicable is reserved for an absent stated trigger, not a change of assessment subject. Practice assessment covers every applicable requirement, with recording and behavioral components distinguished where a clause contains both.

R110-032 A report shall identify the assessed subject, versions of this draft and its dependencies, purpose/profile, applicable requirements, assessor, method, evidence, results and unresolved limitations. Package-only results shall not be presented as assessment of unobserved practice.

R110-033 The report shall distinguish fulfilled, not fulfilled, not assessed and not applicable results for each requirement, with reasons for exclusions. A failed or unassessed applicable requirement shall prevent an unqualified claim that the declared scope satisfies this draft.

R110-034 The report shall distinguish structural or documentary checks from tests of understanding, evidential warrant and institutional performance. It shall not infer truth, complete historical recovery, beneficial generativity or legal validity from structural fulfillment.

The following methods are informative assessment guidance, not additional requirements.

Requirements	Assessment method	Evidence or counterexample
R110-001–004	Inspect declared scope, inventory and responsibilities	An omitted participant or unassigned custodian is visible rather than invented.
R110-005–009	Review claim set, identity and temporal distinctions	Two reports of one event remain two reports; an uncertain date remains uncertain.
R110-010–014	Trace a generative account to its grounds	A proposed enabling relation has an attributed explanation; an unobserved effect is not labelled observed.
R110-015–018	Compare alternatives and evaluative scope	A rejected branch differs from a retrospective possibility; restriction of one group remains visible.
R110-019–023	Replay decision, revision and challenge records	A prior decision retains its earlier grounds; subsequent correction reaches declared dependents.
R110-024–028	Inspect policy and exercise protected lifecycle actions	Authorized views differ; disposal evidence does not reproduce removed sensitive content.
R110-029–031	Reader tasks and view comparison	A reader distinguishes allegation, assessment, decision and omission.

Requirements	Assessment method	Evidence or counterexample
R110-032–034	Inspect report completeness and limitations	A syntax-only result cannot be reported as complete practice assessment.

10 Informative example and source rationale

The accompanying synthetic funding-decision case is in `examples/p1-contested-decision.md`. It includes an inference from missing calibration metadata, contrary testimony, a restricted log, a change in evidential assessment, a separate change in classification, and uncertain downstream effects. It is a design fixture, not an empirical pilot.

Source and interpretation. FM-001, GRE Chapter 1, section 1.14, PDF pp. 78–83, distinguishes authenticity, provenance, representational adequacy and practical trust. FM-005, GRE Chapter 5, sections 5.4 and 5.14, pp. 28–36 and 113–122, distinguishes trace from claim-relative evidence and relational from generative trajectories. Sections 5.18–5.20, pp. 150–176, inform situated evidence, contestation and revision.

Source and interpretation. FM-003, GRE Chapter 3, section 3.12, pp. 129–141, motivates the relation among diagnosis, action, feedback and repair; FM-002 preserves a separately supplied Chapter 3 variant whose chronological relationship remains unresolved. FM-007, Metamodel Part II, sections 7–12 and 16–19, informs distinctions among identity, occurrence, process history, retained description and institutional uptake. These are conceptual sources, not normative dependencies.

The proposed operationalization is recorded in ADR-0004. It requires attributable and scoped generative accounts rather than a universal metric. Separate histories are required where they affect interpretation; no fixed ontology of claim objects, universal clock or exhaustive branch tree is selected.

OPEN. The final minimum profile, recording burden, generativity-return operationalization, metadata subject to protection and interoperability bindings remain open to pilot evidence. Core, Standard and Deep/archival remain historical candidate names; this edition does not adopt their boundaries.

OPEN. Independent practice assessment, full presentation/access/conformance publications and a live institutional pilot remain future work. The example and compilation do not establish those results.

GENERATIVITY STANDARDS PROGRAM

GR-200

Epistemic Recording Framework

Standards-track Working Draft

Draft version 0.1

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WORKING DRAFT FOR REVIEW

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Maturity: PREPARATORY; PROVISIONAL. This document contains candidate requirements for authoring and synthetic examination. It is not an adopted Standard, a formally initiated standards project, or an institutional or legal authorization. Formal initiation remains dependent on governance launch decisions and work-item approval. Requirement language is proposed for review.

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1 Purpose and scope

This draft defines the minimum information needed to examine who asserts what about a target, through which observations and reasoning, on which material, within what scope, with what uncertainty, and with what history of assessment and revision. Its organizing problem is the separation of a convincing or authentic representation from a warranted account of the represented situation.

The requirements concern a declared *epistemic record package*, which can include records, claim references, source locators, assessments, and protected components. The package can be textual, tabular, or implemented in software. This draft does not choose between claims as separate objects, attributed assertions within records, or a hybrid. A claim reference can be a local label and locator; it need not be a globally registered identifier.

GR-100 version 0.1 supplies the draft vocabulary. GR-110 adds requirements for generative trajectories and practical consequences. GR-210 is intended to govern the practice of assessment, challenge, and disposition. This document records those activities when present; it does not substitute a complete adjudication process, guarantee an appeal right, or set an evidential sufficiency threshold for every domain. GR-160 and GR-400 are intended to elaborate protection and institutional use. None of these drafts creates jurisdiction, a legal duty, or factual certainty.

2 Conformance boundary and interpretation

The conformance subject is one named, versioned epistemic record package within a declared purpose, collection boundary, and access scope. Requirements apply to its included claims and assessments, with conditional requirements triggered by the relevant activity. An external source is not required to satisfy these rules merely because it is cited; the package's assertions about it and uses of it are within scope.

E200-001 The package shall declare its reference and version, responsible recording role, intended use, target and collection boundary, included claim set or selection rule, access scope, relevant descriptive regime, and the GR-200 draft version used. It shall identify exclusions and limits that materially affect interpretation.

E200-002 The package shall associate every requirement with an assessment result and an evidence locator. A claim of conformity to this draft shall identify its package boundary and applicable requirement set, and shall disclose failures, unassessed requirements, and restrictions that prevent assessment. It shall not represent technical or recording conformity as proof of factual truth, evidential sufficiency, ethical acceptability, or legal validity.

An assessment result is pass, fail, not assessed, or not applicable with a reason. Only requirements whose stated trigger is absent can be marked not applicable. A package with failures or unassessed applicable requirements can report partial assessment, but not full conformity. This draft has no certification or accreditation scheme.

"Material" in this document means capable of changing a reasonable examination of the declared claim, its warrant, or its consequential use. The package's selection rule states how materiality was judged. Unknown, not collected, withheld, lost, and inapplicable can be explicit informational states where a value is unavailable. They disclose a limitation rather than establish the unavailable value or a substantive negative conclusion.

3 Claims, attribution, method, and scope

E200-003 Each included claim shall have a reference that distinguishes its content and version within the package, stated assertion content, an identifiable target or an explicit unresolved target description, and a link to its recording context. Different assertions or versions shall remain separately referenceable where their attribution, grounds, or disposition differ.

E200-004 Each claim shall identify its represented originating actor or source and the role responsible for entering it into the package. Where these differ, the attribution chain shall distinguish origin from transcription, quotation, translation, summary, or adoption. Unknown, pseudonymous, restricted, or disputed attribution shall be explicit.

E200-005 Each claim shall state its epistemic mode and relevant perspective: for example observation report, testimony, inference, interpretation, retrospective reconstruction, hypothesis, simulation, or normative or institutional judgment. Combined modes shall identify the distinct contributions rather than present inferred content as directly observed. A claim about an occurrence or possibility shall distinguish its asserted actuality or modality from its epistemic basis; retrospective inference can concern an actual occurrence.

E200-006 Each claim shall identify its acquisition or reasoning method, material premises and assumptions, relevant method version when one is used, and known transformations from source material to assertion. Where this information is unavailable, the package shall state the limit and shall not claim reproducibility or direct observation on that basis.

E200-007 Each claim shall state the boundary, scale or level of aggregation, contextual conditions, and temporal horizon relevant to its interpretation. It shall identify known omissions or selection conditions that materially limit generalization. A narrowed scope shall not be silently presented as a claim about a broader target.

E200-008 Each claim shall distinguish target time from the times of observation or source acquisition, recording, and assessment where applicable. Time values shall carry their applicable meaning and known uncertainty or resolution. Unknown order shall remain distinguishable from asserted simultaneity and from recording order.

E200-009 A claim that reidentifies a target across appearances shall identify the identity criterion, the appearances linked, the responsible attribution, and the evidential basis or stipulation. A proposed split, merger, succession, or disputed match shall not silently merge record identity, target identity, and lineage.

Informative note. A testimony can be preserved without claiming its reporter is infallible. Requiring attribution does not require public disclosure of a protected person's name. A role or pseudonymous reference, its protection status, and an accountable custody arrangement can provide the appropriate recording context.

4 Material and evidential roles

E200-010 For each material item invoked in support of, against, or to qualify a claim, the package shall identify the item or pattern, its relevant portion, source or acquisition path, and availability status. It shall distinguish original material, copies, derived representations, and generated material where those differences affect the claimed use.

E200-011 Each assigned evidential role shall link the material to a specified claim and identify the assessor or attributing source, assessment time, role, and rationale addressing relevance, reliability limitations, and material alternative explanations. An item with no assessment shall be marked unassessed rather than silently represented as accepted support.

The role can be supportive, challenging, qualifying, non-discriminating, or another defined relationship. A single item can support one claim and challenge another. The package need not impose a ranking across all evidence forms.

E200-012 Where multiple items are used together as evidence, the assessment shall identify known material derivation or dependence among them and the basis for any asserted independence. Repeated copies, summaries, or citations of one source shall not be presented as independent corroboration solely by their count.

E200-013 A claim of absence or non-occurrence inferred from missing observations or records shall identify the expected observation or recording opportunity, coverage, detection or preservation limitations, and reasoning from the missing material to the claim. If those conditions are not established, the package shall preserve the weaker missingness statement and shall not treat it as established non-occurrence.

E200-014 Each claim assessment shall describe material uncertainty and its location, including relevant alternatives, assumptions, identification limits, measurement limits, temporal gaps, or boundary and model limitations. A numerical confidence quantity, if used, shall state what it measures, its method and assumptions, and the scope of its interpretation.

E200-015 The package shall record material competing claims or explanations known within its declared collection boundary, their attribution, their relationship to the target claim, and any recorded grounds for excluding or preferring them. If alternatives were not examined, this limitation shall be explicit; silence shall not be presented as evidence that no alternative exists.

An alternative need not receive equal evidential weight merely because it is recorded. Recording a disagreement does not mean that it remains unresolved after a reasoned assessment. The disposition and its grounds remain visible, and an attributed rejected interpretation can remain historically consequential.

5 Assessments, revision, and practical uptake

E200-016 Each assessment or determination shall identify its question, responsible assessor or decision role, criteria, material examined, result, date, limitations, and relationship to the assessed claim versions. Provenance/authenticity, factual warrant, institutional acceptance, normative evaluation, legal determination, and technical validation shall remain distinguishable assessment functions.

E200-017 A substantive revision shall link the prior and revised claim or assessment versions and record who revised it, when, why, and which content or scope changed. The reasons shall distinguish target change, evidence or assessment change, and descriptive-regime change, allowing combined reasons. Historical access shall preserve earlier meaning to the declared retention and protection extent; any unavailable earlier content shall have an explicit reconstruction limitation.

E200-018 A change of descriptive regime shall identify the prior and new definitions or methods, grounds for change, affected claim set, and any mapping or transformation used. It shall identify known non-comparability, lost distinctions, or unresolvable mappings; finer classifications shall not be reconstructed from insufficient earlier material as if evidenced.

E200-019 For a revised claim with known dependent assessments, claims, or consequential uses within the package boundary, the package shall identify those dependencies and record whether each was reviewed, updated, left unchanged with reason, or remains pending or unreachable. It shall not claim that external recipients or institutions have corrected their actions without evidence of that correction.

E200-020 Where the package records practical uptake of a claim, it shall distinguish the claim, its assessment, the institutional or other action, the actor responsible, and the asserted basis for acting. Recorded consequences and proposed remedies shall remain separately attributable from the original grounds and intended effects.

E200-021 For a challenge received within the package's declared collection boundary, the package shall record the challenged claim version, challenger or protected source reference, grounds and submitted material, receipt context, and current status. A disposition shall record the responsible role, response, reasons, date, unresolved disagreement, and resulting changes or the reason for no change. A challenge without disposition shall remain visibly pending or otherwise explicitly unresolved.

This clause addresses the record of a challenge. Fair routes for submission, notification, review independence, timeliness, appeal, and remedy are future procedural requirements in GR-210 and relevant institutional profiles. Merely supplying challenge fields does not demonstrate that a person can effectively contest a decision.

6 Machine mediation, protected material, and layered judgments

E200-022 Where computational mediation materially affects a claim's observation, classification, inference, reconstruction, or presentation, the package shall identify the system and available version, its task, supplied source material or its controlled reference, material transformations, output used, and the role responsible for uptake or review. Unavailable system details and resulting limits shall be stated. Generated output shall remain distinguishable from independent source evidence.

This requirement includes rules, statistical models, sensor processing, database transformations, and generative systems when material to the claim. It does not require exhaustive logs of unrelated operations or disclosure of private credentials. A vendor confidence score does not automatically measure the warranted confidence in the package's substantive claim.

E200-023 Where claim context or evidential material is restricted, the package shall identify the restriction and its asserted basis, responsible custodian or accountable role, assessment consequence, and any available route for authorized examination or challenge. A released view shall identify material omissions at a level permitted by the declared protection arrangement and shall not describe unavailable evidence as independently examined.

If even acknowledging an item is restricted, the released view can describe its assessed scope without exposing item-level existence. The protected package still needs an accountable restriction record. This clause supplies neither permission to disclose nor a legal retention rule. Where a reviewer cannot assess a required component, E200-002 requires an unassessed result; a protection reason does not turn missing verification into a pass.

E200-024 A normative or ethical assertion shall identify the evaluative question, attributed evaluator, stated criteria or values, affected parties and scope, and material acknowledged tradeoffs or disagreements. It shall remain distinguishable from the descriptive claims on which it relies and shall not treat a claimed generative effect as inherently desirable.

E200-025 A legal or jurisprudential assertion shall identify the asserted legal concept, source or rule relied upon, relevant institutional or jurisdictional context, attributed authority, temporal applicability, and procedural status, or explicitly state which are unresolved. It shall distinguish a descriptive legal analysis, party allegation, institutional determination, model rule, and policy proposal where applicable. Recording the assertion shall not be represented as creating or confirming its legal effect.

E200-026 When a package is selected, summarized, exported, or transformed and the resulting package is claimed to conform to this draft, it shall preserve the attribution, claim-version relationships, epistemic qualifications, material disagreement, and access/reconstruction limits required within the resulting declared boundary. Omitted or transformed content and the resulting limits shall be identified; a partial view shall not imply completeness of the source package.

This is an implementation-neutral requirement on the resulting package. Format negotiation, transport, identifiers, validation vocabulary, and machine-readable exchange behavior belong in Specifications prompted by the demonstrated need.

7 Worked example (informative; synthetic)

This invented case tests recording distinctions. It supplies no claim about an actual institution or applicable law.

Target. Whether request Q arrived before the deadline specified in a synthetic institution's internal rule R1. The asserted rule and whether it applies are separate claims.

C1 version 1. Clerk A reports that Q arrived after the deadline, inferred from entry log L1. Target time is the claimed receipt time; recording time is the later creation of C1. The method assumes entry time matches receipt time.

Evidence use. L1 supports that an entry occurred at the recorded time. Reviewer B records that its support for receipt time depends on the untested assumption about queue delay. Three copies of L1 are not independent corroboration.

Alternative C2. A protected participant reports earlier delivery; a receipt image R2 is available to an authorized reviewer. The public view identifies restricted evidence and the scope of examination without naming the participant.

Action D1. The institution records exclusion of Q using C1 and R1. This is an attributed institutional act. Its occurrence, justification, and any claimed legal effect remain separate.

Challenge CH1. The participant challenges C1 and provides R2. The record includes the challenged version and receipt time of the challenge; a pending challenge is not displayed as a completed review.

C1 version 2. Review establishes that the entry occurred later than the claimed delivery. The assessed receipt time changes; the entry event does not. The revision links its grounds to R2 and records the continuing uncertainty. C1 version 1 and D1 remain identifiable historical records.

Dependency review. D1 is marked for review. Until a later action is evidenced, correction of C1 is not displayed as restoration of Q's participation. The record can identify consequences of the interval of exclusion separately.

Regime change. If the institution later defines arrival by a different channel, the change of rule/category has its own effective interval. It does not silently recode earlier evidence or establish that earlier actors used the new meaning.

8 Candidate assessment matrix

The following evidence methods are proposed for future assessment. They specify discriminating checks and failure cases; this draft does not claim these cases have been implemented or passed. Each applicable requirement needs its own result even where several use the same dossier. Human review is necessary for meaning, rationale, and sufficiency of disclosure; structural field validation alone is inadequate.

Requirement	Candidate evidence and discriminating check
E200-001	Inspect package declaration and selected claim inventory. Check that a consequential excluded record is disclosed by the collection rule or limitation.
E200-002	Inspect result ledger and evidence locators. An inaccessible required component is not assessed; a syntax pass is not labeled a true fact.
E200-003	Retrieve two versions and two conflicting claims concerning Q. Their content and targets remain distinguishable.
E200-004	Follow testimony through a translator or summarizer. Originating source and recorder remain separate, including protected attribution.
E200-005	Inspect C1. Its late-arrival inference is not presented as direct observation merely because L1 was directly read.
E200-006	Recover the entry-time assumption and method for C1. A missing method produces a stated limit, not a reproducibility claim.
E200-007	Compare a single intake desk's coverage with an institution-wide assertion. A known unobserved delivery route remains a limitation.
E200-008	Recover receipt, acquisition, entry, and review times or their explicit uncertainty; out-of-order recording does not reorder events.
E200-009	Examine an organizational replacement using a reused name. An identity criterion and separate lineage prevent automatic merger.
E200-010	Locate the relevant L1 entry and R2 image or controlled locators; derived transcript and original are distinguished.
E200-011	Recover L1's separate evidential roles for entry time and delivery time, including rationale and assessor.
E200-012	Present three copies derived from L1. Assessment detects shared origin instead of counting three independent observations.
E200-013	Remove the log for one delivery channel. No receipt found remains distinct from evidence that no request arrived.
E200-014	Inspect uncertainty about queue delay and a confidence quantity if used. Its measured quantity and assumptions are explicit.
E200-015	Recover C2 and reasons for its disposition. If no alternative search occurred, the absence of search remains visible.
E200-016	Compare log authenticity check, receipt-time assessment, and D1 decision. Their questions, roles, criteria, and results are distinct.

Requirement	Candidate evidence and discriminating check
E200-017	Retrieve C1 versions and changed grounds. Target change, correction, and category change produce different stated reasons.
E200-018	Apply a category split to records lacking the finer information. Mapping records non-recoverability rather than invented categories.
E200-019	Follow C1 to D1. Pending action review is distinguishable from completed correction and from an unreachable external use.
E200-020	Recover D1, the claimed authority for action, and separately attributed consequences. No automatic remedy is inferred.
E200-021	Trace CH1 receipt through pending and disposed states. A closed status without response, responsible role, and reasons fails.
E200-022	Add a machine summary that invents a link. Recover input, system/version where available, output used, uptake role, and correction.
E200-023	Compare protected dossier and released view. Restriction basis and accountable route are recorded without unauthorized disclosure or a false independent-review claim.
E200-024	Inspect an assessment that exclusion was unfair. Criteria, affected parties, and descriptive premises are distinguishable.
E200-025	Inspect an allegation of unlawful exclusion. Asserted source, jurisdiction, authority, and procedural status are stated or unresolved; no legal effect follows from technical compliance.
E200-026	Examine a textual summary or exported dossier. Correction, dissent, attribution, scope, and protection limitations survive or omissions are explicit.

9 Source trace and requirement rationale (informative)

References are to the supplied local PDFs indexed in `foundation_manuscripts/MANIFEST.md`; page numbers are one-based PDF pages. Source passages provide conceptual grounds, not adopted requirements. No external compatibility or legal claim is made.

Source	Operational proposal and reason
FM-004, §4.2, pp. 11–14; §4.6, pp. 43–45	E200-003–008 distinguish target, manifestation, representation, and observation conditions. A single undifferentiated fact field cannot preserve these questions.
FM-005, §5.4, pp. 28–31	E200-010–013 assign evidence roles relative to claims and preserve trace paths, alternatives, and dependence. Material presence alone does not establish relevance or independent corroboration.
FM-005, §5.17, pp. 141–142	E200-014/015 preserve dimensional uncertainty and alternatives. A single mandatory confidence score was rejected for this draft because methods and uncertainty sources differ.
FM-007, §7, pp. 26–29	E200-009 separates record references, identity criteria, and lineage, permitting unresolved matches. Administrative identifier equality is insufficient as a universal criterion.

Source	Operational proposal and reason
FM-005, §5.20, pp. 168–174	E200-017–020 distinguish evidential, intervention-related, historical, and category revisions, and the historical effects of an earlier representation. Silent overwrite loses those distinctions.
FM-005, §5.19, pp. 160–161, 168	E200-021–023 make machine mediation and contestability inspectable while allowing differentiated access. A declaration that "AI was used" omits material epistemic conditions.
FM-003, §3.10.9, p. 115; §3.13, pp. 141–142	E200-024 separates generative attribution from ethical evaluation and records affected parties and criteria. No universal beneficialness or commensuration is assumed.
Programme Brief, §3A; repository jurisprudential discipline	E200-025 preserves the asserted basis and status of legal claims. This is a recording boundary proposed by the programme, not a legal conclusion derived from a manuscript.

The selected direction is an inspectable claim package with attributed relationships and scoped evidence. Alternatives included a single verified-fact flag, a mandatory new ontology class for every assertion, and a fully specified adjudication process inside this document. The first loses distinctions; the second prematurely fixes implementation architecture; the third conflicts with the planned separation of epistemic representation from GR-210 procedures. The present choice leaves representation and procedural elaboration open while producing requirements that a small synthetic dossier can test.

10 Open issues and specification needs

- **OPEN — Representation.** Whether claim identity is implemented through objects, qualified statements, wrappers, or hybrids requires disagreement, revision, protection, and exchange cases before a Specification decision.
- **OPEN — Burden.** Initial review needs to measure time and participant burden as well as field completeness. Shared context can reduce duplication, but a package-wide statement must not conceal claim-specific differences.
- **OPEN — Evidence assessment granularity.** The minimum useful rationale varies across testimony, measurement, historical interpretation, and routine record entries. Domain profiles need cases and relevant expertise.
- **OPEN — Challenge procedure.** GR-210 needs submission routes, standing, accessible participation, impartial assessment, notification, reasons, timing, appeals, and repair. E200-021 records their results without claiming these practices exist.
- **OPEN — Retention and restriction conflicts.** Historical reconstruction, deletion, protection, and procedural examination can conflict. Named institutional and jurisdictional profiles need explicit review; this draft imposes no universal retention period or disclosure priority.
- **OPEN — Technical needs.** Independently addressable versions, evidence-role links, dependency notifications, missingness states, controlled locators, and loss-aware transformations are candidate inputs to GR-SPEC-120/130/200. No encoding or transport protocol is adopted here.

- **OPEN — Conformance practice.** The matrix is a review design, not a completed validator or certification programme. Independent reviewers need to test whether the same package yields reproducible assessments and whether affected participants can recover its meaning.

GENERATIVITY STANDARDS PROGRAM

GR-210

Evidence, Interpretation, and Contestation

Standards-track Working Draft

Draft version 0.1

22 September 2026

WORKING DRAFT FOR REVIEW

This document is not adopted. Its requirement language expresses proposals for review and rehearsal. Preparation of this text does not establish programme governance, approve a formal standards project, or certify substantive truth, legal validity, or institutional legitimacy.

Publication class, scope, dependencies and unresolved decisions are stated in the document. No ISO, IEC or IEEE affiliation or endorsement is claimed.

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1 Scope and authority

Responsible editor: UNASSIGNED. Canonical source: standards/GR-210-evidence-interpretation/GR-210.tex. Intended readers are procedure operators, affected people, reviewers and assessors.

This document proposes requirements for a bounded procedure through which people can question an attributed account, introduce evidence or an alternative interpretation, obtain a reasoned disposition and seek further review. Its subjects are the procedure operated by a named organization or recording practice and the associated case record.

An evidential assessment, a procedural disposition, an institutional action and an externally competent legal finding remain distinct. This draft provides no universal tribunal, evidentiary ranking or legal right to review. A conforming procedure can conclude that the available evidence does not resolve the dispute.

The document is preparatory standards-track authoring. It is not adopted and the work item is not represented as formally initiated. GR-100 Working Draft 0.1 supplies operational vocabulary. Material claims in a case record are assessed under GR-200 Working Draft 0.1. Both are draft dependencies. GR-110 concerns the broader recording package; full GR-300/310/400 profiles remain in development.

2 Procedure declaration

C210-001 The operator shall publish or otherwise provide an accessible procedure declaration identifying its purpose, eligible users, covered records or decisions, responsible roles, asserted authority, submission routes and exclusions.

C210-002 The declaration shall distinguish technical correction, evidential disagreement, procedural complaint, ethical or conduct complaint and an asserted legal claim, identifying their available handling routes and limits of authority.

C210-003 The operator shall declare response and review periods, their start events, permitted extensions, notice arrangements and the route available when a period is exceeded. The chosen periods shall be justified for the institutional context and affected users.

C210-004 The operator shall declare the information needed to submit a case, the support or alternatives available to users and how restricted evidence or protected identities can be handled. A demand for unnecessary public disclosure shall not be a condition of receipt.

Informative note. No universal period is selected here. The programme's own standards-development comments and appeals are governed by Directives Part 1 if adopted; an institution using records has its own declared procedure and legal context.

3 Receipt and scoping

C210-005 On receiving a submission, the operator shall create a distinguishable case reference and record receipt time, the target record or decision and version if available, the asserted issue and the submitter's attribution or protected-contact arrangement. Receipt shall not be reported as agreement with the submission.

C210-006 The operator shall acknowledge receipt through the declared route or record why acknowledgment is not possible. The response shall explain the next step, expected timing and any missing information needed for further action.

C210-007 Where a case is out of scope, incomplete, duplicated or directed to the wrong recipient, the operator shall record that procedural reason and any available correction or referral route. That outcome shall not be represented as factual refutation.

C210-008 Any restriction on repetitive or abusive submissions shall use declared criteria, record the reason and preserve a route to challenge the restriction. The operator shall not classify a submission as abusive solely because it criticizes an authoritative account or repeats an unresolved material concern.

4 Review responsibilities and participation

C210-009 Before substantive review, the operator shall identify the reviewer or review function, relevant competence, relation to the contested account and conflicts of interest. Material conflicts shall be handled through recusal, reassignment or a disclosed limitation with an appropriate further-review route.

C210-010 The reviewer shall identify the questions within the case, the relevant claim versions, evidence available, known limitations and decision criteria. Factual, normative, procedural and legal questions shall remain distinguishable.

C210-011 Affected parties shall be given an opportunity to respond to material grounds used in the disposition through a procedure consistent with protection and applicable institutional constraints. Where direct disclosure is restricted, the operator shall explain the permitted alternative and its limits.

C210-012 The operator shall record participation barriers known to affect the case, assistance or adjustments offered and material perspectives that could not be obtained. Absence of a response shall not automatically be represented as consent or admission.

Informative note. A reviewer cannot promise that every perspective will be available. The proposed obligation is to expose the evidential and procedural consequence of a material gap.

5 Evidence and interpretation

C210-013 An assessment shall identify the claim under examination, the evidence relied on, how that material bears on the claim, relevant method and assumptions, and known counterevidence or materially plausible alternatives.

C210-014 The reviewer shall distinguish the authenticity or integrity of a source from the warrant it provides for a particular claim. A signed assertion shall not receive an unqualified truth status merely because its signature validates.

C210-015 A conclusion based on missing evidence shall identify the expected trace-production, observation or preservation conditions supporting that inference. Where those conditions are not established, absence of the record shall remain distinguishable from non-occurrence.

C210-016 The assessment shall state uncertainty and its scope without inventing a common probability scale for heterogeneous judgments. Disagreement among assessors shall be attributed and retained where material and permitted.

C210-017 Where a category, method or institutional rule is challenged, the reviewer shall distinguish whether it was applied correctly from whether its adequacy or legitimacy is itself under review. A correct application shall not by itself dispose of a challenge to the rule.

C210-018 A material computational or AI-assisted contribution to the review shall be identified with the inputs or sources available for inspection, its role, relevant limitations and responsible human or institutional uptake. An inaccessible internal process shall not be replaced by an invented explanation.

6 Disposition and practical response

C210-019 The disposition shall state the questions decided, findings and their scope, evidence and reasons, responsible decision function, decision time, remaining disagreement and matters outside its authority.

C210-020 The disposition shall distinguish correction of a record, changed evidential assessment, maintained judgment, changed institutional action, inability to decide and procedural closure. Procedural closure shall not imply epistemic agreement.

C210-021 Where the procedure supports a remedy or practical response, the disposition shall identify the proposed or authorized action, its responsible executor, scope, timing and evidence needed to establish completion. Recording a proposed action shall not establish that it occurred.

C210-022 The operator shall notify the submitter and other relevant recipients through the declared, permitted routes, explain any further-review route and record delivery or known failure. Public notices shall respect the case's disclosure limits.

C210-023 A material correction shall be linked to the earlier account and known dependent views or decisions. The operator shall record which corrections or notices were performed and which downstream effects remain unresolved.

Informative note. A corrected classification can leave lost opportunities, costs or harm unremedied. The procedure records the distinction rather than declaring repair complete because a field changed.

7 Further review, reopening and continuity

C210-024 The procedure shall provide a declared route to request reconsideration of a material error, new evidence or procedural failure, with its scope, competent recipient and limitations. A reviewer of their own contested action shall not be described as independent.

C210-025 A reopened case shall identify the earlier disposition, trigger, changed evidence or criteria, reviewer and new outcome. Later interpretation shall not silently replace the record of what was known or decided earlier.

C210-026 If the operator lacks competence, authority or resources to complete a material step, it shall record the limitation and notify permitted recipients of the available alternative, postponement or closure basis. Passage of time alone shall not establish a finding on the substantive claim.

8 Protection and retention

C210-027 The operator shall specify access, retention, correction and disposal arrangements for submissions, evidence, reviewer notes, dispositions and notifications. Content and audit metadata shall be considered separately; history preservation shall not justify retaining prohibited sensitive material.

C210-028 Disclosure, redaction, access withdrawal or disposal affecting a case shall identify its authority, scope, executor and permitted evidence of the action. The operator shall state known limits concerning copies outside its control.

C210-029 A public summary shall distinguish the accessible grounds from material that cannot be disclosed, where that distinction is itself permitted. It shall not claim full independent inspectability when a material evidential restriction prevents it.

9 Conformance and assessment

C210-030 A conformance report shall identify the procedure or case record assessed, operator, institutional context, this draft and dependency versions, applicable requirements, reviewer relationship, evidence and results. It shall identify the case's material claims as a bounded GR-200 Working Draft 0.1 package and report its applicable requirement results, including package-level obligations. A case-record assessment alone shall not establish that unobserved procedural steps occurred.

C210-031 Each applicable requirement shall receive a supported result of fulfilled, not fulfilled or not assessed; a not-applicable result shall give its trigger-based reason. An unqualified claim of fulfillment shall not omit a failed or unassessed applicable requirement.

C210-032 A procedure assessment shall include an ordinary case and relevant failure cases concerning conflict, unavailable evidence, missed timing, restricted disclosure and correction propagation. A case-record-only assessment shall identify the supplied case and the procedural behavior it cannot establish. Reported success shall be limited to the cases and conditions actually exercised.

This edition defines no reduced case-record conformance profile. A case-only report is a partial documentary assessment. Performance obligations remain not assessed when only their records were examined; not applicable requires an absent stated trigger. A procedure claim covers all applicable requirements and the declared GR-200 package dependency. The multi-case rehearsal obligation in C210-032 is explicitly conditional on procedure assessment.

The following table provides informative methods for the initial rehearsal.

Requirements	Evidence	Failure case
C210-001–004	Procedure declaration and accessible submission exercise	Unstated period, inaccessible route, ungrounded authority.
C210-005–008	Receipt, acknowledgment and scope record	Receipt called acceptance; rejected submission called false.
C210-009–012	Reviewer assignment, conflict and response records	Original author silently decides their own procedural appeal.

Requirements	Evidence	Failure case
C210-013–018	Attributed assessment with evidence and alternatives	Missing metadata treated as proof of non-occurrence; AI summary treated as an observed fact.
C210-019–023	Reasoned disposition, action and notice records	Correction claimed complete without checking known dependent views.
C210-024–026	Further-review and reopening trace	New evidence cannot be submitted; timeout treated as agreement.
C210-027–029	Authorized and public views; scoped disposal trace	Restricted log reproduced in a public appeal report.
C210-030–032	Requirement register and rehearsal evidence	One synthetic case presented as independent live institutional assurance.

10 Informative source rationale and open questions

The synthetic funding case accompanying GR-110 supplies a common example. The procedure's record requirements can be implemented manually before a network protocol is needed. A later Specification would define message correlation, delivery, authorization, concurrent revision and failure semantics in response to demonstrated requirements.

Source and interpretation. FM-005, GRE Chapter 5, section 5.4, pp. 28–36, grounds the distinction between trace and evidence; sections 5.18–5.20, pp. 150–176, motivate participation, machine mediation and revisability. FM-003, GRE Chapter 3, section 3.12, pp. 129–141, motivates practical response and repair. FM-007, Metamodel Part II, sections 16 and 19, pp. 75–78 and 87–90, distinguishes factual warrant, institutional uptake and the evidence needed to evaluate a representation.

The design is a proposed operational procedure recorded in ADR-0004, not a claim that the source manuscripts prescribe this exact sequence. No external legal instrument is a normative dependency of this draft. The cross-domain programme identifies possible legal and policy sources for later contextual analysis.

OPEN. Service periods, independence arrangements, proof of authority, available remedies, costs and admissible disclosure depend on the institution and require a scoped profile. A synthetic procedure cannot establish their validity in a live jurisdiction.

OPEN. Abuse handling, protection of vulnerable participants, meaningful access under low resources and the burden of keeping case histories require review with affected users before live deployment.

GENERATIVITY STANDARDS PROGRAM

Programme Charter

Governance Working Draft

Version 0.2 2026-09-22

Standards Programme Charter

WORKING DRAFT FOR REVIEW

This document contains proposed provisions for technical and institutional review. It is not an adopted Standard or an operative governance instrument. Its scope, application conditions and publication status are specified in the text.

Prepared by the Generativity Standards Program. Reference to external publications does not imply endorsement by ISO, IEC, IEEE or any United Nations body.

Foreword

This document establishes proposed governance requirements for the Generativity Standards Program. It is a Governance Working Draft prepared for review, not an adopted Charter or technical Standard. Its authority depends on the founding procedure specified herein. The foundation manuscripts supply conceptual source authority; they do not constitute a governance adoption instrument.

Responsible editor: `UNASSIGNED`. Canonical source: `governance/standards_programme_charter.tex`. Intended readers are founding participants, administrators, reviewers, contributors, and affected people. Version 0.2 develops authority, participation, resources, oversight, transition, and assessment while retaining the requirement identifiers and obligations introduced in version 0.1.

This document is part of a coordinated draft governance package. Numerical development periods and ballot rules are specified in Directives Part 1. This Charter establishes the powers and accountability within which those rules operate.

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Introduction

The programme responds to instability in the connections among representations, their referents, institutional classifications, and practical trust. Its purpose is to support warranted recognition, reasoned contestation, revision of judgment and action, and preservation of consequential generative trajectories. This includes the conditions under which people can produce evidence, inspect grounds, and influence practices that affect their future possibilities.

The programme's own decisions can shape which accounts are recognized and which infrastructures become authoritative. Governance therefore forms part of the programme's substantive task. Open documents alone do not demonstrate accessible participation; a recorded vote does not establish truth; and a maintained history does not by itself repair the consequences of a mistaken decision. The requirements below assign functions, make their exercise inspectable, and provide routes to correction within the programme's actual authority.

The initial model uses individual contributions and explicitly delegated functions. It permits a small organization without presuming that named committees, independent reviewers, funding, or institutional mandates already exist. A transition to another participation model remains subject to recorded amendment.

1 Scope

1.1 Subject and application

This Charter specifies requirements for the programme's founding, mission, publication authority, participation, appointments, decision accountability, resources, records, external relations, and institutional continuity. The assessed subject is the programme's governance arrangement and its exercise during a declared review period. A work item or publication can supply evidence of that exercise without itself constituting governance adoption.

1.2 Boundaries

The portfolio includes recording, preservation, exchange, presentation, assessment, contestation, revision, and accountable institutional use of generativity-related records. The Charter does not settle a complete metaphysics or create authority over external legal decisions. Its requirements concern decisions and resources within the recorded programme mandate.

2 Normative references

2.1 Coordinated draft dependencies

The following documents contain provisions needed to apply identified requirements of this Charter. The cited editions are Governance Working Drafts, version 0.2. Their listing establishes a draft dependency only. The founding instrument fixes the exact coordinated editions accepted for operation.

Directives Part 1 — Procedures for Development and Maintenance. `governance/directives_part_1.tex`. Provides development stages, review periods, dispositions, ballots, appeals, emergency action, and maintenance procedure.

Directives Part 2 — Structure and Drafting Rules. `governance/directives_part_2.tex`. Provides publication classification, provision structure, traceability, and production requirements.

GR/TC 1 Charter — Generativity Records and Infrastructure. `governance/technical_committee_charter.tex`. Defines committee scope, technical coordination, review, and pilot responsibilities.

Ethics, Conflict-of-Interest, and Contribution Rights Policy. `governance/ethics_ip_policy.tex`. Provides conduct, conflict, impact, contribution, and rights-handling requirements.

2.2 Use of references

CH-042 The founding or amending authority shall identify the exact coordinated governance editions, resolve conflicting provisions, and record the resulting allocation of authority before dependent decisions proceed. A later draft of a referenced document shall not replace the operative edition automatically.

External sources listed in the bibliography are informative. Their citation neither incorporates their procedures wholesale nor grants their institutional authority.

3 Terms and definitions

3.1 Programme authority

A person or constituted body with an expressly recorded mandate to decide specified programme matters. The term identifies the scope of decision power; it does not imply governmental authority or legal

personality.

3.2 Founding instrument

The record of actual signatories, capacities, express commitments, accepted governance editions, effective conditions, appointments, and limits by which the programme adopts its initial governance.

3.3 Delegation

A bounded assignment of a function by an authority entitled to assign it, together with responsibility, limits, duration or review point, and reporting obligations.

3.4 Affected interest

A person, group, practice, or condition materially affected by a proposed programme activity. An identified affected interest does not imply that a particular participant represents it.

3.5 Decision eligibility

Recorded authority to participate in a particular formal decision under announced criteria. It is distinct from the opportunity to contribute or comment.

3.6 Material governance change

A change affecting authority, decision eligibility, participation rights, appeal independence, publication powers, essential resources, or the ability to maintain operative obligations.

3.7 Reserved decision

A decision retained by the programme decision authority rather than assigned to an editor or administrator. Its classification concerns programme accountability and does not establish a legal classification.

3.8 Governance evidence

Records or observed actions supporting an assessment of a governance requirement, identified by version, custodian, access conditions, and relevant limitations.

4 Mission and programme commitments

4.1 Mission application

CH-006 Programme publications shall distinguish metamodel, record ontology, epistemic representation, normative assessment, jurisprudential status, institutional governance, political economy, and technical implementation wherever a requirement or claim depends on more than one of these layers.

CH-007 The programme shall preserve the distinction between theoretical GR concepts and scoped operational requirements. Intentional narrowing, operationalization, or departure shall identify its foundation sources, alternatives, rationale, and recorded architectural decision.

CH-008 Programme publications and public claims shall not present technical conformance, authentic provenance, a programme decision, or a recorded institutional finding as sufficient proof of factual truth, ethical legitimacy, legal validity, or international endorsement.

CH-009 The programme shall identify jurisdictional and institutional authority separately whenever a proposal concerns legal duties, rights, admissibility, liability, or public power. Unresolved applicability shall remain explicit.

CH-003 Each proposed programme work item shall identify the recognition or practical problem it addresses, its intended beneficiaries and affected interests, its anticipated contribution to the mission, and the evidence by which that contribution will be evaluated.

CH-004 Programme evaluations shall distinguish demonstrated improvements in recording, interpretation, contestation, or practical response from broader claims about restored trust, justice, or future generative capacity. A broader claim shall identify its evidence and limitations.

CH-005 The programme shall examine its own classification, recording, decision, and publication practices as potential sources of exclusion, dependency, and concentrated authority. Findings and corrective decisions shall enter the programme's maintained issue record.

CH-043 The programme decision authority shall maintain a current statement of objectives that links active work to the mission, identifies the practical capacities being developed, and distinguishes intended benefits from effects supported by evaluation. Each annual review shall examine whether the active portfolio still addresses those objectives.

4.2 Selection and review of work

CH-044 When prioritizing work, the programme decision authority shall record the relative need, affected interests, alternatives to new standardization, resource demands, dependencies, and consequences of delay. A priority based on available funding shall identify the resulting coverage gaps and influence conditions.

CH-045 Where evidence shows that a programme activity materially undermines participation, inspectability, contestation, or future access, the responsible authority shall examine revision, narrowing, suspension, or closure and record the chosen response and follow-up evidence. Publication volume shall not alone justify continuation.

5 Publication authority

5.1 Classes and approval boundaries

CH-010 Each publication shall declare its class, maturity, version, responsible editor, and decision authority. Specifications, adopted Standards, policy proposals, governance documents, Technical Reports, and manuals shall retain their distinct authority.

CH-011 The programme shall reserve the designation adopted Standard for an edition approved under its operative development procedure. A draft, schema, prototype, protocol, or technically normative Specification shall not acquire that designation through technical completion alone.

CH-012 Standards-track work shall begin with a stated normative problem, scope, terminology, intended requirements, conformance subjects, and relevant constraints. A dependent Specification work item shall identify the reusable technical need that motivates it. Draft requirements and Specifications may co-evolve through pilots and review.

CH-013 A policy proposal shall identify its intended institution or class of institutions, mandate assumptions, institutional alternatives, expected effects, safeguards, and evaluation approach. Its recommendations shall not amend technical conformance requirements outside the standards-development procedure.

CH-014 Formal work-item approval shall depend on the governance launch conditions in this Charter and Directives Part 1. Preliminary source research, draft preparation, synthetic examples, and technical exploration shall retain their preliminary status while those conditions remain unmet.

5.2 Reserved and delegated powers

CH-046 The programme decision authority shall reserve approval of governance amendments, creation or material alteration of committee mandates, formal work-item initiation, Standard adoption, substantive publication maintenance, and agreements creating programme commitments. A delegation of an operational step shall not transfer a reserved decision unless the operative founding or governance instrument expressly permits it.

CH-047 An editor or repository administrator shall exercise only recorded editorial or custodial powers. Technical ability to merge, publish, assign identifiers, change access, or remove material shall not substitute for authorization of a substantive decision.

CH-048 Before an authorized release, the release owner shall verify the applicable adoption or publication decision and the exact artifact set. If the intended public statement exceeds the recorded decision, the statement shall be corrected or referred for a new decision before release.

6 Participation and consideration

6.1 Entry and access

CH-015 The programme shall provide a documented route for interested individuals to contribute proposals and comments and to receive reasoned dispositions. Employment, institutional sponsorship, a proprietary tool account, payment, or travel shall not be a prerequisite for submitting a relevant comment.

CH-016 The participant register shall distinguish participation in an individual capacity from authorized institutional representation. It shall record relevant affiliations, interests, assigned roles, and any limits on a representation mandate, subject to justified protection of sensitive information.

CH-017 For each work item, the coordinator shall identify affected interests, reviewer competence needed, known participation gaps, outreach undertaken, and feasible measures for language, disability, time-zone, connectivity, and resource barriers. Unfilled gaps shall remain visible in progression decisions.

CH-018 The programme shall provide an asynchronous contribution route and a human-readable account of proposed substantive changes. A contribution requiring assistance with format shall be assessed for its substance after proportionate assistance or an accessible alternative has been offered.

CH-049 The coordinator shall publish the purpose and actual availability of each contribution route, the information needed to handle a submission, access and attribution choices, and the process for obtaining assistance. Failed contact, inaccessible material, or unmet accommodation shall be recorded and referred to the responsible review chair.

6.2 Consideration and protection

CH-019 Funding, institutional affiliation, authorship volume, technical access, or control of repository credentials shall not by itself confer decision rights or priority in comment disposition. The decision authority shall assess whether concentrated interests or unpaid-work burdens materially limit fair consideration.

CH-020 Any restriction on participation shall state the conduct or process reason, its scope, duration or review trigger, responsible decision maker, and available challenge route. Restrictions shall not be

imposed solely because a participant disputes a proposal or authoritative interpretation.

CH-050 Before closing a review, the review chair shall examine recorded access failures and participation gaps, determine their materiality to the decision, and document extension, targeted outreach, alternative access, narrowed claims, or deferral as appropriate. The absence of a complaint shall not alone establish adequate access.

CH-051 When an affected person cannot participate through the published format, the coordinator shall offer a feasible alternative or explain the resource limitation and a route to review it. An assisted submission shall preserve the contributor's intended meaning and identify substantive interpretation by the assisting person.

CH-052 The programme shall distinguish endorsement, consultation, contribution, representation, and assent in public accounts. A participant's name, affiliation, or contribution shall not be used as evidence of support for a decision without an established basis for that attribution.

6.3 Decision eligibility

CH-039 Before constituting a decision roster, the programme decision authority shall publish the proposed decision scope, nominations route, closing date, competence or affected-perspective criteria, expected review commitment, and conflict rules. Eligible individuals shall have an accepted bounded role, disclosed relevant interests, agreed applicable conduct terms, and a recorded capacity for the particular decision. Institutional representation shall require an identified mandate.

CH-040 Selection to or exclusion from a decision roster shall have recorded reasons against the announced criteria and an available procedural challenge. The authority shall assess concentrated interests and missing perspectives before fixing the roster. A roster shall not change during a ballot except through the correction and restart rules of Directives Part 1.

CH-053 A change in an eligible person's affiliation, capacity, or material interest shall be assessed before their next affected decision. The coordinator shall record whether the accepted role remains valid, requires a new mandate, or requires recusal or replacement under the operative procedure.

Eligibility establishes a bounded role. It does not give priority to a participant's factual assertion or make institutional status a substitute for reasons and evidence.

7 Organization and accountable appointments

7.1 Required functions

The minimum functional arrangement comprises founding authority, programme decision authority, coordinator and records custodian, committee convenor, editors or work-item leads, independent procedural review, ethics contact and alternate, rights review, release ownership, and maintenance ownership. All actual appointments are `UNASSIGNED` unless separately recorded.

The programme decision authority corresponds to the governance authority in Directives Part 1. The coordinator and records custodian performs the Secretariat function. The neutral procedural reviewer performs the independent appeal-review function. A review chair is assigned to a particular review. Functions can be combined where competence, capacity, and conflict controls permit.

CH-021 An appointment shall identify the person, appointing authority, accepted mandate, decision limits, relevant interests, start date, term or review date, alternate or vacancy arrangement, and removal or replacement procedure. An office shall not be treated as staffed until acceptance is recorded.

CH-022 The programme decision authority shall publish reasons for appointments, renewals, and

removals at a level compatible with necessary protection. A challenged appointment or removal shall have access to neutral procedural review under Directives Part 1.

CH-023 Where one person holds multiple functions, each decision record shall identify the capacity exercised and any resulting conflict. A person shall not conduct the neutral review of their own challenged decision.

CH-024 The programme shall not delegate a decision to an automated system. AI-assisted drafting, summarization, analysis, or validation shall retain an accountable human role responsible for checking the resulting material and recording consequential use.

CH-025 The programme shall not exercise a delegated function while its required responsible role is vacant or recused without an authorized substitute. Unaffected preliminary work may continue with its status declared.

7.2 Acceptance, performance, and replacement

CH-041 An appointment renewal or proposed removal shall receive a recorded grounds statement and an opportunity for the affected person and relevant participants to respond before a final decision. A non-conflicted authority shall decide the matter within its mandate and provide access to neutral procedural review. Urgent temporary protective measures shall follow the ethics policy and emergency procedure, with a stated review point.

CH-054 Before granting operational access for an appointed role, the appointing authority shall confirm the holder's accepted mandate, relevant competence or induction needs, conflict assessment, and knowledge of escalation and protection duties. Credentials shall be limited to the tasks actually assigned.

CH-055 Each role holder shall report inability to perform a material assigned duty, loss of required access, or a conflict preventing performance to the appointing authority. The authority shall assign an authorized substitute, narrow the activity, or defer dependent decisions and record the response.

CH-056 A role handover shall identify pending decisions, deadlines, records and access responsibilities, conflicts, accepted commitments, and unresolved risks. The outgoing and incoming custodians shall verify transferred access and the disposition of credentials; absence of an outgoing holder shall be recorded with recovery actions.

CH-057 Role performance review shall consider completion and quality of assigned duties, handling of objections, protection of records, influence concerns, and resource limits. An adverse assessment shall identify evidence and permit a response before a final appointment action, subject to time-limited protective measures.

8 Founding and decision accountability

8.1 Founding review and express adoption

CH-001 The programme shall identify this document as a Governance Working Draft until a founding adoption record identifies the adopting persons, their actual authority over programme resources and publications, the edition adopted, its effective date, and the scope of that authority.

CH-002 An adoption record shall distinguish the programme's own publication authority from any claim to represent a profession, institution, community, jurisdiction, or international constituency. Each representation claim shall identify its actual mandate and limits.

CH-036 Before founding adoption, the prospective founding signatories shall identify their actual capacities and proposed commitments, publish the exact governance package within cleared rights, identify

proposed appointments and decision-eligibility criteria, and announce a founding review that applies the public-review, comment-disposition, reply, and material-change periods in draft Directives Part 1 as explicit conditions of that founding process.

CH-037 The founding signatories shall execute an adoption instrument only after review dispositions, a governance rehearsal, accepted minimum appointments, and independent assessment of the founding process are recorded. The instrument shall identify each signatory's express agreement, scope of commitment, dissent, outstanding limits, and the exact texts adopted. A person or institution shall not be bound or represented by a signature that lacks actual authority.

CH-038 The founding instrument shall identify the first programme decision authority, its delegated limits, appointment and succession route, and review date. Founding adoption shall not itself approve GR/NWIP-001 or any technical Standard. Subsequent formal adoption and maintenance decisions shall use the applicable ballot and review rules of operative Directives Part 1, distinguishing substantive maintenance from editorial correction and confirmation.

CH-058 The founding review notice shall distinguish the proposed founding signatories from reviewers and commenters, identify the actual resources or functions they can commit, and explain how additional participation or an objection to authority will be considered. A claimed mandate disputed during review shall receive a reasoned disposition before reliance on that mandate.

CH-059 Execution of the founding instrument shall identify the exact agreement accepted by each signatory, any reservation and its agreed effect, verification of assent, and satisfaction of effective conditions. An unsigned field, synthetic signature, or recorded invitation shall not be treated as assent.

8.2 Readiness and decision evidence

CH-026 Each consequential progression, adoption, mandate, or appointment decision shall identify the operative procedure, authority, evidence considered, interests and recusals, alternatives, material objections, reasons, consequences, and review route.

CH-027 A claim of consensus shall include evidence that relevant concerns were considered and that remaining substantial objections received reasoned treatment. Silence, elapsed time, a vote total, or lack of a funded alternative shall not alone establish consensus.

CH-028 Before formal work-item initiation, the governance launch record shall identify the adopted Charter and Directives, committee mandate, ethics and contribution arrangements, public-review route, maintenance and records arrangements, accepted appointments, and an available neutral procedural review route. It shall include the results and dispositions of a governance rehearsal.

CH-029 If neutral review is unavailable for a consequential contested decision, the programme shall defer that disputed progression or adoption decision and record the capacity gap. The programme shall continue research and drafting that do not depend on the contested authority.

CH-060 The governance launch assessment shall classify each required capacity as available and evidenced, limited with a stated consequence, or unavailable. A rehearsal result shall be recorded separately from actual staffing, public review, permissions, and independent-review availability. Unmet mandatory launch conditions shall prevent formal work-item initiation.

CH-061 For a decision involving multiple functions, the decision record shall identify who prepared the evidence, who reviewed it, who decided, and who implements the result. Combined capacities shall be explicit, and the record shall identify which findings depend on independent consideration.

8.3 Amendment and interpretation

CH-030 An amendment to governance shall follow the change and review procedure in Directives Part 1, state its effective date and transition arrangements, and preserve the prior edition. A procedure shall not be changed retrospectively solely to validate a disputed decision.

CH-062 A request to interpret an operative governance provision shall identify the text, affected decision, competing readings, and practical consequences. The governance authority shall publish a reasoned interpretation within its mandate; an interpretation changing authority, eligibility, obligations, or minimum safeguards shall use the amendment procedure rather than operate as an editorial clarification.

CH-063 A governance amendment shall assess pending proceedings and identify the edition governing each transition. A pending participant's opportunity for reply or procedural review shall not be removed by an undisclosed change of rule.

9 Resources and infrastructure

9.1 Funding and expenditure authority

CH-031 The programme shall maintain an inspectable record of material funding, in-kind support, decision-related conditions, and control of essential infrastructure. Restricted details shall have a stated reason for restriction and an accountable reviewer.

CH-032 A funding or hosting arrangement shall not authorize a sponsor to suppress relevant criticism, require adoption of its preferred technical solution, or bypass review. Material changes in support shall trigger a capacity and continuity assessment.

CH-064 Before accepting material support or expenditure commitments, the authorized holder shall record the purpose, amount or nature of support, actual committing authority, conditions, expected benefit, duration, and effect on independence and continuity. A contribution shall not create an undisclosed priority or publication veto.

CH-065 The programme decision authority shall compare planned obligations with available financial, human, technical, and accessibility resources before authorizing an activity. An unfunded essential safeguard or maintenance duty shall be resolved by resourcing, scope reduction, or deferral rather than recorded as an assumed future capacity.

9.2 Custody and continuity

CH-066 The coordinator shall maintain an inventory of essential repositories, identifiers, contact routes, publication locations, build resources, and protected record stores, with accountable custodians, actual access, recovery arrangements, and dependencies on external providers. Sensitive recovery information shall be protected.

CH-067 The responsible custodian shall periodically exercise recovery of essential publication and decision records and record the recovered version, access limitations, failures, and corrective action. The review interval and extent shall reflect identified continuity risks and shall be included in the governance records schedule.

CH-068 Before a change of hosting or custody, the governance authority shall record preservation of identifiers, versions, access restrictions, permissions, and continuity of comment and review routes. Unrecoverable losses shall be disclosed with their effect on pending decisions and publication claims.

10 Records and external relations

10.1 Inspectable institutional history

CH-033 The records custodian shall maintain access to publication status, version history, work scopes, decision reasons, comment dispositions, and correction notices. Protection or deletion of underlying sensitive records shall retain a non-sensitive account of the action and its authority where permitted.

CH-069 The records custodian shall distinguish operative decisions from proposals, superseded decisions, implementation reports, and unresolved questions. Corrections shall link the changed account to the reason and authority, preserving prior material subject to the applicable protection and retention decision.

CH-070 Where a public account omits protected material, the custodian shall record the basis and scope of restriction and the availability of authorized review. The public account shall disclose its limitation without revealing protected existence, identity, or content where that disclosure would defeat protection.

10.2 Liaison, public statements, and agreements

CH-034 An external liaison, pilot, endorsement, submission, or agreement shall identify who is authorized to act, its purpose and limits, and any external institution's actual assent. Participation in the programme shall not be represented as institutional endorsement.

CH-071 An external agreement proposal shall identify the counterparty's actual mandate, authorized programme signatory, commitments and costs, control of resulting material, publication rights, protection duties, review and termination arrangements, and effects on programme independence. Unresolved authority or rights material to the agreement shall prevent execution of the affected commitment.

CH-072 An authorized spokesperson shall distinguish the programme's adopted position from personal analysis, a committee draft, or a policy option. An inaccurate public claim of adoption, affiliation, or representation shall receive a recorded correction through the same relevant communication route where feasible.

11 Oversight, transition, and closure

11.1 Programme review

CH-035 The programme decision authority shall review mission performance, participation gaps, concentrated influence, conflicts, unresolved appeals, review capacity, and maintenance resources at least annually with the programme account required by Directives Part 1 and after a material institutional change. The review shall record remedial actions, owners, and follow-up.

CH-073 The annual governance review shall identify open corrective actions, repeated procedural failures, unresolved capacity gaps, resource concentration, overdue maintenance, and the practical effects of earlier remedies. The authority shall assign owners, review points, and escalation conditions for actions it retains.

CH-074 A material governance failure shall receive an assessment of affected decisions and publications. The governance authority shall record whether renewed participation, independent review, correction, repetition of a stage, or suspension is required; correcting the administrative record shall not alone validate the original decision.

11.2 Transition and orderly closure

CH-075 A transition to institutional or hybrid participation shall identify representation mandates, decision eligibility, related-entity influence, existing participant treatment, resource needs, and appeal independence, and shall undergo Charter amendment before the new model governs decisions.

CH-076 A proposal to suspend or close programme operations shall identify the reason, actual deciding authority, current commitments, pending reviews and complaints, custodial destination of publications and protected records, rights limits, and feasible maintenance or withdrawal arrangements. The transition shall be reviewed under Directives Part 1 before permanent disposition.

CH-077 A closure or suspension notice shall state which activities stop, which publication statuses remain operative or change, the custodian and available contact route, and unresolved matters. It shall not represent loss of operational capacity as erasure of historical decisions or as retroactive cancellation of external uses.

12 Assessment

12.1 Subject, evidence, and findings

CH-078 A governance assessment shall identify the operative or experimentally assessed edition, review period, scope, assessor, interests, and evidence for each applicable Charter requirement. Results shall distinguish fulfilled, not fulfilled, not assessed, and not applicable, with reasons and corrective actions.

CH-079 An assessor shall examine actual records and demonstrated routes relevant to the claim, including appointments, decision authority, access, recusal, independent review, resources, and continuity. A blank template, announced intention, or unperformed rehearsal shall not be accepted as evidence of completed performance.

12.2 Response and follow-up

CH-080 The programme decision authority shall respond to material assessment findings with an action, owner, due or review date, and consequence for dependent decisions. A finding shall be closed only with recorded evidence of the action or a reasoned change of scope, while preserving any unresolved historical effect.

Annex A

(normative)

Minimum governance evidence records

A.1 Common record elements

CH-081 Each governance evidence record shall include a stable identifier, record type, responsible actor, relevant date or interval, applicable governance edition, subject and version, evidence location or access limitation, status, related records, and correction history. Unknown information shall be explicitly identified rather than supplied by inference without attribution.

A.2 Authority and appointment record

The authority and appointment record contains: actual person or body; source and scope of power; accepted capacity; reserved and delegated decisions; start and end or review conditions; interests and management; substitute or vacancy route; contact; and evidence of assent. Where public and protected versions differ, their relationship is identified through the access record.

CH-082 The appointing authority shall maintain the authority and appointment elements in this annex for each operative role and shall update the record when its holder, scope, interests, acceptance, or effective status changes.

A.3 Decision and review record

The decision record contains: question; authority; input editions; evidence and alternatives; participating capacities; conflicts and recusals; material objections and replies; procedure and any ballot reference; reasons; result; conditions; implementation owner; notice; and review route. The review record adds findings, limitations, corrective actions, follow-up dates, and verified completion.

CH-083 The responsible decision maker shall ensure that a consequential decision has the decision and review elements in this annex before it is relied on for progression. Where evidence is restricted, authorized review access and a safe public account shall be identified.

A.4 Continuity and transition record

The continuity record identifies essential resources, their custodians, recovery and access arrangements, test results, dependencies, and unresolved failures. The transition record identifies outgoing and incoming responsibility, transferred obligations, untransferred material, permission limits, notices, and acceptance of custody.

CH-084 The governance authority shall use the continuity and transition elements in this annex when authorizing a transfer, prolonged suspension, or closure and shall record material gaps and their disposition.

A.5 Selection of assessment evidence

CH-085 The assessor shall select evidence appropriate to the requirement using the minimum evidence families in Table A.1. An assessment based on sampling shall identify the population, selection rationale, excluded cases, and limits on conclusions. Documentary completeness shall not replace observation of a route whose actual availability is claimed.

Table A.1 – Governance evidence families and assessment limits

Function	Evidence and method	Limitation requiring separate treatment
Founding and delegation	Inspect actual commitments, mandates, accepted appointments, effective conditions, and edition references.	A signature or role name does not establish authority beyond the scope supported by its recorded basis.
Participation	Inspect notices and accommodation records; exercise public and protected routes with authorized test material.	A working contact route does not demonstrate that affected perspectives were reached or their concerns considered.
Decision and challenge	Trace input versions, objections, replies, reasons, conflicts, independent review, and implementation of remedies.	Procedural completeness does not establish substantive truth or agreement of an absent constituency.
Resources and independence	Inspect support conditions, essential resource control, actual staffing, and response to concentration findings.	Stated independence does not demonstrate that a reviewer is available or free of the relevant interest.
Continuity and records	Observe a permitted recovery exercise and compare restored versions, access controls, identifiers, and unresolved losses.	A successful copy does not establish preservation of meaning, rights, or the ability to resume a pending review.
Transition and closure	Inspect notices, accepted custodial transfer, unresolved commitments, status changes, and accessible contact.	A declared closure does not dispose of external rights or eliminate consequences of earlier programme decisions.

Annex B

(informative)

Application examples and design rationale

B.1 Funding concentration

A prospective host offers free infrastructure subject to exclusive control over publication access. The funding record exposes the condition, while the authority record shows that the host has no adoption power. Review examines an alternative host, portable copies, protected records, and continuity costs. Acceptance depends on resolving the condition consistently with programme independence; the price alone does not determine the result.

B.2 Founding capacity shortfall

Prospective signatories complete draft charters and a synthetic appeal exercise but have no available independent reviewer. The governance assessment records completed drafting and rehearsal separately from missing operational capacity. Source inquiry and document development continue. Formal work-item initiation remains pending until accepted appointments and the actual review route meet the launch requirements.

B.3 Changed representation

A committee participant changes employment during a ballot. The coordinator examines whether the accepted capacity was individual or institutionally mandated and whether the new interest affects recusal or the roster. The applicable Directives determine whether correction requires a restarted ballot. The participant's earlier contribution remains attributed even if their decision capacity changes.

B.4 Basis for the selected model

Open individual contribution lowers initial organizational barriers but can concentrate influence among people able to contribute unpaid time. Bounded appointments, explicit affiliations, assistance routes, and review of missing perspectives address that risk without claiming universal representation. Institutional membership and hybrid chambers remain alternatives requiring demonstrated mandates and administrative capacity.

B.5 Unresolved adoption decisions

OPEN ISSUE Founding signatories, organizational form, actual appointments, neutral-review capacity, operating resources, protected contact routes, and operative contribution terms remain unresolved. This draft supplies the requirements against which their proposed resolution can be reviewed.

OPEN ISSUE The minimum accessibility target, longer-term participation model, and evidence needed to assess societal effects remain subjects for governance and work-item review. The Charter does not assume that successful programme procedure demonstrates restored social trust.

Bibliography

Source and interpretation: Programme Brief, version 0.4; comprehensive development plan, version 0.1; cross-domain programme; foundation traceability map, particularly FT-01 and FT-06. Local paths: `PROGRAMME_BRIEF.md` and `docs/planning/`. These explain the mission and candidate operational direction.

Source and interpretation: Foundation manuscripts: FM-001, `GRE_Chapter_01.pdf`, section 1.14.2–1.14.5, pp. 79–83; FM-003, `GRE_Chapter_03.pdf`, section 3.12, pp. 129–132; FM-005, `GRE_Chapter_05_Complete_First_Draft.pdf`, section 5.18, pp. 150–153. Files are in `foundation_manuscripts/`. These ground the orientation to representational instability, revisable action, and unequal evidential capacities; they do not enact these governance clauses.

Source and interpretation: WTO, Principles for the Development of International Standards, Guides and Recommendations, official presentation of the 2000 TBT Committee decision, consulted 2026-09-22: https://www.wto.org/english/tratop_e/tbt_e/principles_standards_tbt_e.htm. Its treatment of transparency, participation, impartial consideration, relevance, coherence, and resource barriers informs process design. Local requirements and organization are programme proposals, not a claim of WTO recognition.

Source and interpretation: United Nations, National Quality Assurance Frameworks Manual for Official Statistics, 2019: https://desapublications.un.org/publications/united-nations-quality-assurance-frameworks-manual; official overview consulted 22 September 2026. The sector-specific quality-assurance approach informs examination of institutional capacity alongside outputs. Programme governance remains local and does not acquire a national-statistics mandate through this comparison.

Source and interpretation: ISO, Model International Standard, third edition, 2023: https://www.iso.org/iso/model_document-rice_model.pdf. Its formal document organization informs the distinction among front matter, provisions, and annex status. Local scope and authority remain those recorded in this Charter.

GENERATIVITY STANDARDS PROGRAM

Directives Part 1

Governance Working Draft

Version 0.2 2026-09-22

Procedures for Development and Maintenance

WORKING DRAFT FOR REVIEW

This document contains proposed provisions for technical and institutional review. It is not an adopted Standard or an operative governance instrument. Its scope, application conditions and publication status are specified in the text.

Prepared by the Generativity Standards Program. Reference to external publications does not imply endorsement by ISO, IEC, IEEE or any United Nations body.

Foreword

This document proposes an executable development procedure for the Generativity Standards Program. Its clauses govern the programme only after explicit governance adoption. It is a **PROVISIONAL Governance Working Draft**, not an adopted Standard, an approved project, or evidence that a committee exists. Its numbered requirements are proposed requirements. A rehearsal can test them without making them operative.

Responsible editor: `UNASSIGNED`. Canonical source: `governance/directives_part_1.tex`. Intended readers are founding participants, procedural administrators, editors, reviewers, affected people, and prospective implementers of the development procedure. The assessed subject is a particular project-development or maintenance procedure and its records, not the substantive truth of a resulting Standard.

This edition expands draft 0.1 while preserving the meaning of D1-001 through D1-058. The additional schedules specify evidence and handling responsibilities rather than constitute programme offices. Draft 0.1 remains a historical publication. The proposed local numerical defaults are unchanged.

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Introduction

The procedure supports inspectable, revisable recognition and practical action by preserving grounds, alternatives, objections, decisions, and subsequent changes in standards development itself. Its central object is a justified progression decision: who could contribute, what was considered, why a direction was selected, which disagreements remain, and how later correction can occur.

The programme examines standards-development practice without assuming the institutional resources or representative mandate of an established international standards body. Explicit work authorization, documented review, conflict-sensitive decision making, public scrutiny, and maintenance are adapted to actual available capacity. A short procedure can conceal an unavailable role just as easily as an elaborate organizational chart. These Directives consequently make vacancies and failures visible and prevent a document's apparent completeness from substituting for an operative institution.

Public participation and evidential adequacy are related but distinct. A numerical majority cannot establish a substantive fact, and a well-supported technical conclusion does not excuse exclusion from the prescribed process. Standards development can affect access, cost, classification, and future practical possibilities; review therefore examines these consequences alongside implementation and conformance.

1 Scope

1.1 General

These Directives specify development, review, decision, publication, maintenance, and appeal procedures for programme publications. They address officials, editors, contributors, reviewers, affected participants, and assessors. They do not determine the truth of recorded claims, settle GR theory by vote, or confer external legal authority. A procedure assessment identifies its project or decision scope and does not establish programme-wide fulfillment from a single dossier.

2 Normative references

2.1 Draft dependencies

The following companion Governance Working Drafts, version 0.2, provide proposed internal dependencies: the Standards Programme Charter, Directives Part 2, the GR/TC 1 Charter, and the Ethics, Conflict-of-Interest, and Contribution Rights Policy. Their source files are in `governance/`. References are dated to these draft editions for coordinated review; none is represented as adopted. The founding instrument identifies the exact adopted editions and applicable transition arrangements. A dependency change requires review of affected provisions and assessments.

External standards-development and United Nations system publications are informative comparison sources. No external voting rule, institutional mandate, or legal entitlement is incorporated by reference. The programme's own public-review periods and thresholds arise from its governance choice.

3 Terms and definitions

3.1 Operational procedural terms

Governance authority The body or bounded transitional authority constituted by the adopted Charter; its mandate determines which decisions it can take.

Technical committee An actually constituted committee with a bounded project mandate; not a label that itself establishes authority.

Substantive change A change that could alter scope, meaning, duties, permissions, conformance outcomes, interoperability, protection, or practical consequences.

Substantive objection A reasoned concern about technical adequacy, evidence, scope, procedure, rights, participation, harm, or feasibility relevant to the proposed decision.

Consensus assessment A documented assessment of participation, consideration of concerns, remaining disagreement, and grounds for progression. It is distinct from a ballot tally.

Eligible participant A person assigned decision rights under the Charter and recorded for the specific decision; authorship, payment, or attendance alone does not confer those rights.

Calendar day A day counted using the closing time and time zone stated in the notice. A notice states an exact closing timestamp.

4 Founding, responsibilities, and participation

4.1 General

D1-001 The programme shall apply the adopted Charter for decision authority and appointments, these Directives for development procedure, Directives Part 2 for drafting, and the adopted Ethics, Conflict-of-Interest, and Contribution Rights Policy for conduct, conflicts, and rights. A conflict between these instruments shall be referred to the governance authority and resolved before a dependent decision proceeds.

D1-002 Every procedural decision shall identify its accountable decision maker, operative authority and procedure versions, input document versions, grounds, outcome, date, and review or appeal route. Drafting, a repository merge, an ADR, or successful compilation shall not constitute governance adoption or Standard approval.

D1-003 An organizational function without an appointed holder and recorded mandate shall remain `UNASSIGNED`. Formal project initiation and adoption shall remain pending while required authority or an independent appeal route is unavailable. Preliminary research, drafting, and synthetic rehearsals may continue with explicit status labels.

D1-004 Before formal standards-project approval, the founding adoption record shall identify the founding basis, adopted governance texts and versions, participants and capacities, decision method, dissent, transitional limits, review date, and replacement route. Governance adoption shall follow the founding procedure recorded under the Charter, rather than assume that these draft Directives have already authorized themselves.

D1-005 The governance authority shall assign oversight, project progression, public-review administration, release, maintenance, conflict handling, and independent appeal functions. The assignment register shall identify holders, terms, delegated limits, substitutes, and contact routes. Combined roles shall be disclosed; an interested decision maker shall not determine their own procedural appeal.

D1-006 The Secretariat shall maintain an accessible work programme and participation route. A project notice shall identify the problem, scope, current status, available documents, contribution terms, comment routes, decision roles, and intended review dates. Public comment shall not require voting membership or endorsement of the proposal.

D1-007 The review chair shall document outreach to affected interests and relevant expertise, participation barriers, affiliations relevant to dominance, and remaining gaps. The chair shall provide an asynchronous contribution route and record requested accessibility or language accommodations and the response. Lack of response shall not be recorded as consent.

D1-008 Before a formal decision, the chair shall confirm current conflict declarations and apply the adopted recusal procedure. The record shall identify recusals and their effect on eligibility and quorum without disclosing protected details unnecessarily. If conflicts prevent a valid decision or impartial review, progression shall be deferred.

NOTE 1 Participant eligibility and appointment belong to the Charter; conduct and contribution permissions belong to the Ethics, Conflict-of-Interest, and Contribution Rights Policy. These Directives do not grant membership, impose a license, or establish a legal entity.

5 Project initiation and scope control

5.1 General

D1-009 A New Work Item Proposal shall identify purpose, intended users and affected people, publication class, bounded deliverables, exclusions, proposed conformance subjects, alternatives to new standardization,

source basis, dependencies, review expertise, pilot evidence, resource needs, and prospective maintenance responsibility.

D1-010 The proposal shall explain how the work addresses warranted recognition or generative trajectory and identify epistemic assumptions, ethical impacts, legal and institutional boundaries, public-policy implications, accessibility, protection needs, and distribution of recording and implementation burdens. A claimed institutional mandate shall identify its source and limits.

D1-011 The technical committee shall begin with the normative problem and assessment needs. A dependent Specification proposal shall identify the draft requirements requiring reusable technical infrastructure, the implementation alternatives, and intended tests. A protocol proposal shall additionally identify actors, interactions, states, transitions, outcomes, failure handling, and authority boundaries.

D1-012 The authorized project decision maker shall record accept, revise, defer, or reject, with reasons, scope, assigned responsibilities, dependencies, and review milestones. A coordinated proposal shall retain a separate bounded scope and progression record for each deliverable. A technical dependency shall not acquire Standard status through inclusion in a proposal.

D1-013 A proposed expansion beyond approved scope shall receive impact review and an explicit scope decision before dependent progression. A Specification intended for promotion to a Standard shall enter an explicit standards-track proposal and the applicable review stages; technical stability alone shall not authorize promotion.

5.2 Proposal handling and accountable capacity

D1-059 The Secretariat shall register a proposal with an identifier, receipt date, proposer, proposed class, scope version, and handling status. It shall acknowledge receipt within seven calendar days and identify the authority responsible for scheduling its consideration. An incomplete proposal shall receive a specific request for information or a reasoned deferral; registration shall not confer project approval.

D1-060 Before accepting a project, the decision authority shall verify that the editor and maintenance owner accept their responsibilities, required review competence can be obtained, the resource estimate includes participation and protection work, and the work plan states review dates and capacity limits. An unfilled essential role shall be resolved through assignment, a narrower scope, or deferral, rather than entered as an assumed resource.

D1-061 The project register shall distinguish proposed, active, suspended, closed, and completed work and retain the reason for a change of status. A proposer may withdraw a proposal before authorization; withdrawal shall preserve its record and relevant unresolved issues. Suspension or closure of approved work shall be authorized with affected-participant notice and a disposition of dependencies, contributions, and remaining records.

NOTE 1 Acceptance authorizes bounded work, not its expected conclusion. A negative pilot or a well-supported decision that standardization would add excessive burden can justify scope reduction or closure. A sponsor's preferred implementation remains an alternative to evaluate rather than the implicit criterion of success.

6 Stages and progression evidence

6.1 General

The following codes are the programme's local lifecycle. They retain the repository's grouping of review, revision, and withdrawal under stage 90. Specifications have separately declared maturity; stage 60 is reserved here for adopted Standards.

Table 1 – Local development stages and progression evidence

Stage	Local status	Evidence for progression
00	Preliminary	Need, preliminary sources, alternatives, and draft NWIP; no project authority presumed.
10	Proposal	Approved bounded scope, capacity, assignments, dependencies, and review plan.
20	Working Draft	Candidate clauses, source and decision traceability, assessment methods, and example or pilot design.
30	Committee Draft	Integrated requirements, review findings and dispositions, pilot evidence and limitations, proposed public-review package.
40	Public Review Draft	Versioned notice, accessible draft, comments and responses, material-change review, and remaining objections.
50	Final Approval Draft	Frozen approval package, consensus assessment, valid ballot, procedural checks, and appeal handling.
60	Published Standard	Recorded adoption and release authorization, verified publication package, maintenance owner and next review date.
90	Review / revision / withdrawal	Issue and impact evidence; recorded confirmation, correction, amendment, revision, supersession, or withdrawal.

D1-014 Each progression decision shall state the current and proposed stage, evaluate the relevant evidence, identify remaining limitations, and record approval, return for revision, deferral, or closure. A stage label shall not substitute for the decision record. No Standard shall skip public review or final approval by claiming that a prototype or pilot already establishes acceptance.

D1-015 The editor shall retain versioned drafts, a requirement-to-source and assessment map, an issue register, and substantive decision records identifying alternatives, selected direction, rationale, and affected artifacts. GR interpretation shall use relevant foundation manuscripts and preserve unresolved source differences; operational narrowing affecting architecture shall have an ADR.

D1-016 At committee review, named reviewers shall evaluate epistemic adequacy, practical usability, ethical and distributional effects, accessibility, preservation and protection, legal/institutional boundaries, and technical feasibility within declared competence. Missing expertise or evidence shall be reported and resolved, or the scope narrowed, before unsupported requirements advance.

D1-017 Pilot reports shall identify the tested versions, cases and negative cases, methods, participants' roles, failures, burdens, limitations, and resulting changes. Synthetic or author-operated tests shall be labelled accordingly. External institutional participation, access authority, independent validation, and legal validity shall not be inferred from a synthetic rehearsal.

6.2 Stage controls and project records

D1-062 The project lead shall assemble the entry and exit evidence specified in Annex A before requesting progression. The decision authority shall record its assessment of each applicable item, the evidence locator, responsible reviewer, result, and any required action. An inapplicable item shall have a scope-based reason; unperformed work or unavailable evidence shall not be recorded as fulfilled.

D1-063 A Working Draft shall identify open design alternatives and any unresolved requirements or dependencies. A Committee Draft shall integrate the selected proposal, source rationale, assessment method, and issue disposition sufficiently for a reviewer who did not participate in authoring. Neither designation shall imply that open issues have disappeared merely because the document has been renumbered.

D1-064 Before public review, the chair shall verify that applicable requirements have identified conformance subjects and assessment methods, examples are distinguished from obligations, material pilot failures are visible, and unresolved issues are bounded. A requirement whose interpretation depends on unavailable material or an unsettled contradiction shall be revised, narrowed, or withheld from the proposed normative scope.

D1-065 A coordinated package shall identify authoritative locations for shared requirements, exact dependency versions, change propagation responsibilities, and release sequencing. The responsible editors shall assess a material dependency change against affected scopes, tests, examples, and users before progressing any dependent release. Circular references shall not be used to conceal an unassigned obligation or unsupported conformance claim.

D1-066 A meeting used for a consequential decision shall have prior notice, an agenda and accessible materials, an assigned chair, identified participants and capacities, declared conflicts, and a decision record. A person unable to attend shall have the declared asynchronous opportunity to contribute before the decision closes. Meeting attendance alone shall not replace the prescribed ballot, public review, or reply period.

D1-067 The chair shall circulate a proposed decision record for correction of factual inaccuracies and attribute unresolved corrections before using it as progression evidence. An editorial correction to minutes shall not alter the decision taken; a proposed change to that decision shall use the relevant reconsideration or new-decision procedure. The register shall distinguish a proposal, recommendation, authorization, and completed action.

7 Public review and comment disposition

7.1 General

D1-018 Before opening public review, the chair shall freeze a uniquely identified draft and publish its scope, class, maturity, change summary, dependencies, known limitations, review questions, exact opening and closing times, submission routes, and intended treatment of commenter information. Required supporting material shall be accessible to reviewers under workable terms.

D1-019 Public review shall remain open for at least 60 calendar days. The chair shall record outreach, access interruptions, and accommodation needs; a material access failure shall receive an extension sufficient to restore meaningful opportunity, with reasons and revised closing time published.

D1-020 The Secretariat shall accept comments in an accessible free-text route as well as any structured template. It shall assign a stable identifier, record the affected version or topic, requested change if supplied, receipt date, and disclosure preference, and acknowledge receipt within seven calendar days. A comment shall not be rejected solely for lacking technical drafting expertise.

D1-021 The Secretariat shall offer a protected route for justified confidential submissions and explain its access limits. The chair shall arrange competent consideration and publish a safe summary of the issue and disposition where possible. If essential grounds cannot be exposed sufficiently for fair review, the chair shall record the limitation and defer or narrow the affected decision.

D1-022 The responsible review group shall give every in-scope comment a disposition of accepted, accepted with modification, not accepted, or deferred, with reasons and links to affected clauses or issues. Out-of-scope and duplicate comments shall retain identifiers and a reason or linked disposition. Deferral shall identify an owner, next action, and why the unresolved issue does not invalidate proposed progression.

D1-023 The chair shall target initial dispositions within 30 calendar days after review closes. If that target cannot be met, the chair shall publish reasons, interim status, and a new target before it expires. A

target extension shall not deem comments resolved. Commenters shall receive disposition notice and at least 30 calendar days to reply before final approval.

D1-024 The chair shall assess each reply and record remaining disagreement. Late comments shall be logged with reasons for current-cycle consideration or later referral; a newly identified material safety, rights, or validity defect shall receive assessment before adoption regardless of receipt date.

D1-025 A substantive post-review change shall undergo public re-review for at least 30 calendar days, showing the changed text, reasons, effects, and affected dependencies. The chair shall notify previous commenters and newly affected interests. A change that substantially alters the purpose, affected constituency, or conformance subject shall receive renewed scope approval and a full 60-day review.

D1-026 Re-review shall permit comments on changed material and its consequences for unchanged clauses. Further substantive changes shall repeat the applicable review. Editorial changes shall be logged with a reason why meaning and conformance remain unchanged.

7.2 Comment register and review administration

D1-068 The Secretariat shall maintain the comment and disposition register specified in Annex B. A combined response may address duplicate issues only if each original comment remains traceable and its distinct material grounds are considered. Splitting a submission into issues shall preserve the connection to its original meaning. Summary statistics shall not substitute for the disposition of an unresolved substantive concern.

D1-069 A review closure record shall identify the exact closing time, submissions received, submissions awaiting acknowledgement or clarification, late submissions, access failures, extensions, and next steps. The chair shall distinguish closure of intake from completion of dispositions. The count of unresolved comments shall not become zero merely because the public submission window has closed.

D1-070 For each proposed disposition, the review group shall identify the responsible respondent, material evidence, affected requirements, reason, resulting text or decision, and review required by the change. A not-accepted disposition shall address the substantive grounds rather than rely solely on lack of votes, institutional rank, drafting inconvenience, or an unsupported assertion that the issue was already settled.

D1-071 If a submission includes conduct allegations or protected information together with a technical objection, the Secretariat shall separate access and handling while retaining a safe cross-reference. The technical issue shall continue to receive consideration unless a recorded reason requires a stay. Protected reporting shall not confer permission to publish personal details in the public disposition register.

D1-072 When sending a disposition or re-review notice, the Secretariat shall record its intended recipients, authorized route, content version, dispatch time, and known delivery failures. Where a material failure prevents meaningful reply, the chair shall provide a workable alternative or extend the affected reply opportunity and record the resulting progression consequence. A failed delivery shall not be represented as silence by the recipient.

NOTE 1 A long review period does not demonstrate effective participation if a relevant person could not obtain the text, understand the submission route, or receive a response. Accessibility and outreach are assessed through the record of practical barriers and responses, not inferred from the existence of a public URL.

8 Consensus, ballots, and final approval

8.1 General

D1-027 Before recommending progression, the chair shall produce a consensus assessment identifying participation and gaps, objections, attempts at resolution, evidence and alternatives considered, remaining dissent, and reasons for the recommendation. Numerical approval shall not establish substantive truth or by itself dispose of an objection.

D1-028 A sustained substantive objection shall receive reasoned consideration and an opportunity for reply. It shall not automatically confer a veto. Unresolved defects in mandatory procedure, decision authority, rights to participate, or required evidence shall prevent progression until remedied. Other remaining disagreement shall be visible in the approval package and assessed by the authorized decision maker.

D1-029 For adoption, substantive maintenance decisions, and other decisions assigned a formal ballot by the Charter, the Secretariat shall circulate a frozen package and proposed resolution for at least 30 calendar days. It shall state eligible participants, recusals, closing time, threshold calculation, ballot options, and challenge route. Ballots shall be approve, disapprove, or abstain; nonresponse shall be recorded separately.

D1-030 The eligible non-recused roster shall be fixed before ballot opening. Each eligible person shall have one ballot in their declared capacity; proxies and duplicate capacities shall not count. Eligibility corrections or later recusals shall be recorded. A change materially affecting the electorate, quorum, or result shall require a new ballot; membership shall not be manipulated to obtain a desired outcome.

D1-031 Let N be the number of eligible non-recused participants, R valid returned ballots including abstentions, Y approvals, and D disapprovals. A ballot shall meet quorum only if $R \geq \lceil 2N/3 \rceil$. Approval shall also require at least three substantive ballots, $Y + D \geq 3$, and $Y \geq \lceil 2(Y + D)/3 \rceil$. Abstentions shall count for returned-ballot quorum but not the substantive-ballot minimum or approval denominator; nonresponses shall count for neither.

D1-032 The result shall include the frozen roster count, recusals, returned ballots, approvals, disapprovals, abstentions, nonresponses, calculation, minority grounds, and decision. Failure of quorum or threshold shall return the matter for further work or deferral, without deemed approval. A substantive change during ballot shall return to the applicable review stage.

D1-033 Final approval shall require a procedurally valid ballot, reasoned consensus assessment, completed dispositions and reply periods, resolved blocking findings, compatible normative dependencies, rights clearance, maintenance assignment, and an authorized adoption record. The Secretariat shall publish accessible decision notice, notify participants and commenters, and record when the appeal period starts. Release shall await that period and resolution of any appeal affecting adoption or publication.

OPEN ISSUE All numerical values in this draft are local proposals requiring author and participant review before governance adoption. They are not ISO/IEEE rules. A valid three-person ballot does not itself demonstrate stakeholder breadth or independent review capacity; the informative defaults annex identifies these participation-risk choices for explicit review.

8.2 Ballot administration and authorization

D1-073 The ballot notice shall include the exact resolution, frozen text and associated artifacts, consensus assessment, dispositions, remaining objections, eligibility basis, and required calculation. The Secretariat shall provide each eligible person a means to submit one attributable ballot without disclosing unnecessary personal information and shall identify a neutral route for challenges to ballot administration.

D1-074 A participant may replace their own ballot before the declared closing time; the Secretariat shall count only the latest valid submission and retain a protected audit of the replacement. An ambiguous or

unverifiable submission shall receive a clarification request and shall not be silently converted to approval or abstention. Ballot validity decisions shall identify the rule applied and the available challenge route.

D1-075 A ballot extension shall be announced before the original close, state the access or participation reason and new closing time, and apply equally to the eligible electorate. An extension shall not change the resolution or threshold or be used solely to solicit a desired result. A frozen package requiring substantive change shall be withdrawn from ballot and returned to applicable review.

D1-076 A non-conflicted person other than the person compiling the tally shall verify eligibility counts, duplicate or replacement handling, recusals, arithmetic, and the consistency of the declared result with the frozen resolution. The verification record shall identify any unresolved discrepancy. A numerical pass with an unresolved blocking procedural finding shall not authorize adoption.

D1-077 The adoption or release authorization shall identify the approved publication class and edition, resolution, vote result where required, consensus rationale, authority exercised, effective date, appeal notice, and conditions affecting release. The release owner shall distinguish this authorization from compilation, distribution, and commencement of an institution's use. An institution's uptake shall not be inferred from programme publication.

9 Procedural appeals and separate complaint routes

9.1 General

D1-034 A participant, commenter, or person directly affected by a programme decision may lodge a procedural appeal identifying the decision, alleged procedural failure, available evidence, and requested remedy. Membership or payment shall not be a condition. The ordinary filing period shall be 30 calendar days after accessible notice of the decision; lack of effective notice or newly discovered concealed procedural failure shall permit a reasoned extension by the independent reviewer.

D1-035 The Secretariat shall acknowledge an appeal within seven calendar days and refer it to an appointed reviewer independent of the disputed decision. The reviewer shall disclose relevant involvement and interests, consider conflict objections, and record independence. The decision's author, a materially interested participant, or a person deciding a related complaint about their own conduct shall not determine the appeal.

D1-036 The reviewer shall state scope, admissibility reasons, record access arrangements, and timetable; provide the appellant and responsible decision maker a meaningful opportunity to reply; and issue a reasoned determination. An initial determination shall be targeted within 30 calendar days of receipt, with reasoned extensions and updated dates notified before expiry. No response or elapsed time shall constitute rejection.

D1-037 An appeal concerning adoption, public-review exclusion, or authority shall pause the affected publication decision. Other appeals shall receive a recorded decision on whether a stay is necessary to prevent prejudice. If no independent reviewer is available, consequential contested progression shall remain pending while unaffected work continues.

D1-038 The reviewer may uphold the process, require disclosure or correction of records, set aside a procedurally defective decision, or remit the matter for renewed participation, review, or ballot. The reviewer shall not substitute a ruling on factual truth, external legal entitlement, or technical merit for procedural review. The accountable body shall record implementation of the remedy before renewed progression.

D1-039 Technical reconsideration, conduct complaints, record-specific access or correction requests, and external legal remedies shall have distinguishable routes. Misrouted submissions shall receive assisted referral rather than silent rejection. Protected conduct handling shall follow the adopted ethics policy;

disagreement alone shall not be treated as misconduct. Internal review shall not be presented as replacing external rights or remedies.

9.2 Appeal case management

D1-078 An appeal record shall identify the challenged decision, appellant or protected reference, grounds, requested remedy, receipt and notice dates, admissibility assessment, appointed reviewer, disclosed conflicts, participation opportunities, stay status, outcome, reasons, and implementation responsibility. Refusal to admit an appeal shall receive reasons and the same independence safeguards as a determination on its merits.

D1-079 The reviewer shall distinguish an objection to the substantive proposal from an allegation that the operative process was not followed. A submission containing both shall receive coordinated handling without forcing the appellant to abandon either ground. A procedural remedy shall identify which decision or stage is affected and what evidence is required before the stay can be lifted.

D1-080 A protected appeal shall give each affected party sufficient grounds and opportunity to respond for the determination being made. If disclosure limits prevent fair determination, the reviewer shall narrow the finding, obtain an authorized independent examination, or defer with stated reasons. Confidentiality shall not be described as proof that the undisclosed account is correct.

D1-081 The Secretariat shall track implementation of an appeal remedy and provide the appellant with its status through the permitted route. A remitted decision shall cite the appeal and demonstrate completion of the required reconsideration or repeated stage. Closing the appeal file shall not establish that a correction, new review, or practical remedy has been completed.

NOTE 1 Repeated submissions of the same disposed procedural point can be consolidated with an explanation and a preserved reference. Newly available evidence, a different material procedural failure, or alleged nonimplementation of a remedy requires an assessment of whether the case should be reopened; a previous closure is not a universal bar.

10 Publication and release integrity

10.1 General

D1-040 The release owner shall verify that the exact publication package implements the approved text and decision. The package shall identify edition, date, class, maturity, adoption authority, conformance scope, dependencies, licenses or permissions, known limitations, maintenance contact, next review date, and superseded publications where applicable.

D1-041 The release manifest shall identify authoritative source files, rendered publications, schemas or fixtures where included, their versions and integrity checks, build instructions and tool versions, and the approval record. A reviewer other than the final editor shall compare the rendered output with the approved source for omitted, altered, or unreadable requirements and record the result.

D1-042 The release owner shall resolve source/build discrepancies before release. Source corrections affecting meaning shall return to substantive review; a rebuild shall not silently change an adopted requirement. Public notices shall distinguish an adopted Standard, a Specification, an informative publication, and a policy recommendation and shall not claim ungranted endorsement or certification.

10.2 Release dependencies and distribution

D1-082 Before release, the owner shall complete the release register in Annex B, including dependency availability, permission basis, source/render verification, accessibility limitations, unresolved issues, appeal

status, distribution locations, and withdrawal contact. A dependency that is unavailable on usable terms shall trigger scope revision or deferral rather than an unsupported interoperability claim.

D1-083 A corrected build or accessible alternative representation shall identify its relationship to the approved edition and whether substantive content is unchanged. Where two representations disagree, the owner shall issue a notice, determine the approved content from the decision record, and correct the affected artifacts under the applicable change procedure. A hidden preference for the newest file shall not resolve normative disagreement.

11 Maintenance, review, and withdrawal

11.1 General

D1-043 Every release shall have an assigned maintenance owner, issue intake route, and next review date. The default review interval shall be two years, shortened by a recorded risk-based decision. Loss of ownership, serious defects, changed dependencies, inaccessible implementation rights, or evidence of material exclusion or harm shall trigger earlier review. An overdue review shall be publicly marked and escalated; silence shall not confirm continued suitability.

D1-044 The maintenance owner shall log reported issues, classify their effect, identify affected versions and dependencies, and publish disposition or investigation status. A correction request shall not be rejected merely because the reported behavior matches the current text.

D1-045 A corrigendum shall correct an error without introducing a new obligation, altering intended meaning, or changing a valid conformance outcome. It shall identify the affected text, corrected text, justification, reviewer, and authorization. If semantic effect is uncertain, the change shall use the amendment or revision route. Historical publications shall remain identifiable rather than silently overwritten.

D1-046 An amendment shall make a bounded substantive change to a named edition; a revision shall issue a consolidated new edition. Both shall receive scope approval, assessment of dependent artifacts and users, appropriate pilots, committee and public review, and final approval under these Directives. An incompatible change shall include migration, coexistence, and deprecation information without claiming lossless conversion absent evidence.

D1-047 Periodic review shall invite evidence from users and affected parties and record confirmation, correction, amendment, revision, supersession, or withdrawal with reasons. Confirmation shall require a maintenance report and an authorized decision; it shall not erase known limitations.

D1-048 Proposed withdrawal or supersession shall receive a public notice of reasons, dependencies, transition consequences, and alternatives for at least 60 calendar days, followed by comment disposition, reply, and formal approval. Withdrawn editions shall remain identifiable with status and date; withdrawal shall not retroactively change what a past conformance claim asserted. Necessary protection of underlying records shall follow D1-052, D1-053, and EIP-039.

11.2 Maintenance decisions and compatibility

D1-084 An issue assessment shall distinguish editorial error, conflicting requirements, implementation defect, changed external dependency, emerging misuse or harm, accessibility failure, and proposed new scope. The maintenance owner shall state the affected editions, current mitigation, evidence required, accountable next action, and review date. Classification shall be reconsidered when new evidence changes the issue's substantive effect.

D1-085 A proposed corrigendum shall be reviewed by a person other than its editor against examples and known conformance outcomes material to the correction. If the parties disagree whether meaning

changes, the owner shall preserve the disagreement and use substantive review unless the uncertainty is resolved with recorded grounds. Issuing a corrected file shall not erase the original published error and its applicability interval.

D1-086 An amendment or revision proposal shall assess current users, dependencies, historical records, version negotiation, migration losses, and coexistence needs. The approval record shall distinguish prospective requirements from statements about previous editions. A deprecated feature shall have a reason, affected scope, intended alternative, and transition notice; deprecation alone shall not retroactively change an earlier conformance result.

D1-087 A confirmation decision shall identify the review evidence, known limitations, current maintenance capacity, dependency status, and next review date. If review cannot establish continued suitability, the authority shall select further investigation, narrowing, revision, suspension of programme recommendations, or withdrawal rather than confirm by default. A dormant publication shall remain findable with its actual status.

12 Emergency safeguards and continuity

12.1 General

D1-049 An authorized governance or release holder may issue a time-limited warning or suspend programme distribution or programme recommendations for new use where a documented serious protection, rights, or integrity risk requires immediate action. The action shall state evidence, scope, authority, duration, contact, affected users, and safe public reasons. It shall remain within programme authority and shall not create or amend normative requirements or purport to invalidate external legal decisions.

D1-050 Emergency action shall receive independent review within seven calendar days and expire within 30 calendar days unless the governance authority records a justified extension, next review date, and remedy plan. Unavailable independent capacity shall not authorize emergency adoption. Permanent amendment or withdrawal shall follow the ordinary procedure; protective handling of unlawfully or improperly disclosed material remains governed by the applicable policy and context.

D1-051 A vacant role shall trigger recorded reassignment within the Charter's mandate or deferral of dependent decisions. A temporary substitute shall meet the same conflict and independence conditions. Emergency procedure shall not be used to avoid consultation because ordinary development is late or under-resourced.

12.2 Incident follow-up

D1-088 The owner of an emergency action shall maintain an incident record identifying the triggering evidence, protection decision, consultations, users notified, independent review, expiry or extension, and restoration criteria. At closure, the governance authority shall assess whether ordinary maintenance, a procedural amendment, or further support is needed and publish permitted reasons. Repetition of temporary measures shall not conceal an unresolved need for substantive review.

13 Records, transparency, and external liaison

13.1 General

D1-052 The Secretariat shall preserve linked proposal, draft, comment, disposition, decision, ballot-result, appeal-outcome, release, and maintenance records. Public readers shall be able to follow the grounds

and changes of a decision without mandatory access to private correspondence. Record corrections shall retain the prior account and correction relationship where lawful and appropriate.

D1-053 A records schedule shall state purpose, custodian, access category, retention period or trigger, restriction review, and authorized disposition for each record category. Public publication history and safe decision reasons shall be retained durably; sensitive submissions and personal data shall not be retained indefinitely by default. A restriction or deletion shall preserve a safe explanation when permitted, without revealing protected existence or identity.

D1-054 The governance authority shall publish an annual account of active work, decisions, unresolved objections, participation gaps, funding influence, overdue maintenance, and procedural incidents at a level that protects affected people. The account shall distinguish claimed representation from evidenced participation.

D1-055 External liaison shall have an explicit mandate identifying purpose, authorized speaker, commitments permitted, and reporting duties. A policy proposal shall identify its intended institution and review route and remain recommendatory. Liaison, use of external sources, and informal participation shall not imply affiliation, institutional endorsement, or adoption of another body's procedures.

13.2 Publication routes outside Standard adoption

D1-056 Before external release of a Specification or informative publication, the responsible authority shall approve a work-item review plan identifying publication class, maturity criteria, release authority, reviewers and needed competence, public-comment arrangements and period with rationale, objection disposition, appeal route, maintenance responsibility and rights clearance. The release record shall identify fulfillment and remaining limitations. Drafting alone shall not constitute that approval.

D1-057 A Specification release containing technical conformance requirements shall use the technical review, public review, disposition, ballot and appeal rules in this Part, while retaining Specification status and its declared maturity. Its release shall not use stage 60 or imply Standard adoption. Promotion shall require an explicit Standard work-item and adoption decision with review of changed scope, requirements and prior evidence.

D1-058 A Policy or Institutional Proposal shall receive a separate mandate-specific release decision identifying its intended addressee, institutional and affected-interest review, public-comment opportunity, considered alternatives and unresolved objections. Its review plan shall preserve a reasoned disposition and the procedural appeal route in this Part. An informative report or manual shall likewise identify its review and release decision without claiming technical Standard conformance authority.

13.3 Procedure assessment and continuing improvement

D1-089 An assessment against these Directives shall identify the procedure, project and decisions covered, operative or rehearsal editions, assessor and relationship, methods, evidence, and results for every applicable requirement. Documentary checks and observation of performed procedures shall be distinguished. An unobserved action shall remain not assessed when only a designed form or hypothetical record is available.

D1-090 The governance authority shall review procedural failures and participant feedback for recurring barriers, delay, concentrated influence, unavailable remedies, or unmanageable burden. The review shall identify corrective actions, owners, and follow-up evidence. A procedural amendment shall itself follow the Charter's review and transition rules and shall not retrospectively validate a defective decision.

Annex A

(normative)

Stage evidence and procedural schedule

A.1 General

This annex defines the evidence schedule invoked by D1-062. The stage labels apply to Standards-track development; D1-056 through D1-058 define how other publication classes use the applicable controls without acquiring Standard status. Evidence can be held in one coordinated dossier with references rather than duplicated in separate files.

D1-091 The stage dossier shall identify each scheduled evidence item, its location and version, custodian, access limitations, assessment result, and unresolved action. An item may be reused from an earlier stage when the responsible reviewer confirms that its scope and evidence remain applicable. Reuse shall not imply that a later change has been reviewed when it has not.

Table A.1 – Required stage-entry and exit evidence

Stage	Entry and work evidence	Exit and failure disposition
00	Identified problem, preliminary sources, affected interests, and alternatives, including reuse or no new publication.	A registered proposal with limitations; preliminary work retains that label if authority, need, or capacity is not established.
10	NWIP scope, class, conformance subjects, source questions, dependencies, impact and participation analysis, planned evidence and resources.	Authorized scope and accepted assignments, maintenance responsibility, review milestones, and decision rationale; incomplete capacity produces revise or defer.
20	Approved scope and candidate requirements, definitions, source map, ADRs for architectural choices, and assessment design.	Integrated Working Draft suitable for committee examination, with open issues, examples, and planned pilot; an editor's preference alone does not close an unresolved material issue.
30	Reviewer assignments and competence; integrated draft; pilot or other relevant evidence; dependency and rights review.	Committee findings and dispositions, horizontal review, known limitations, exact public-review package and outreach plan. Unsupported requirements return for revision or narrower scope.
40	Frozen Public Review Draft, available dependencies and evidence, notice, submission and protection arrangements.	Comment register, dispositions, replies, required re-review, remaining objections, and consensus assessment. A materially changed text does not advance on comments about its predecessor alone.
50	Frozen Final Approval Draft, eligibility and conflict records, completed review dossier, final resolution and maintenance proposal.	Verified valid ballot, authorized decision, notice and appeal record, resolved release blockers. A failed threshold returns to work or deferral rather than automatic withdrawal of the dissent.

Stage	Entry and work evidence	Exit and failure disposition
60	Release authorization and closed appeal conditions; exact source, render and artifact manifest; accessible status and terms.	Publication notice, maintenance route, next review date and archived decision trace. A build discrepancy prevents release until the applicable corrective process is complete.
90	Issue intake, usage and impact evidence, dependencies, maintenance capacity and review notice.	Reasoned confirmation, correction, amendment, revision, supersession or withdrawal. Substantive changes return through applicable stages; current limitations stay visible during investigation.

A.2 Timing and clock records

D1-092 Every notice governed by a period in Table A.2 shall state the starting event, time zone, closing timestamp, responsible function, extension rule, and next route if the period is missed. The period shall be measured from effective accessible notice or the specified receipt event. A changed closing time shall remain traceable to the prior notice and its reason.

Table A.2 – Local procedural periods and their effect

Action	Proposed period	Meaning and controlling requirement
Proposal, comment, appeal acknowledgement	Within seven calendar days of receipt	Receipt response; not acceptance of the substantive claim. D1-020, D1-035, D1-059.
Initial public review	At least 60 calendar days	Minimum opportunity; access failures can require extension. D1-019.
Material re-review	At least 30 calendar days	Full 60-day review when purpose, constituency, or conformance subject changes substantially. D1-025.
Initial comment disposition	Target 30 calendar days after close	Reasoned extension and updated target before expiry; no deemed resolution. D1-023.
Reply to dispositions	At least 30 calendar days before approval	Material reply assessed; renewed review where resulting change requires it. D1-023/024.
Ballot	At least 30 calendar days	Frozen resolution and roster; controlled extension or restart. D1-029/075.
Ordinary appeal filing	30 calendar days after accessible notice	Reasoned extension for ineffective notice or newly discovered concealed failure. D1-034.
Initial appeal determination	Target 30 calendar days from receipt	Independent handling and reasoned extensions; silence is not rejection. D1-036.
Maintenance review	Default two years	Earlier risk-based review; annual governance review remains separate. D1-043 and Charter.

Action	Proposed period	Meaning and controlling requirement
Withdrawal notice	At least 60 calendar days	Disposition, reply and formal approval follow; an emergency warning is distinct. D1-048.
Emergency review and expiry	Review within seven; expiry within 30 calendar days	Extension requires recorded reasons, next review, and remedy plan. D1-050.

D1-093 A missed acknowledgement or target date shall remain visible as a procedural event with reason, effect, corrective action, and notice to permitted recipients. An extension shall not erase the missed service obligation or cure exclusion retrospectively. An unresolved failure material to fair consideration shall prevent dependent progression until remedied.

Annex B

(normative)

Registers and minimum decision records

B.1 General

The schedule below defines record content, not a mandatory database schema. A protected locator can replace publicly identifying detail when the accountable custodian and basis remain available for authorized review. The applicable retention schedule determines what survives; the record of a disposition does not itself authorize indefinite preservation of its underlying sensitive evidence.

D1-094 The Secretariat shall maintain the registers in Table B.1 for applicable activities. Each record shall have a distinguishable reference, version or correction relationship, responsible custodian, creation time, and permitted access scope. A shared register may satisfy several functions if each required distinction remains retrievable.

Table B.1 – Minimum procedural register contents

Register	Required content in addition to common identification and custody
Work and scope	Need; proposer; class; current scope; exclusions; dependencies; status; assignments; resources; milestones; changes; decision and affected projects.
Roles and eligibility	Accepted capacity; mandate; term; criteria; nomination and selection reasons; interests; recusals; substitute; decision-specific eligibility; challenge and disposition.
Issues and alternatives	Source or trigger; affected clauses; materiality; alternatives; evaluation; selected direction; rationale; remaining uncertainty; affected artifacts; owner and next action.
Comments and dispositions	Submission and issue references; target version; grounds; requested change if supplied; receipt; protection preference; response; reasons; changed text; reply; remaining disagreement; re-review decision.
Consensus and decisions	Participants and gaps; substantial objections; resolution attempts; evidence; rationale; authority; operative procedure; outcome; date; limitations; notification and appeal route.
Ballots	Frozen package and resolution; roster and conflicts; valid and replacement ballots; exclusions and reasons; returned, yes, no, abstain and nonresponse counts; calculations; verification; final decision.
Appeals and remedies	Challenged decision; grounds; standing; notice; independent assignment; disclosures; replies; stay; determination; remedy; responsible executor; verification and unresolved implementation.
Releases	Publication class and edition; approval record; dependency versions; source and build manifest; rights and accessibility review; corrections; distribution; appeal status; owner; next review.
Maintenance and incidents	Affected editions; reported issue; classification; severity and limits; interim protection; users notified; review and expiry; compatibility consequences; final disposition and follow-up.

D1-095 A public decision view shall preserve enough permitted information to identify the issue, authority, reasons, outcome, status, and challenge route. An authorized assessor shall be able to locate

the underlying protected record when their mandate permits. A restriction that prevents assessment shall produce a stated assessment limitation rather than a presumed pass.

Annex C

(informative)

Proposed defaults and alternatives

C.1 General

These choices make the draft exercisable; they remain **PROVISIONAL** until explicit governance adoption. A future change to operative thresholds or minimum periods needs governance amendment and does not apply retrospectively to an open ballot or review.

Table C.1 – Local defaults, purposes, and alternatives

Proposed default	Purpose	Alternative and evidence needed
60-day public review; 30-day material re-review	Allow asynchronous participation while enabling bounded iteration.	Longer multilingual review or shorter narrow review; test notice reach, access, and actual response burden. Shortening minima needs prior governance amendment.
30-day disposition target and reply period; seven-day acknowledgement	Make receipt and delay visible while preserving substantive consideration.	Different service targets; test volunteer capacity and accessibility needs. A target is not an automatic closure rule.
30-day ballot and appeal periods	Give participants time to read a fixed package and challenge process.	Longer periods for complex work; test availability and remedy effectiveness.
Two-thirds returned-ballot quorum; three substantive votes; two-thirds approval	Prevent adoption based on one affirmative vote and abstentions; require substantial expressed support.	Larger minimum electorate or stakeholder balance conditions. Three voters do not demonstrate constituency breadth; assess actual participation and available competence.
Two-year maintenance review	Require periodic attention without continuous reballoting.	Annual or longer scope-specific review; evaluate dependency change, harms, issue volume, and maintenance resources.
Seven-day emergency review; 30-day expiry	Limit exceptional authority and expose delays.	Shorter periods for urgent privacy incidents; test reviewer availability and restoration of ordinary review.

Annex D

(informative)

Worked progression and rehearsal evidence

D.1 Worked progression

Consider a synthetic proposal for a record-correction protocol. Its first version assumes that only record custodians can challenge a classification. An affected-participant reviewer explains why that scope excludes people whose records are used in decisions. The editor proposes an accessible participant route and identifies the additional authentication and protected-contact infrastructure required. The Specification need follows the normative problem; it is not inferred from an available software library.

The committee records the competing alternatives: custodian-only correction, direct participant submission, and assisted representative submission. Its selected draft uses the latter two within a declared authority boundary. The decision retains the rejected alternative and reasons, including participation burden and risk of exposing identities. A public-review comment then demonstrates that the selected route still requires an unavailable identifier. Removing that prerequisite changes accepted inputs, requiring material re-review and corresponding changes to tests and explanatory examples.

Suppose the later ballot has five eligible non-recused people and four returns: two approvals, one disapproval, and one abstention. The numerical conditions pass because four returns meet the quorum, three substantive votes meet the minimum, and two approvals satisfy the two-thirds threshold. The objection still needs its disposition and consensus assessment. If the disapproving participant identifies a mandatory review omission, that blocking failure prevents approval despite the tally. The case distinguishes evidential reasons, consensus assessment, numerical support, and authority to progress.

A procedural appeal subsequently establishes that the affected reviewer never received the changed draft. The independent reviewer remits the decision for renewed notice and reply. The new decision cites the remedy and evidence that the opportunity was restored. No prior vote is silently relabelled as agreement with a text it did not consider. Publication then identifies the exact approved source, rendered edition, protocol artifact, and maintenance owner. Later correction of an example is evaluated for substantive effect before the owner chooses corrigendum or amendment.

This sequence is a design example only. Its people, comments, votes, appeal, and release have not occurred. The evaluated arithmetic cases in `examples/p0-governance-rehearsal.md` cover finite calculations, not the operational behavior described here.

D.2 Rehearsal method and evidence

A useful rehearsal records actors as fictional or unassigned, uses identified draft versions, and leaves a complete decision trail. It is not actual public review, proof of representativeness, or governance adoption.

Assessment uses an evidence register with a row for each applicable D1 identifier, the procedure or decision assessed, required record location, reviewer, result (fulfilled, not fulfilled, not assessed, or not applicable), and unresolved action. A not-applicable result identifies the absent trigger. Document inspection assesses notices, disclosures, reasons, and manifests; arithmetic recalculation assesses ballot results; observed exercises assess intake, recusal, reply, appeal, and restoration behavior. Independent procedural review assesses contested fairness and authority. Missing records or unperformed procedures are not counted as fulfillment.

1. Process a bounded NWIP through accept, revise, and defer alternatives. Identify an infrastructure need without presuming a Specification or Standard already exists.
2. Receive an accessible free-text comment, a protected submission, and a sustained minority objection. Show acknowledgement, reasoned disposition, reply, and safe publication.

3. Re-review a material change and demonstrate why a change of constituency restarts full review. Preserve unsuccessful alternatives and source uncertainty.
4. Recalculate a ballot after recusal: with five eligible people, four returns meet quorum; two approvals, one disapproval, and one abstention satisfy the approval threshold. Repeat with two returns and show deferral.
5. Test three returns consisting of one approval and two abstentions. Record failure of the three-substantive-vote minimum even though returned-ballot quorum can be met.
6. Appeal exclusion from review; document independent appointment, conflict challenge, stay, reply, remedy, and renewed decision. Repeat with no independent reviewer and show pending progression.
7. Compare approved source and rendered output, detect an omitted requirement, and prevent release. Distinguish typographic correction from a changed conformance result.
8. Simulate maintenance, incompatible revision, withdrawal, an urgent warning, and role vacancy. Demonstrate that an emergency cannot adopt a Standard.

The rehearsal report records failures, required staffing, elapsed effort, participation and confidentiality barriers, revised clauses, and remaining questions before the founding participants assess readiness.

Annex E

(informative)

Source tailoring and open decisions

E.1 Comparison and local choices

The programme's Brief and comprehensive plan supply the mission and local lifecycle. The comparative planning study supplies the alternatives examined. This draft proposes its own procedures and values; it does not claim ISO, IEEE, or WTO conformity, accreditation, or international representativeness. For the expansion decision and alternatives, see `decisions/ADR-0005-expanded-drafts-and-source-models.md`. The external-model comparison is maintained in `docs/references/drafting_models.md`; neither record substitutes for governance adoption.

ISO's model document informs the separation of foreword, introduction, scope, references, terminology, clauses, annexes, and bibliography. IEEE's procedural material informs the distinction between project supervision, review, ballot, and appeal functions. ITU-T's working-method and author guidance provide a United Nations system comparison for organized technical contributions and Recommendation preparation. These are comparisons of document and procedural functions; this programme has neither those organizations' constituencies nor their institutional powers.

The United Nations National Quality Assurance Frameworks Manual supplies a complementary comparison: attention to institutional environment, production processes, and outputs helps avoid evaluating only the finished publication. D1-060, D1-062, and D1-089 accordingly examine capacity, process evidence, and the limits of the resulting claim separately. This is a programme interpretation, not a declaration that the statistical framework governs generativity standards.

OPEN ISSUE The comparative study records an access gap for the full ISO/IEC Directives Part 1:2026 and Part 2 amendment text. This draft makes no clause-level claim about those unverified texts. Founding authority, actual appointments, contribution terms, neutral review availability, and numerical defaults need explicit resolution before governance adoption.

Bibliography

Source and interpretation: ISO, *International harmonized stage codes*, official webpage checked 22 September 2026, https://www.iso.org/stage-codes.html. The source distinguishes publication, review, and withdrawal; this programme retains its existing local stage 90 grouping. No ISO substage deadlines or voting rules are imported.

Source and interpretation: IEEE SA, *Standards Board Operations Manual*, clause 5, official webpage checked 22 September 2026, https://standards.ieee.org/about/policies/opman/sect5/. Its separation of project supervision, review, and appeals informs comparison. The programme's staffing, deadlines, eligibility, and remedies above are new local proposals, not statements of IEEE requirements.

Source and interpretation: WTO, *Principles for the Development of International Standards, Guides and Recommendations*, official presentation of the 2000 TBT Committee decision, checked 22 September 2026, https://www.wto.org/english/tratop_e/tbt_e/principles_standards_tbt_e.htm. Its process principles inform scrutiny of transparency, participation, relevance, and coherence; no determination of legal status under the TBT Agreement is made.

Source and interpretation: ISO, *Model document of an International Standard*, 2023, https://www.iso.org/iso/model_document-rice_model.pdf. Informative structural model, not a conformance dependency.

Source and interpretation: ITU-T, *Recommendation A.1: Working methods for study groups of the ITU Telecommunication Standardization Sector*, September 2019, official edition/status record: https://www.itu.int/itu-t/recommendations/rec.aspx?rec=a.1; and *Author's Guide*, June 2023, https://www.itu.int/dms_pub/itu-t/oth/0a/0f/T0A0F0000040005PDFE.pdf. Informative organizational and drafting comparisons; no ITU procedure is incorporated.

Source and interpretation: United Nations, *United Nations National Quality Assurance Frameworks Manual for Official Statistics*, 2019, https://unstats.un.org/unsd/methodology/dataquality/references/1902216-UNNQAFManual-WEB.pdf. Informative comparison of institution, process, and output quality; no statistical-system mandate is claimed. The programme's comparison record is `docs/references/drafting_models.md`.

GENERATIVITY STANDARDS PROGRAM

Directives Part 2

Governance Working Draft

Version 0.2 2026-09-22

Structure and drafting rules for programme publications

WORKING DRAFT FOR REVIEW

This document contains proposed provisions for technical and institutional review. It is not an adopted Standard or an operative governance instrument. Its scope, application conditions and publication status are specified in the text.

Prepared by the Generativity Standards Program. Reference to external publications does not imply endorsement by ISO, IEC, IEEE or any United Nations body.

Foreword

This document establishes the proposed editorial and document-engineering rules of the Generativity Standards Program. It is intended for document editors, technical reviewers, terminology maintainers, implementers of associated artifacts and publication assessors.

Responsible editor: `UNASSIGNED`. Canonical source: `governance/directives_part_2.tex`.

This second preparatory draft develops the requirements of Working Draft 0.1 into a publication architecture, drafting method and assessment procedure. Requirement identifiers D2-001 to D2-045 are retained. Additional identifiers designate new provisions. The earlier edition is preserved in the programme's source archive. Neither edition has been adopted as an operative governance instrument.

The foreword, introduction, notes, examples, informative annexes and bibliography provide information. Requirements in the main body and normative annexes are proposed requirements for the declared assessment subject. Their use in a rehearsal does not constitute programme adoption. The publication models consulted include ISO, IEEE and United Nations system materials; their institutional authority and proprietary presentation elements are not incorporated.

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Introduction

A standardization programme requires documents whose provisions can be located, interpreted, implemented and assessed consistently. Length alone does not establish completeness. A short document can be complete for a narrow question, whereas a programme-wide recording or procedural document can require extensive definitions, conditions, assessment methods and interfaces.

The first publication cycle identified a recurring weakness: a list of requirements can state desirable outcomes without specifying how an implementer determines applicability, obtains the necessary evidence, handles exceptions or reports a failure. This edition requires those elements to be developed together. Formal drafting is used to increase precision and reviewability, while explanatory material retains a separate role.

The programme also requires distinctions that conventional technical documentation can leave implicit. A statement about a represented event differs from a claim about its evidence, an ethical evaluation, a legal allegation or an institutional decision. A manuscript can supply conceptual grounds without supplying normative authority. A schema can validate a representation without establishing its factual warrant. The drafting rules provide means to preserve these distinctions across publications.

The local publication profile draws selectively on established models. It uses decimal clauses, dated dependencies, separately identified annex status, controlled terminology and explicit assessment subjects. It does not reproduce another organization's foreword, approval process, legal status or branding. The detailed comparison and access record are maintained outside the normative provisions in `docs/references/drafting_models.md`.

1 Scope

This document specifies requirements for the structure, language, terminology, references, associated artifacts and editorial assessment of publications prepared within the Generativity Standards Program.

It applies to governance documents, Standards-track drafts, Specifications, Technical Reports, Manuals and Policy or Institutional Proposals. The applicable structural profile depends on publication class. The assessment subject is an identified publication package comprising the document source, rendered edition and explicitly associated artifacts.

This document does not prescribe a universal theory of generativity, select a technical interchange syntax, confer Standard status or determine the legal effect of a publication. Approval, review periods, release authority and maintenance decisions are governed by Directives Part 1 when adopted. Historical source manuscripts remain source records and are not retroactively edited to meet this document.

2 Normative references

2.1 Dated draft references

For coordinated assessment of this preparatory edition, the following programme drafts supply the provisions explicitly invoked in the text. References are dated to the stated draft version; later changes require dependency review.

- Standards Programme Charter, Working Draft 0.2: CH-010 and CH-011 on publication classes and the limits of Standard designation. Source: `governance/standards_programme_charter.tex`.
- Directives Part 1, Working Draft 0.2: D1-040 to D1-048 on exact-edition publication, correction, revision and maintenance, together with the procedure invoked for the applicable draft stage or publication class under D2-045. Source: `governance/directives_part_1.tex`.
- Ethics, Conflict-of-Interest, and Contribution Rights Policy, Working Draft 0.2: EIP-028 to EIP-031 on artifact-specific terms, source rights and intended distribution, and EIP-039 on custody and protected case information. Source: `governance/ethics_ip_policy.tex`.

These references form a proposed governance package. Listing them does not establish that they are operative. External drafting guides and foundation manuscripts are informative sources unless a particular requirement explicitly incorporates a separately identified technical provision. No ISO, IEEE or United Nations document is a normative dependency of this edition.

2.2 Bounded application and unavailable dependencies

D2-094 For coordinated assessment of this edition, the editor shall apply CH-010 and CH-011 to the publication-class and Standard-status statements required by D2-001 to D2-003; the applicable D1-040 to D1-048 provisions and the identified stage-specific procedure to the publication and change-control subjects invoked by D2-042 to D2-045; and EIP-028 to EIP-031 and EIP-039 to incorporated source material, intended distribution and protected case information where present. The dependency record shall identify the provisions triggered, exact editions, source locators and evidence. An unavailable or incompatible dependency shall leave the affected result not assessed pending resolution.

The incorporated scope concerns the named questions, not an assertion that this publication fulfils each governance instrument in its entirety. A draft without a release decision does not acquire adopted authority through editorial assessment. An absent distribution or case-information trigger can make the corresponding dependency provision inapplicable; missing rights evidence for an intended distribution is not an absent trigger. Programme authority, development procedure, rights and protection, and editorial

assessment remain distinct responsibilities. A conflict is recorded for the competent governance decision rather than resolved by treating a draft as already operative.

3 Terms and definitions

3.1 publication package

identified set of source texts, rendered documents and associated artifacts submitted for a stated review or release purpose

NOTE 1 A package can include a schema, assessment fixture or change record. Inclusion does not make every artifact normative.

3.2 provision

expression in a document that states a requirement, recommendation, permission or explanatory information

3.3 requirement

provision specifying an outcome or condition that is necessary to support the declared claim of fulfillment

3.4 conformance subject

identified object, practice, procedure, system or application against which requirements are assessed

3.5 applicability condition

stated circumstance that determines whether a requirement applies to the declared subject

3.6 normative reference

reference to an identified external provision whose fulfillment is necessary to fulfill an invoking requirement

3.7 informative reference

reference that supplies explanation, conceptual grounds, comparison or further information without adding a conformance obligation

3.8 profile

identified set of application conditions and permitted selections, additions or restrictions relative to specified parent requirements

3.9 editorial correction

change that corrects presentation without changing the meaning, applicability or assessment result of a provision

3.10 substantive change

change that can alter a provision’s meaning, applicability, authority, permitted behavior or assessment result

3.11 assessment evidence

material and recorded reasoning used to support a result for an identified requirement and subject

3.12 hanging paragraph

text attached directly to a clause that also contains numbered subordinate clauses, leaving its structural position ambiguous

4 Publication identity and document architecture

4.1 Identity and standing

D2-001 A publication shall identify its code or other identifier, title, publication class, maturity status, version, responsible editor or unassigned responsibility, and source location near its beginning.

D2-002 A draft shall state that it is not adopted and shall distinguish authoring progress from formally authorized project status. A publication shall not imply ISO, IEC, IEEE or governmental authority without a documented basis.

D2-046 A revision shall identify the preceding edition and summarize substantive changes. The publication package shall preserve a retrievable change relationship and the status of the earlier edition. A new rendering of unchanged text shall not be represented as a new normative decision.

The document identifier and the requirement identifier serve different purposes. A document identifier locates a publication family and edition. A requirement identifier supports the continuity of an obligation across editorial reorganization. A file name or page number is not sufficient to perform both functions.

4.2 Publication classes and audience

D2-003 An editor shall assign one principal publication class and state its intended readers, use and authority. A Standard, Specification, Technical Report, Manual, governance document and Policy or Institutional Proposal shall not be treated as interchangeable classes.

D2-004 A protocol description shall identify its containing publication class. Protocol behavior shall be distinguished from the institutional authority and procedure under which that behavior is used.

D2-005 A Policy or Institutional Proposal shall distinguish factual background, interpretation, objectives, options, mandate, implementation implications and unresolved questions. It shall not create technical conformance obligations through an unapproved policy recommendation.

D2-047 A document containing material of more than one publication class shall identify the principal class and separate the subsidiary material by a stated structural boundary. The editor shall state whether each part defines requirements, supplies guidance or proposes an institutional option.

Technical detail does not make a document an adopted Standard. A Specification can contain exact and testable provisions while retaining Specification status. A policy proposal can recommend adoption or experimentation without defining technical conformance. A protocol is a subject described within a publication, not an additional source of institutional authority.

4.3 Required structural components

D2-006 The scope shall identify the subject of conformance, intended use, relevant environment and exclusions. A claim of conformance shall be assessable within that stated boundary.

D2-007 Normative and informative material shall be distinguishable at clause, annex or artifact level. Notes, examples and informative annexes shall not introduce additional requirements.

D2-008 Every table, figure, annex and associated artifact shall have a stated role and, where interpretation depends on it, a stated authority status. A normative requirement represented in a diagram shall also have an identifiable textual formulation.

D2-048 A technical or governance draft prepared under this document shall contain a title and status statement, a foreword, a scope clause, a normative-reference clause, a terms-and-definitions clause, substantive provisions and an assessment or application clause. It shall identify the role of every annex and associated artifact. An informative bibliography shall be provided when informative external sources are cited.

D2-049 The foreword shall record publication history, responsible preparation and material edition changes without introducing technical requirements. The introduction, when present, shall explain the problem, approach and intended use without creating additional conformance obligations.

D2-050 The scope shall identify both inclusions and material exclusions. It shall not contain requirements that can be located only in the scope or imply applicability to environments for which the document supplies no assessment basis.

The principal body normally begins with Scope, Normative references and Terms and definitions, in that order. A document having no normative references states that fact. It does not populate the clause with a reading list. A vocabulary document can use a more extensive terminology structure, provided that definition entries and vocabulary-application requirements remain distinguishable.

4.4 Clause hierarchy and navigation

D2-051 The editor shall assign decimal clause and subclause numbers, use descriptive titles and place substantive text at an identifiable leaf of the hierarchy. If a clause has subclauses, introductory provisions belonging to that clause shall be placed in a General subclause or another identified subclause.

D2-052 A cross-reference shall identify a stable requirement, clause, table, figure or annex as appropriate. References such as above, below, elsewhere or the latest text shall not be the sole locator of content necessary for interpretation or assessment.

The depth of subdivision follows the complexity of the subject. Repeated one-sentence subdivisions can impair reading; long unstructured blocks can conceal distinct conditions. Editors select a hierarchy that permits a reviewer to identify the actor, trigger, action and evidence without reconstructing a paragraph's unstated scope.

5 Formulation of provisions

5.1 Requirement construction

D2-009 A requirement shall identify the responsible actor or object, the applicable condition, the required behavior or property, and an outcome or evidence by which fulfillment can be assessed.

D2-010 A requirement shall use a stable identifier independent of its displayed section number. An identifier shall not be reassigned to a different obligation after circulation; a withdrawn identifier shall remain traceable.

D2-011 A requirement shall not combine independent obligations whose applicability or assessment differs so materially that one result would conceal another. Related obligations can be grouped when their joint assessment is explicit.

D2-012 Terms such as adequate, appropriate, trustworthy or significant shall have a scoped criterion, declared decision responsibility or assessment procedure when they determine conformance. A broad aspiration alone shall not be presented as a testable requirement.

D2-053 Each requirement shall be linked to at least one discriminating assessment question. The question shall distinguish an acceptable outcome from a materially different outcome that would not fulfill the requirement.

D2-054 Where one identifier groups related obligations, the assessment schedule shall identify the components and record a result for each materially distinct component. Fulfillment of one component shall not conceal an unassessed or failed component.

An obligation normally identifies the responsible subject, any triggering condition, the required action or property and the information needed to determine fulfillment. A requirement can depend on a scoped judgment, but the judgment's criteria, decision responsibility and record are then part of the assessable arrangement. Formal drafting does not require every judgment to be reduced to a number.

5.2 Verbal forms

D2-014 The editor shall distinguish mandatory conditions, recommendations, permissions and capability statements consistently. A recommendation's non-fulfillment shall not be reported as failure of a requirement.

D2-055 The editor shall use shall and shall not for requirements and prohibitions, should and should not for recommendations, may for permission, and can for possibility or capability. Must shall not be used as an alternative requirement verb in programme-authored provisions.

D2-056 A statement of external necessity, including a stated legal constraint, shall identify its source and context. The editor shall distinguish that external constraint from an obligation created by the publication.

The grammatical present can describe a definition, process model or fact. It is not used to conceal an additional obligation. A statement that information can be recorded describes capability; it does not require the information to be retained in a particular record. Permissions are assessed in relation to mandatory limits, not as exceptions to them.

5.3 Conditions, exceptions and incomplete knowledge

D2-013 A permission shall not override a requirement implicitly. Exceptions shall identify the affected obligation, conditions, authority, required record and any limitation on the resulting conformance claim.

D2-015 A conditional requirement shall state its trigger and how applicability is determined. A result of not applicable shall include its reason; it shall not substitute for unavailable evidence or an unperformed assessment.

D2-016 When complete information is not realistically available, a recording requirement shall specify whether a justified unknown, limitation or restricted disclosure satisfies the obligation. It shall not require invented content to complete a mandatory field.

D2-057 A provision permitting an unknown value, unavailable source or restricted disclosure shall state the required declaration, responsible role and assessment consequence. The editor shall distinguish fulfillment of that declaration requirement from resolution of the underlying factual question.

D2-058 An exception shall state its eligibility condition, decision authority, permitted departure, duration or review trigger, required evidence and effect on the resulting claim of fulfillment. An exception shall not be implied solely by a resource limitation.

A conditional requirement remains mandatory when its condition is met. A requirement that has not been assessed is not made inapplicable by the absence of evidence. The document can require a justified declaration of uncertainty while leaving the substantive matter unresolved. It can also require access that the subject cannot provide, in which case the assessment reports the consequence rather than inventing an authorization.

5.4 Completeness and proportionality

D2-059 For each substantive topic in scope, the editor shall identify normal operation, material boundary cases, failure conditions and applicable interfaces. A topic shall not be treated as specified solely because it appears in a list of objectives.

D2-060 Where requirements can impose material recording, review or participation burdens, the document shall identify the intended operating scale and the evidence needed to assess that burden. A reduced profile shall state its limitations and shall not silently claim the coverage of the parent document.

Proportionality is expressed through explicit conditions, profiles and scope. It is not achieved by using undefined terms such as sufficient or appropriate as a substitute for deciding what an implementer records. Conversely, mandatory collection of every available detail can be inconsistent with purpose, protection and feasible participation.

6 Terminology and conceptual sources

6.1 Definition entries

D2-017 An operational definition shall state its scope and shall not imply that it exhausts a broader philosophical concept. A definition imported or adapted from a source shall identify that source, edition and the nature of the adaptation.

D2-061 A definition entry shall identify the preferred term, a unique term locator, the relevant domain where needed, and a definition that distinguishes the concept from adjacent concepts. Notes and examples shall remain separate from the definition.

D2-062 The editor shall use a defined term consistently within its declared scope. A synonym, abbreviated term, deprecated term or narrower profile-specific use shall be identified explicitly rather than introduced as an unexplained substitution.

Definitions describe concepts. They do not contain procedural obligations that belong in requirements. A definition can specify constitutive characteristics, while a later provision states when a conforming application has to record or satisfy those characteristics. Circular definitions and definitions consisting only of synonyms require revision unless the document explicitly identifies an unresolved terminology issue.

6.2 Foundation interpretation

D2-021 A draft shall distinguish occurrence claims, observations, evidence assessments, interpretations, normative evaluations, legal assertions and institutional determinations wherever conflation would strengthen a claim beyond its grounds or authority.

D2-018 For a substantive GR definition, the editor shall record the relevant foundation passage, alternatives, unresolved differences and the rationale for operational use. A material narrowing or departure shall have an Architecture Decision Record before the definition is stabilized for adoption.

D2-019 An operational definition of Entity, State, Event, Process, Relation or Property shall address admissibility, identity, temporal behavior, allowed relations, required and optional information, examples,

counterexamples and unresolved edge cases. A declaration that an item remains provisional shall identify the missing decisions.

D2-020 The editor shall not equate a formal state with an archival State, a mechanism with a Process, or formal change with an Event without an explicit argument and scoped decision. The six record roles shall not be presented as exhaustive constituents of reality.

D2-063 A source trace for a GR-specific operational definition shall identify the manuscript version, passage locator, interpreted distinction, operational narrowing, material alternative and affected provision. A source discrepancy shall remain visible until its disposition is recorded.

The foundation corpus supplies conceptual source authority. It does not determine the programme's approval procedure. A formal model's carrier, transition or mechanism does not automatically supply the identity or metadata of an archival State, Event or Process. A record ontology can support a practical distinction while leaving a deeper philosophical or mathematical question open.

6.3 Translations and mappings

D2-064 A translation or cross-vocabulary mapping used to determine conformance shall identify the source and target editions, responsible reviewer, correspondence asserted and known non-equivalences. An untranslated or unmapped distinction shall not be represented as preserved without supporting evidence.

Translations can be reviewed documents without being authoritative editions. The publication identifies which edition controls interpretation in the declared programme process. Disagreement over equivalence is recorded as a technical issue; an editor does not resolve it by silently changing the source term.

7 References and dependency management

7.1 Normative references

D2-022 An external reference used to support a normative or scholarly claim shall be verified against an identified primary source. Inaccessible text, uncertain edition, incomplete review and unverified compatibility shall be identified rather than reconstructed as fact.

D2-023 A normative reference shall identify the exact document and edition required to apply a requirement, the part relied on and a means of obtaining it. Informative motivation shall be listed separately from normative dependencies.

D2-065 Each normative reference shall be invoked by an identifiable requirement or application rule. The dependency record shall state the incorporated scope, required edition and assessment consequence of an unavailable or incompatible dependency.

The invocation can incorporate a whole profile or a bounded set of provisions. It does not automatically incorporate every recommendation, example or later amendment in the source publication. A draft dependency can be used for preparatory assessment if its status and exact edition are declared; it cannot supply an adopted authority that it does not possess.

7.2 Informative sources and external publication models

D2-024 A draft depending on another draft shall identify the dependency's version and status and the consequences of a change. It shall not imply the dependency has already been adopted.

D2-066 A bibliography entry shall provide enough information to distinguish the cited source and locate the relevant edition. Where an external model is used for drafting or comparison, the source record shall

distinguish directly inspected material from catalogue metadata, secondary description and unavailable text.

An organization's publication name does not establish that every document it issues has the same authority. For example, a technical Recommendation, a statistical manual and an institutional policy proposal can differ in their adoption procedure, audience and implementation effects. The programme therefore records the source's actual class before deriving a local design proposal.

7.3 Dependency review

D2-025 Before approval for publication, the editor shall produce a dependency review identifying incompatible versions, unavailable dependencies, circular requirements and licensing or access constraints material to implementation.

D2-067 A material dependency change shall identify affected requirements, definitions, assessment cases and associated artifacts. The editor shall record whether each affected element remains valid, requires revision or cannot yet be assessed.

A circular reference is not resolved by citing the two documents more precisely. Technical definitions and conformance conditions require a determinate interpretation. Governance instruments can be adopted as a coordinated package, but their allocation of authority, procedure and assessment still needs a documented reading order and conflict rule.

8 Conformance and assessment provisions

8.1 Subjects, scope and claims

D2-031 A draft shall state the limits of its conformance claims, including the distinction between record structure and factual truth, between source authentication and evidential warrant, and between technical conformance and legal or ethical judgment.

D2-026 A claim of equivalence, compatibility or interoperability with another model shall identify its direction, scope, tested cases, unsupported distinctions and known loss. Matching terminology alone shall not justify that claim.

D2-027 The conformance clause shall distinguish the assessed subject, publication edition, profile, applicable requirements, assessment method, assessor and result. It shall distinguish a record, producer, protocol participant, presentation, archive and organizational procedure when their obligations differ.

D2-068 A document allowing more than one conformance subject shall specify the requirement set applicable to each subject or state that the available assessment is partial. It shall distinguish examination of a record from observation of the practice or procedure represented by that record.

A statement about a completed institutional action requires evidence of that action. A narrative describing the action is evidence of an assertion and can be assessed as a record. It is not automatically sufficient evidence that the underlying action occurred or that an affected person received its result.

8.2 Assessment methods and results

D2-032 An automated check shall identify the constraints it actually assesses. A passing automated result shall not be presented as evidence of a human or institutional action that the check did not observe.

D2-028 Each requirement shall have at least one stated assessment method and evidence expectation. Structural checks, protocol tests, human interpretation and procedural review shall have separately identifiable results.

D2-029 A conformance report shall distinguish fulfilled, not fulfilled, not assessed and not applicable results. A missing assessment shall not be counted as fulfillment.

D2-069 An assessment method shall specify its objective, input conditions, procedure, relevant tools or competence, expected observations, result rule and material limitations. The method shall identify the conditions under which an inconclusive or not-assessed result is required.

D2-070 An assessment report shall retain failed and unassessed applicable requirements and their effect on the overall result. A summary shall not replace the underlying requirement-level evidence register.

Automated checks are suitable for such questions as syntax, identifier uniqueness or required structural elements. Evidential relevance, meaningful participation and the adequacy of a protected response can require competent judgment or observation. A document identifies these limits instead of describing every assessment as machine validation.

8.3 Profiles and optional features

D2-030 A profile shall state its parent requirements, additions, permitted restrictions, exclusions and intended users. It shall not silently weaken a parent requirement while claiming unqualified parent conformance.

D2-071 For an optional capability, a document shall state the condition under which associated obligations become mandatory. An implementation selecting that capability shall be assessed against the complete selected requirement set.

Optional selection and optional implementation quality are different questions. A subject can be permitted to omit a feature. If it claims to supply that feature, the relevant correctness, protection and failure-handling obligations apply according to the profile.

9 Information models, protocols and technical artifacts

9.1 Separation of semantics and bindings

D2-036 A schema, API or encoding choice shall be traceable to a stated requirement or interoperability need. Implementation convenience alone shall not be described as a philosophical necessity or universal institutional rule.

D2-072 A data dictionary shall distinguish semantic information requirements from serialization names, storage types and transport behavior. Each mandatory or conditional element shall identify its meaning, applicable subject and permitted absent or unknown states.

An abstract information requirement can be implemented in a narrative dossier, table or technical binding. The existence of a field in one implementation does not make its name or data type normative. When interoperability depends on that choice, a Specification work item provides the explicit binding and its assessment evidence.

9.2 Protocol behavior

D2-033 A protocol Specification shall define its participants, inputs, preconditions, state transitions, observable outputs, effects, refusal and failure cases, recovery behavior, version assumptions and authorization boundaries.

D2-034 An artifact package shall identify the relationship between its prose requirements and its schemas, examples, vocabularies, test fixtures and executable components. Conflicts shall have a documented resolution rule that does not silently amend an approved requirement.

D2-073 A protocol description shall distinguish sending, transport delivery, receipt, acknowledgment, acceptance for processing and substantive disposition when those states have different consequences. A transport success shall not imply institutional acceptance or completion of a remedy.

D2-074 Where concurrent updates or repeated messages are in scope, the protocol description shall specify correlation, version preconditions, duplicate handling, conflict disposition and recovery after interruption. If those behaviors are not specified, the interoperability claim shall identify that exclusion.

An institutional procedure can be implemented manually. A network protocol can support its exchanges but cannot itself assign legal competence, decide an evidential dispute or grant an institutional remedy. The document specifies the interface between technical behavior and the responsible institutional function.

9.3 Associated artifacts

D2-037 Executable validation or rendering shall not silently retrieve unpinned remote resources, disclose protected input or substitute a current external vocabulary for the edition declared in the package. Any required external processing shall be explicit.

D2-035 Examples intended to be valid shall identify the supported profile and expected result. Negative examples shall identify the intended defect. Synthetic evidence shall be labelled as synthetic.

D2-075 Each associated schema, vocabulary, executable example or test fixture shall identify its owner, version, publication class or role, controlling requirements and status. Its release manifest shall state whether the artifact is normative, informative or experimental.

D2-076 A discrepancy between prose and an associated artifact shall be recorded with affected conformance outcomes. The release package shall identify the controlling interpretation or remain pending resolution; implementers shall not be required to infer priority from file format.

10 Presentation, accessibility and contextual statements

10.1 Tables, figures and formulae

D2-077 Every substantive table and figure shall have a unique number, descriptive caption and an explicit reference or structural purpose in the surrounding text. Required information shall not be encoded solely by colour, shape or visual position.

D2-078 A formula used in a requirement or assessment method shall identify its variables, domain, units where applicable, assumptions and interpretation. Undefined quantities and unsupported numerical precision shall remain explicit limitations.

Table headings can state shared conditions, but a condition necessary for conformance is not left to typographic inference. Units and scales are attached to the represented quantity. A percentage without its denominator or a confidence score without an interpretation is insufficiently specified for a substantive assessment.

10.2 Examples and accessibility

D2-038 A publication shall use headings, table labels, link text and readable typography that expose its structure. Essential meaning shall not depend solely on color, visual position or a diagram.

D2-039 An editor shall provide a usable source or alternative reading representation and identify known accessibility limitations of the rendered document. Successful PDF compilation alone shall not establish accessibility conformance.

D2-079 An example shall state whether it is synthetic, adapted or empirical and identify any omitted material that affects its use. Expected behavior in an authored scenario shall remain distinguishable from observed behavior in an executed assessment.

D2-080 The publication assessment shall identify intended reading modes, known barriers and the evidence used to assess accessibility. Availability of source text, PDF text extraction or a successful build shall not alone establish accessibility conformance.

10.3 Legal, ethical and institutional assertions

D2-040 A legal or institutional assertion used in a requirement shall identify the context, asserted source of authority and scope. A proposed model rule or policy option shall be labelled as such rather than described as generally applicable law.

D2-041 The editor shall record cross-domain review findings relevant to scope, including epistemic, ethical, legal, institutional, political-economy, archival, security and accessibility questions. Unavailable competence or unresolved material objections shall remain visible in progression records.

D2-081 A policy or institutional recommendation shall identify the intended decision maker, asserted mandate, feasible alternatives, implementation conditions, affected interests and evaluation approach. Adoption of a technical requirement shall not be presented as resolving those policy choices automatically.

Contextual reviewers assess the questions within their competence. A legal statement identifies its jurisdiction and procedural status; an ethical statement identifies its evaluative grounds and affected interests. An unavailable review remains an identified gap rather than being replaced by a generic assurance sentence.

11 Versioning and publication production

11.1 Source and artifact control

D2-042 Each circulated edition shall identify its canonical source and rendered artifacts. Changes to proposed requirements shall be traceable through the change record, with superseded reasoning retained subject to justified access and retention rules.

D2-043 A release candidate shall be built from the declared source revision, with build instructions, required tooling and an artifact manifest sufficient to reproduce and compare its substantive content.

D2-044 The release check shall detect broken internal references, duplicate requirement identifiers, missing glyphs, visibly clipped material, mismatched status labels and disagreement between declared source and generated artifact. Unresolved defects shall be reported with their effect on use.

D2-082 The editor shall distinguish the canonical authoring source, any generated representation and the exact edition submitted for decision. A release manifest shall identify source and artifact integrity references, build instructions, tool versions and the associated review record.

Byte-identical rendering is not assumed. Compiler metadata and timestamps can change binary output without changing substantive content. Integrity references identify what was actually reviewed; comparison procedures identify whether the intended provisions, identifiers and status survived rendering.

11.2 Amendment and source preservation

D2-045 An editorial correction shall not silently change the substance of a requirement. A substantive change to an adopted normative edition shall use the amendment or revision procedure in Directives Part 1, including affected-artifact and compatibility review. A draft change shall follow the change-control and

re-review rules applicable to its current stage. Changes to a released Specification shall follow its declared maintenance procedure and promotion shall require a separate decision.

D2-083 A changed requirement shall retain its identifier when its continuity is defensible and identify the nature of the change. A withdrawn requirement shall remain traceable. Reorganization shall provide a correspondence map when clause numbering or placement changes materially.

D2-084 An archival source snapshot shall record the source set, edition and integrity references. A historical snapshot shall be marked as historical and shall not replace the current edition's status or dependency declarations.

12 Assessment of a publication package

12.1 Assessment declaration

D2-085 The assessor shall identify the publication package, assessed edition, applicable structural profile, assessment scope, assessor relationship and required competence before issuing an overall result. Missing expertise and unavailable artifacts shall be reported.

D2-086 The assessment shall use the record specified in Annex B and examine the structural schedule in Annex A. Each applicable requirement shall receive an individual supported result.

12.2 Disposition of findings

D2-087 A finding shall identify the affected provision or artifact, the observed defect, its effect on interpretation or assessment, the proposed disposition and the responsible action. A correction shall identify the revised edition and the evidence used to close the finding.

D2-088 An overall publication result shall distinguish structural checks, technical review, source interpretation, cross-domain assessment and authorization for release. Fulfillment of one category shall not be reported as fulfillment of an unperformed category.

Annex A

(normative)

Structural schedule for programme publications

A.1 Application

D2-089 The editor shall apply the structural schedule in Table A.1 according to the declared publication class. A departure shall identify its rationale, alternative location and effect on assessment. The schedule shall not require an empty clause to simulate completeness.

Table A.1 – Structural components and required treatment

Component	Technical or governance publication	Informative or policy publication
Identity and standing	Identifier, title, class, edition, date, responsible preparation and adoption status.	The same identity controls; identify recommendatory or informative authority.
Foreword	Preparation, edition history and principal changes; no technical requirements.	Publication context, responsibility and history where relevant.
Introduction	Optional problem and approach explanation; distinguish it from scope.	Purpose and context can be substantive, with recommendations distinguished from background.
Scope	Subject, intended use, operating environment and material exclusions.	Intended readers, question, context and limits of conclusions.
Normative references	Identify invoked dependencies or state that none apply.	Identify any incorporated requirements separately from a bibliography; no implied conformance authority.
Terms and definitions	Numbered operational definitions and referenced vocabulary.	Define terms needed to avoid ambiguity; do not restate an adopted vocabulary inconsistently.
Substantive body	Requirements, applicability, interfaces, exceptions and failure behavior.	Analysis, evidence, alternatives, recommendations and implementation implications.
Assessment or evaluation	Subjects, requirement sets, methods, result rules and limitations.	Evaluation questions and proposed evidence; distinguish proposed from measured results.
Annexes	Each annex designated normative or informative; references from the body.	Normally informative; any proposed normative model remains explicitly a proposal.
Bibliography	Informative sources and edition locators, distinct from dependencies.	Sources supporting analysis and recommendations, with access limits recorded.
Associated artifacts	Role, version, controlling requirements, integrity reference and maintenance owner.	Role and limitations; no implied normative priority from machine readability.

A.2 Minimum completion review

D2-090 Before submission for final approval, the package review shall determine whether each in-scope topic has a defined subject, required behavior or outcome, applicability rule and assessment basis. An unresolved topic shall be excluded explicitly, retained as an open issue preventing the affected claim, or returned for development.

Annex B

(normative)

Requirement assessment record

B.1 Record components

D2-091 The assessment record shall include the information specified in Table B.1. Protected evidence shall be referenced through a permitted locator and its examination limits shall remain explicit.

Table B.1 – Assessment record information

Component	Required information
Subject declaration	Publication, edition, source set, artifacts, profile, scope and exclusions.
Requirement locator	Stable identifier, containing clause and controlling edition.
Applicability decision	Trigger, determination, basis and any dependency affecting applicability.
Method	Inspection, recalculation, execution, competent review or user task; procedure and conditions actually used.
Evidence	Source or observation locator, relevant portion, acquisition date, access status and assessment rationale.
Result	Fulfilled, not fulfilled, not assessed or not applicable; component results where a clause groups obligations.
Attribution	Assessor, competence, relationship to the author or operator, and actual date.
Limitations	Unavailable evidence, unresolved interpretation, sampling scope and excluded conclusions.
Disposition	Required correction or additional evidence, responsible action, status and closure evidence.

B.2 Result rules

D2-092 Fulfilled shall be reported only when the stated assessment method and evidence support the applicable obligation. Not applicable shall identify an absent trigger. Unavailable evidence or an unperformed assessment shall be reported as not assessed unless another specified result rule applies.

D2-093 An unqualified claim of fulfillment of the declared publication profile shall not be issued while an applicable requirement is not fulfilled or not assessed. A partial result shall identify the assessed subset and excluded conclusions.

Annex C

(normative)

Publication self-assessment schedule

C.1 Method and applicability

D2-095 An assessment of this document or a publication prepared under it shall apply the topical checks in Table C.1 to every applicable D2 requirement, using the record in Annex B. Each requirement and each materially distinct grouped component shall receive its own result and evidence. A grouped table row shall not authorize one undifferentiated result for its identifiers.

The objective is to distinguish inspectable, correctly scoped provisions from plausible wording that loses a necessary distinction. Inputs are the declared source and rendered edition, dependency and source registers, associated artifacts, change history and actual review or build evidence. The assessor examines the identified passages, follows their references and applies the discriminating question in the table. Text searches and build checks support inspection; meaning, source interpretation and contextual authority require relevant review competence. Where execution or user examination is needed, a document describing that activity is not substituted for observing it.

The expected observation is the retained distinction or controlling evidence named in the check. A demonstrated contradiction or missing required component is not fulfilled; an unavailable examination or needed competence is not assessed; an absent stated trigger is not applicable. A fulfilled result requires evidence for every applicable component. The assessor may use a domain-equivalent check with its rationale and equivalent failure condition recorded. Results remain limited to the examined edition, artifacts, uses and procedures.

C.2 Topical checks

Table C.1 – Requirement groups, discriminating questions and evidence

Identifiers	Discriminating assessment question and evidence
D2-001, D2-002, D2-046	Compare title, foreword, metadata and preceding edition. Can a reader distinguish authoring revision from authorized initiation, adoption and an unchanged rebuild? Trace any authority assertion to its record.
D2-003, D2-004, D2-005, D2-047	Follow an implementation rule and a policy recommendation to their containing class and audience. Does a protocol or subsidiary policy passage silently acquire a different authority? Inspect structural boundaries.
D2-006, D2-007, D2-008, D2-048, D2-049, D2-050	Compare scope, body, annexes and associated artifacts. Is any necessary obligation present only in scope, a note, introductory narrative or an unclassified visual? Locate its controlling formulation.
D2-051, D2-052	Walk the clause tree and follow a substantive reference without surrounding conversation. Can its leaf, exact target and edition be identified, or does interpretation depend on an unlocated paragraph or latest text?
D2-009, D2-010, D2-011, D2-012, D2-053, D2-054	Apply a requirement to a normal and boundary case. Can the actor, trigger, criterion and outcome be determined? Compare grouped components with different results and check identifier continuity in the change record.
D2-014, D2-055, D2-056	Search modal verbs and inspect their contexts. Does an optional recommendation become a failure, a capability become an obligation, or an asserted legal necessity lack a scoped source?

Identifiers	Discriminating assessment question and evidence
D2-013, D2-015, D2-016, D2-057, D2-058	Apply an exception and an unknown value to a triggered obligation. Recover authority, permitted departure, review limit and result consequence; distinguish an absent trigger from an unavailable assessment.
D2-059, D2-060	Select a substantive topic and its failure case. Is behavior specified beyond an objective label, and can its burden be examined at the declared scale without assuming a reduced profile preserves full coverage?
D2-017, D2-061, D2-062	Trace a numbered term from definition to use and source. Do notes, synonyms or domain qualifications change its operative meaning without an explicit boundary? Compare an adjacent concept or counterexample.
D2-018, D2-019, D2-020, D2-021, D2-063	Compare an operational GR definition with its manuscript passage and decision record. Does a formal carrier become an archival class, or a source disagreement disappear, without a scoped argument and recorded disposition?
D2-064	Test a translation or mapping on a meaning that is narrower in one edition. Is the difference retained, with reviewer and editions, or silently described as equivalence?
D2-022, D2-023, D2-065	Follow an invoked dependency to the exact primary provision. Can a reader obtain the incorporated edition and determine what failure or inaccessibility means, rather than relying on a reading-list citation?
D2-024, D2-066	Compare the bibliography with access records and draft status. Does catalogue-only or unavailable material appear as directly inspected content, or a dated draft as an adopted authority?
D2-025, D2-067, D2-094	Examine an affected dependency version or unavailable source. Are incorporated clauses, impacted results and resolution recorded, including bounded Charter, Part 1 and ethics obligations? Check for circular or incompatible interpretations.
D2-026, D2-027, D2-031, D2-068	Compare a record-only result with a practice or interoperability claim. Is unobserved performance, lost meaning or legal/factual assurance incorrectly inferred from structure or vocabulary agreement?
D2-028, D2-029, D2-032, D2-069, D2-070	Reconstruct one assessment from its inputs, method and evidence. Can a failed or unavailable component be recovered from the summary, and does an automatic check claim only what it actually examined?
D2-030, D2-071	Select an optional feature and compare the profile to its parent. Are its triggered obligations assessed together, or is selecting the feature used to excuse a correctness or protection requirement?
D2-036, D2-072	Trace a mandatory data element to its semantic need and allowed missing states. Can another encoding preserve the meaning, or is a software convenience presented as a philosophical necessity?
D2-033, D2-034, D2-073, D2-074	Replay a refusal, duplicate or interrupted exchange where applicable. Can participants distinguish delivery, receipt and disposition, identify controlling text and recover without inventing institutional acceptance?
D2-035, D2-037, D2-075, D2-076	Run or inspect an associated fixture against its declared result and controlling edition. Are remote inputs or protected processing explicit, and does a prose/artifact conflict have a recorded resolution?
D2-077, D2-078	Read a table, figure or formula without relying on colour or position. Are role, variables, scale, units, assumptions and controlling textual requirements recoverable? Inspect unsupported numerical precision.
D2-038, D2-039, D2-079, D2-080	Examine source and rendered reading modes and available user evidence. Does an authored example appear as observed performance, or successful compilation as tested accessibility? Record barriers and unperformed examination.

Identifiers	Discriminating assessment question and evidence
D2-040, D2-041, D2-081	Follow a legal, ethical or policy assertion to its context and reviewer. Can mandate, affected interests, alternatives and evaluation be located without assuming technical adoption resolves the political choice?
D2-042, D2-043, D2-044, D2-082	Compare source, manifest and rendered artifact. Can the exact reviewed edition be rebuilt and inspected for omitted provisions, missing glyphs, clipped content, duplicate IDs and incorrect status?
D2-045, D2-083, D2-084	Compare an alleged editorial correction with prior permitted outcomes. If a single character changes an obligation, is substantive review triggered and the earlier edition still locatable?
D2-085, D2-086	Inspect the assessment declaration and its annex records. Are subject, profile, competence and unavailable artifacts identified before an overall result rather than supplied by a generic assurance?
D2-087, D2-088	Trace a finding to correction and closure evidence. Does closure identify the new artifact and actual recheck, and remain separate from unperformed technical review or release authorization?
D2-089, D2-090	Compare an in-scope topic against the structural schedule and final-approval evidence. Is an unresolved gap explicitly excluded, blocking or returned for work, rather than hidden by an empty heading?
D2-091, D2-092, D2-093	Inspect a mixed-result assessment record. Does unavailable evidence remain not assessed and prevent unqualified fulfillment, with protected evidence linked only through permitted locators?
D2-095	Compare this schedule with the completed requirement register. Does each applicable identifier and distinct component have evidence and a result, rather than inheriting a single group pass?

Annex D

(informative)

Drafting examples and discriminating assessments

D.1 A recording obligation

The sentence “The system should contain trustworthy information” does not identify a conformance subject, a meaning of trustworthy or an assessment method. An operational alternative is to require an attributed claim, its scope and version, the evidence role assigned to cited material, and the responsible assessment. The resulting assessment asks whether these distinctions are present and whether the stated evidential reasoning is inspectable. It does not infer that every recorded claim is true.

D.2 A conditional disclosure obligation

A requirement to publish the entire history would conflict with some legitimate protection and retention arrangements. A bounded provision can require the responsible practice to identify permitted public material, the basis of a restriction, its effect on examination and the available review route. The assessor then examines those decisions and the resulting view. The mere existence of a privacy statement is not equivalent to observing that access control was enforced.

D.3 A protocol acknowledgment

A message receipt and a favorable decision are different states. A technical specification can define a receipt identifier, correlation reference and retry behavior. A procedural document can define who determines admissibility and gives reasons. A test that confirms transport delivery establishes neither the substantive decision nor the legitimacy of the deciding body.

D.4 A numerical result

An assertion that an outcome has high confidence is ambiguous unless the assessed question and grounds are stated. Where a number is used, the document identifies the quantity, scale, method, assumptions and scope. Where heterogeneous uncertainties cannot be commensurated, separate descriptions are preferable to an unsupported aggregate score. This is a requirement to preserve meaning, not a prohibition on quantitative methods.

D.5 An editorial correction

Changing a misspelled word without altering meaning can be editorial. Changing a response period, required metadata element, exclusion rule or approval denominator changes permitted outcomes. The latter requires substantive change control even if it occupies only one character. The classification follows the effect of the change, not its visual size.

Annex E

(informative)

Editorial model, differences and unresolved matters

E.1 Selected local model

The programme combines a conventional standards-document structure with its own traceability identifiers and explicit publication classes. ISO's publicly available model provides an example of ordered preliminary elements, numbered requirements and labelled annexes. ITU's authoring guide distinguishes integral annexes from supplementary appendices. This programme instead labels each annex normative or informative, maintaining one alphabetic sequence. The source distinction is preserved in function without adopting two incompatible naming systems.

IEEE's published procedural guidance informs the separation of draft status, normative material and informative support. UN statistical quality guidance supplies a useful comparison for linking institutional arrangements, production processes, output quality and improvement evidence. Those functions are adapted to the programme's own subjects; a statistical quality framework does not supply a universal test of factual truth or generativity.

E.2 Implementation choices

The current authoring system uses TeX sources, a shared preamble and a manifest-driven LuaLaTeX build. Roman pagination distinguishes preliminary pages from the Arabic-numbered main body. Clauses run continuously; annexes have explicit status headings. No target page count, blank filler or enlarged type is used as a completeness criterion. The assessment includes substantive coverage, traceability, counterexamples and known limitations.

E.3 Open matters

The final accessibility target and a tested alternative reading representation remain open. The exact incorporation of licensed external terminology requires rights review. The full IEEE style-manual download and the complete ISO/IEC Directives edition identified in the external register were not retrieved during this revision; no conformity claim is made to unavailable text. Local participation and approval choices remain matters for programme governance rather than editorial styling.

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GENERATIVITY STANDARDS PROGRAM

GR/TC 1 Charter

Governance Working Draft

Version 0.2 2026-09-22

Generativity Records and Infrastructure

WORKING DRAFT FOR REVIEW

This document contains proposed provisions for technical and institutional review. It is not an adopted Standard or an operative governance instrument. Its scope, application conditions and publication status are specified in the text.

Prepared by the Generativity Standards Program. Reference to external publications does not imply endorsement by ISO, IEC, IEEE or any United Nations body.

Foreword

This document specifies the proposed mandate and working obligations of GR/TC 1. It is a Governance Working Draft and does not constitute the committee or approve a work item. Version 0.2 retains the original TC requirement identifiers and develops the operational steps, review records, pilot controls, and readiness evidence required to exercise the mandate.

Responsible editor: `UNASSIGNED`. Canonical source: `governance/technical_committee_charter.tex`. Intended readers are the programme decision authority, prospective committee participants, editors, domain reviewers, affected people, implementers, and maintenance owners.

The Charter concerns committee performance and the evidence submitted for programme decisions. Programme authority, formal review periods, voting, and appeals remain governed by the companion programme Charter and Directives. Technical requirements are adopted through those procedures, not through this document's existence.

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Introduction

Developing infrastructure for warranted recognition requires coordination across several kinds of work. A coherent representation can remain evidentially weak; an accessible presentation can expose protected people; and a successful prototype can rely on an institutional authority that does not exist. Committee work therefore needs explicit responsibilities for source interpretation, requirements, practical procedures, implementation, multidisciplinary review, and evidence of effects.

The committee's organizing task is to preserve distinguishable histories of the situation under inquiry, evidence and judgment, and the categories or methods used to recognize it. Requirements begin with a bounded practical or normative problem. Specifications implement reusable infrastructure where that need is demonstrated. Pilots test the resulting practices and reveal costs, exclusions, loss, and failures as well as successful behavior.

One coordinated committee is proposed initially. Additional working groups are activated by actual scope and accepted participation rather than by a list of anticipated disciplines. Review of epistemic, ethical, institutional, legal, political-economic, archival, and technical issues remains distributed across competent and affected participants, with missing capacity reported.

1 Scope

1.1 Committee subject

This Charter specifies constitution, work-item control, assignment of functions, source and requirements discipline, multidisciplinary review, pilot management, publication progression, and maintenance coordination for GR/TC 1. The assessed subject is an identified committee activity or deliverable-development process within its recorded mandate.

1.2 Limits and portfolio

The proposed scope includes vocabulary, recording requirements, epistemic representation, evidence and interpretation, contestation and revision, institutional use, information models, exchange, presentation, preservation, access, and assessment.

2 Normative references

2.1 Internal dependencies

The following Governance Working Drafts, version 0.2, contain provisions required by this Charter. Their exact operative editions are fixed by the recorded programme adoption and committee mandate.

Standards Programme Charter. `governance/standards_programme_charter.tex`; authority, participation, appointments, resources, reserved decisions, and governance launch.

Directives Part 1. `governance/directives_part_1.tex`; work-item initiation, stages, public review, decisions, appeals, and maintenance.

Directives Part 2. `governance/directives_part_2.tex`; publication structure, normative drafting, dependencies, conformance, and production.

Ethics, Conflict-of-Interest, and Contribution Rights Policy. `governance/ethics_ip_policy.tex`; conflict, protection, substantive impact, and contribution-rights handling.

2.2 Edition control

TC-031 The convenor shall record the governance editions applicable to committee work and identify unresolved conflicts before dependent action. A new draft or external source shall not change an operative committee obligation by implication.

Foundation manuscripts and external documents cited in the bibliography provide informative sources. A technical publication's own normative references are assessed separately.

3 Terms and definitions

3.1 Work item

An authorized bounded activity with a problem, scope, intended outputs, responsibilities, dependencies, review plan, and expected evidence. A preliminary proposal is not an authorized work item.

3.2 Requirement baseline

An identified edition of candidate provisions and their associated source, decision, dependency, and assessment records used for a specified review or exercise.

3.3 Review finding

A recorded assessment of a stated question within a reviewer's competence, identifying evidence, reasons, limits, effect on progression, and requested disposition.

3.4 Blocking finding

A finding that a mandatory procedural, authority, protection, rights, or evidential condition for the proposed progression remains unmet. Its materiality is recorded against that progression, not asserted by a label alone.

3.5 Pilot

A bounded exercise of proposed practices or implementations under a declared purpose, case, authority, permissions, evaluation method, and stopping arrangements.

3.6 Independent evidence

Evidence produced or reviewed with the relevant organizational, authoring, financial, and practical dependencies declared and assessed for the particular independence claim.

3.7 Assessment method

A specified means of evaluating an applicable requirement, including its inputs, procedure, expected evidence, result categories, and limits.

3.8 Coordination issue

A disagreement or dependency spanning deliverables or domains whose resolution affects scope, meaning, implementation, assessment, or authority.

4 Mandate and work programme

4.1 Authorization and entry

TC-001 The committee shall become active only through a recorded mandate under the adopted programme Charter. The mandate shall identify its convenor, responsible decision authority, participating capacities, accepted work items, review resources, and mandate review date.

TC-002 The committee shall develop coordinated recording and practical procedures that support warranted, contestable, revisable recognition and preservation of consequential generative trajectories. Each accepted work item shall state its contribution to this purpose and the limits of its expected effects.

TC-003 Committee work shall distinguish changes in the situation under inquiry, changes in evidence and judgment, and changes in categories or methods of recognition. A technical representation connecting these histories shall preserve their distinguishable meaning.

TC-004 The committee shall retain the distinctions between theoretical metamodel, operational record ontology, epistemic representation, normative assessment, jurisprudential status, institutional governance, political economy, and implementation when defining scopes or allocating work.

TC-005 The committee shall not claim authority to certify substantive historical truth, resolve a complete metaphysics, determine legal rights across jurisdictions, endorse a political choice on technical grounds alone, or mandate unrestricted disclosure of recorded material.

TC-006 The committee shall preserve existing publication identifiers when refining scopes. A proposal to change a publication's class, merge or divide its scope, or introduce a new identifier shall record the reason, dependencies, alternatives, and authorizing decision before the change is treated as operative.

TC-007 A work-item proposal shall identify purpose, scope and exclusions, conformance subjects, affected interests, foundation sources and tensions, existing alternatives, related publications, anticipated Specifications, reviewer competence, practical evidence, and maintenance ownership.

TC-010 A proposed substantive scope expansion shall return to the responsible decision authority with its consequences for participation, sources, dependencies, review, and resources. Work outside the authorized scope shall remain exploratory pending a decision.

TC-032 On acceptance of a work item, the convenor shall create a project record linking the authorized proposal, actual decision, bounded outputs, accepted assignments, resources, milestones, dependencies, and unresolved conditions. The record shall distinguish preliminary drafting already performed from work formally authorized.

TC-033 Before scheduling a progression review, the convenor shall verify that the work remains within its mandate, that required responsibilities are staffed, and that necessary evidence is available. A scope or capacity defect shall receive correction, narrowing, or deferral rather than an unsupported stage label.

4.2 Programme coordination

TC-008 The committee shall record work-item dependencies and allocate requirements to their responsible publication before producing a normative technical binding. A shared requirement shall have one authoritative location, with versioned references from dependent work.

TC-009 Editors shall begin with the normative or procedural need and create a Specification proposal when reusable infrastructure is required to satisfy or assess it. A prototype shall not silently determine a theoretical definition or institutional obligation.

TC-034 The committee shall maintain a dependency register identifying each shared concept, requirement, interface, profile, or artifact; its responsible publication and owner; its exact version; and the consequence of change. Competing normative homes shall be resolved before the affected requirement is stabilized.

TC-035 For a coordination issue, the convenor shall identify affected editors and reviewers, record alternatives and semantic or institutional consequences, and seek an explicit decision within the appropriate authority. Technical convenience shall not resolve a normative, legal, or theoretical disagreement without that decision.

TC-036 A split, merger, pause, or termination of a work item shall identify the fate of requirement identifiers, comments, evidence, responsibilities, dependencies, and publication expectations. The programme decision authority shall authorize the revised scope before dependent formal progression.

4.3 Specification and protocol initiation

TC-037 A Specification proposal shall identify the candidate requirement it supports, the need for a reusable technical contract, implementation alternatives, version assumptions, and the evidence expected from a prototype. An institutional procedure shall identify its actual authority separately from protocol mechanics.

TC-038 Before treating a protocol draft as ready for implementation, its editor shall define participants, inputs, preconditions, state transitions, observable outcomes, refusals, failures, recovery, authorization boundaries, and responsibility for interrupted or conflicting operations. Unresolved behavior shall be marked and excluded from unsupported completeness claims.

5 Organization and conduct of work

5.1 Assignments and competence

TC-011 For each active deliverable, the committee shall record an accepted editor or lead, a maintenance contact, required review competence, available reviewers, and unfilled roles. Multiple roles held by one person shall be declared.

TC-012 A new working group shall have a bounded scope, actual willing participants, an accountable lead, dependencies, intended outputs, and review or closure conditions. Its formation shall not imply autonomous adoption authority.

TC-013 A reviewer shall identify the domain and scope of their assessment, relevant competence or situated knowledge, interests, material limitations, and whether they contributed to the material reviewed. A self-review shall not be labelled independent.

TC-014 Where required expertise or affected perspectives are unavailable, the committee shall record the gap and its material effect on progression. It shall narrow claims, seek additional review, or defer the affected decision when the gap prevents a justified assessment.

TC-039 An editor shall accept responsibility for the deliverable's current baseline, change record, source and requirement trace, pending comments, and progression evidence. A reviewer shall accept a bounded assessment assignment rather than an unspecified endorsement of the entire publication.

TC-040 The convenor shall compare each work item's planned drafting, review, accessibility, protection, and maintenance tasks with actual participant capacity. A shortage affecting mandatory evidence or a safeguard shall change the schedule or scope and be reported to the programme decision authority.

5.2 Meetings and asynchronous work

TC-041 For a substantive committee discussion, the convenor shall circulate the purpose, input versions, questions, expected output, access arrangements, and route for asynchronous contributions before the decision is taken. Participants unable to attend shall have the applicable opportunity to contribute under Directives Part 1.

TC-042 The discussion record shall distinguish persons present from represented institutions, information reported from findings accepted, and recommendations from authorized decisions. Material reasons, alternatives, objections, actions, owners, and affected baseline versions shall be recorded.

TC-043 Where new material changes the basis of a proposed decision during a meeting, the chair shall identify the change and apply the relevant further-review procedure. Attendance or an informal show of support shall not replace required notice, reply, or ballot.

5.3 Handover and group closure

TC-044 An editor or working-group handover shall provide the current baseline, requirement and source registers, unresolved comments and findings, dependencies, permissions, build or assessment instructions, and pending deadlines. The convenor shall verify receipt and record any gap before further reliance on the work.

TC-045 A working group that has no accepted lead or capacity to discharge its mandate shall be reported as inactive or pending reassignment. Its outputs shall retain their actual maturity, and unfinished responsibilities shall be reassigned or explicitly deferred.

6 Source interpretation and requirements

6.1 Foundation and external sources

TC-015 Before introducing or materially changing a GR definition, notation, ontology class, or compatibility claim, the responsible editor shall examine the relevant foundation manuscripts and record exact source locations, terminology, scope, historical differences, and the proposed operational translation.

TC-016 The committee shall preserve unresolved foundation differences rather than harmonizing them silently. A material operational narrowing or departure shall be recorded through an architectural decision with alternatives, rationale, affected publications, and remaining uncertainty.

TC-017 A candidate record-class definition shall identify its definition, admissibility conditions, identity criterion, temporal behavior, permitted relations, required and optional metadata, examples, counterexamples, and unresolved edge cases, or explicitly identify which elements remain under development.

TC-018 An external compatibility or reuse proposal shall identify the exact source and edition, verified relevant provisions, mapping assumptions, exclusions, and evidence needed to support the claimed relationship. Similar terminology shall not alone establish equivalence.

TC-046 The source register shall distinguish source wording, editorial paraphrase, historical variant, operational proposal, and accepted programme decision. Each material interpretation shall identify the relevant passage and version, verification status, and unresolved difference.

TC-047 When a source is revised, newly available, or found to have been misinterpreted, the editor shall identify affected definitions and requirements, assess the consequence, and submit necessary changes through the appropriate procedure. Earlier interpretations and the reason for revision shall remain traceable.

6.2 Requirement formation

TC-048 For each candidate requirement, the editor shall identify the responsible actor or subject, applicability condition, required outcome, assessment method, evidence expectation, source or operational rationale, and related issue or decision. A requirement with unresolved scope or testability shall retain a visible development issue.

TC-049 The editor shall separate independently assessable obligations where one result would conceal different applicability or failure. Recommendations, examples, and explanatory theory shall remain distinguishable from mandatory provisions.

TC-050 Before stabilizing a requirement baseline, the review group shall examine examples, counterexamples, unknown or unavailable information, restricted records, and relevant conflicting interpretations. Required uncertainty declarations shall not be replaced by invented information to complete a record.

6.3 Assessment design and claims

TC-026 A conformance proposal shall identify the assessed subject, edition, profile, applicable requirements, methods, evidence, unresolved findings, and limits of the resulting claim. Syntax checks, semantic interoperability, procedural compliance, usability, and substantive warrant shall receive distinguishable results.

TC-027 The committee shall substantiate an interoperability claim with independent implementation or exchange evidence appropriate to the claim. A single internally consistent prototype shall be reported as such.

TC-051 The requirement-to-assessment register shall identify which findings arise from automated checks, observed human tasks, documentary review, independent implementation, or substantive expert judgment. The reported result shall not claim evidence beyond what the chosen method establishes.

TC-052 A proposed profile shall identify inherited requirements, additions, permitted restrictions, applicability, and assessment consequences. The editor shall identify any divergence that prevents unqualified parent conformance and propose an appropriately bounded claim.

TC-053 An asserted external mapping shall identify direction, supported distinctions, unsupported cases, loss, and the exact tested source versions. An untested mapping shall be labelled proposed rather than interoperable.

7 Multidisciplinary review

7.1 Planning and scope

TC-019 At work-item scoping, before a real pilot, and before publication progression, the committee shall maintain a review dossier covering applicable epistemic, ethical, jurisprudential, institutional, political-economic, archival, privacy/security, accessibility, and technical questions. Each domain shall have findings or an explicit justified statement of non-applicability or unassessed scope.

TC-020 The review dossier shall identify evidence, reviewers and their capacities, affected perspectives, conflicts, alternative designs, findings, dispositions, owners of corrective action, and residual limitations. A metadata field or completed checklist shall not by itself count as domain assessment.

TC-054 The review plan shall state the questions, needed competence and affected perspectives, evidence, review independence sought, access arrangements, and decision points for each applicable domain. It shall distinguish non-applicability from unavailable review capacity.

7.2 Findings and disagreement

TC-055 Each domain reviewer shall classify a finding by the affected requirement or assumption, evidence and uncertainty, consequence for the proposed decision, and proposed disposition. A disagreement about values or policy shall be identified as such rather than converted into an unexplained technical defect.

TC-056 The editor shall respond to each material finding with acceptance, modification, reasoned non-acceptance, or deferral, linking the resulting text or action. A deferred finding shall retain an owner, next action, and explanation of whether progression is prevented.

TC-057 Where reviewers disagree across domains, the convenor shall preserve their respective questions, evidence, competence, and reasons and obtain a decision from the authority competent for the matter. A technical majority shall not substitute for an absent legal mandate or resolve a philosophical source conflict by assertion.

TC-058 Before recommending progression, the convenor shall verify that material findings and replies have been considered and that mandatory authority, evidence, rights, and protection conditions are satisfied. A decision to narrow scope shall identify the excluded behavior and prevent it from appearing in the resulting conformance claim.

7.3 Jurisprudential and policy interfaces

TC-021 A legal or institutional profile shall state its jurisdiction or forum, target action, relevant sources and status, claimed authority, temporal scope, unresolved conflicts, and reviewing competence. Generic technical conformance shall not replace assessment of actual applicability.

TC-022 A policy proposal arising from committee work shall follow the separate policy-publication route and compare plausible institutional options, including existing infrastructure or deferral when relevant. The committee shall not present participation in technical review as assent to a policy recommendation.

TC-059 A jurisdictional or institutional reviewer shall distinguish a party's assertion, an applicable source identified by the reviewer, an institution's operative decision, and an unresolved interpretation. The profile shall state the temporal and contextual limits of that review.

TC-060 For an institutional or international-policy proposal, the committee shall identify which technical findings are evidence for the proposal and which recommendations concern mandate, funding, distribution, oversight, or adoption choices. Unaccepted institutional participation shall remain prospective.

8 Pilot preparation and authorization

8.1 Protocol and evidence plan

TC-023 Before a pilot begins, its record shall identify the case and baseline, questions and success criteria, participants and actual authority, material and access permissions, resource burden, anticipated harms, challenge and correction routes, stop conditions, and responsible reviewers. Synthetic cases shall be labelled synthetic.

TC-024 The initial coordinated demonstration shall exercise a claim and its grounds, a consequential relation or contribution, an alternative or challenge, a reasoned response, a historical revision, a protected or unavailable record, and a presentation that makes their distinct status understandable.

TC-061 The pilot plan shall pin the requirement baseline, artifacts, scenario, input material, evaluation tasks, expected results, assessors, and comparison baseline before results are interpreted. A change during the exercise shall identify the reason and its effect on comparability.

TC-062 For a real pilot, the responsible authority shall verify participant and institutional permissions, rights to material, protection arrangements, accessible challenge routes, available remedy, and stopping authority before the affected activity starts. A planned safeguard shall not be reported as operational without evidence of implementation.

TC-063 A pilot relying on restricted evidence shall identify how authorized assessors can evaluate the relevant requirement and how a public result can communicate limitations safely. Lack of public access shall not be equated with absence of evidence or accepted as proof of adequacy.

8.2 Execution and interruption

TC-064 The pilot operator shall retain observations of performed tasks, relevant inputs and outputs, failures, participant assistance, departures from the plan, and protection incidents, within the approved access and retention conditions. Simulated events shall remain distinguishable from observed real behavior.

TC-065 When a stopping condition is met or an unanticipated material harm or authority defect is identified, the pilot operator shall pause the affected activity, notify the responsible authority, protect necessary evidence, and obtain a recorded disposition before restart. Unaffected activity may continue only within its existing authority and safeguards.

TC-066 A pilot restart shall identify the corrected condition, evidence that the response is operational, changed baseline or scope, required further permissions or notice, and the decision maker. A technically successful repair shall not alone establish restored participant protection.

9 Pilot evaluation and implementation evidence

9.1 Results and learning

TC-025 Pilot findings shall report failed tasks, missing or conflicting evidence, excluded participants, unmet assumptions, and burdens alongside successful behavior. The committee shall trace each material finding to a requirement change, retained decision with reasons, further inquiry, or scope limitation.

TC-067 The evaluator shall report the actual participant population, excluded or unavailable perspectives, resource burden, supported tasks, failed cases, assistance required, uncertainty, and limits on transfer to other contexts. A small cooperative exercise shall not be presented as evidence of general institutional adoption.

TC-068 The committee shall compare pilot results with the declared objectives and assessment criteria and trace each material finding to a requirement change, retained decision with reasons, further inquiry, or narrower claim. Unexpected benefits and harms shall be identified separately from the planned criteria.

TC-069 Where an outcome depends on later institutional action or effects on future capacity, the report shall state whether that action or effect was observed, is pending, or was outside the study period. A corrected record shall not be treated as evidence that downstream consequences were repaired.

9.2 Reproducibility and independence

TC-070 An implementation-evidence package shall identify source and artifact versions, configuration, test material, expected and actual outcomes, access or licence constraints, and instructions sufficient for an authorized reviewer to repeat the relevant assessment. Reproduction gaps shall be disclosed.

TC-071 For an independence claim, the convenor shall record who authored the requirements, implemented the artifacts, selected the cases, performed the assessment, and funded or controlled the work. The claimed degree of independence shall be limited to the separations actually evidenced.

10 Progression, maintenance, and publication

10.1 Readiness dossier

TC-028 For each requested progression decision, the convenor shall assemble the current draft, requirement and source trace, comment dispositions, unresolved objections, multidisciplinary findings, pilot or other assessment evidence, rights-clearance status, and maintenance proposal. The programme decision authority shall apply Directives Part 1.

TC-072 The progression dossier shall identify the requested decision and provide a requirement-by-requirement evidence status, unresolved finding register, dependency review, public-comment status where applicable, source and rights clearance, and implementation or pilot limitations. Missing evidence shall remain visible rather than being treated as tacit approval.

TC-073 Before forwarding a public-review or release package, an assigned reviewer shall check that the source, rendered document, associated artifacts, and declared status agree and that references, identifiers, and essential content remain usable. Material discrepancies shall be corrected through the applicable change procedure.

10.2 Change and maintenance

TC-029 The committee shall retain a link from a corrected or superseded requirement to the prior text, reason, decision, affected dependencies, and migration consequence. Historical decisions shall remain

distinguishable from the current authoritative edition.

TC-030 The committee shall submit scope, participation, resource, and outstanding-risk information at its mandate review and when material conditions change. An inactive or unstaffed work item shall receive an explicit status and continuity disposition.

TC-074 A substantive change shall identify affected requirements, interpretations, assessment fixtures, profiles, dependencies, existing users, and migration consequences. The maintenance owner shall distinguish a correction from an altered obligation and invoke the corresponding Directives route.

TC-075 On evidence of a serious defect or loss of a necessary dependency, the convenor shall notify the authorized maintenance or release holder with the affected versions, evidence, consequences, and proposed interim response. The committee shall not issue a permanent normative change through an informal implementation update.

11 Committee assessment

11.1 Assessment method

TC-076 An assessment of committee performance shall declare the activity, period, mandate and governance editions, assessor, interests, applicable TC requirements, evidence, and result for each requirement. Results shall distinguish fulfilled, not fulfilled, not assessed, and not applicable.

TC-077 The assessment shall include a trace from a selected material problem through source interpretation, candidate requirement, alternatives, assessment method, pilot or review evidence, disposition, and authorized decision. Breaks in the trace shall be recorded with their effect on the claimed readiness.

11.2 Correction and oversight

TC-078 The convenor shall assign owners and review dates for material performance findings and report unresolved scope, participation, capacity, or protection issues to the programme decision authority. Closing an action shall identify evidence of completion and any remaining limitation.

Annex A

(normative)

Committee dossier and record content

A.1 Work-item and baseline record

TC-079 The committee shall maintain a work-item and baseline record containing the authorized problem and scope, decision and mandate, output classes, accepted roles, sources, dependencies, versions, requirements, assessment methods, review milestones, permissions, resources, and remaining conditions. Each substantive update shall identify the responsible actor and reason.

A.2 Source and requirement trace

TC-080 The editor shall maintain a trace for each material requirement identifying its stable identifier, responsible publication, condition and subject, source passage or operational proposal, alternatives, decision rationale, assessment method, evidence, dependency versions, and unresolved question. Superseded interpretations shall remain linked to their replacements.

A.3 Domain finding record

TC-081 A domain finding record shall identify the question, scope, reviewer and competence, relevant interests, evidence and access limitations, assessed alternatives, finding and reasons, progression effect, response, reply, action owner, and closure evidence. A safe public account shall be linked where the full record is restricted.

A.4 Pilot and assessment record

TC-082 A pilot record shall identify its authorization, actual participants, baseline versions, scenario, data and permissions, evaluation tasks, expected and actual outcomes, failures, burdens, deviations, stopping or restart decisions, evidence limitations, and requirement dispositions. Synthetic and independent elements shall be explicitly identified.

A.5 Progression and handover index

TC-083 The convenor shall provide an index linking the current baseline, scope decision, review and comment dispositions, pilot evidence, blocking findings, rights status, artifact manifest, maintenance assignment, and requested decision. The index shall identify unavailable or incomplete elements and their proposed treatment.

Annex B

(informative)

Worked review and implementation cases

B.1 Missing evidence mistaken for non-occurrence

A synthetic institution records an uncalibrated instrument because no calibration field was present. A participant later supplies a restricted maintenance log. The exercise tests whether the representation distinguishes absent metadata from an occurrence claim, whether authorized review can consider the log, and whether the presentation exposes the changed basis without disclosing protected detail. Source and requirements review examine the inference; institutional review examines who can reconsider the consequential decision.

B.2 Technically successful but incomplete exchange

Two implementations exchange a current judgment successfully but omit its prior category and an unresolved objection. A syntax result can remain successful while trajectory and presentation requirements fail. The failure becomes evidence for a changed exchange requirement or an explicitly narrower profile, rather than being hidden by the successful parse.

B.3 Conflicting review considerations

An archival reviewer favors retaining an earlier attribution, while a protection reviewer identifies a risk in public release. Their findings address different questions. The committee examines preservation with restricted access, a safe public correction, and retention limits. A decision states the authority and evidence for each outcome without declaring either archival value or protection irrelevant.

B.4 Deferred theory and bounded implementation

A proposed mapping treats Property and the metamodel manuscript's Attribute as identical. The foundation register retains the difference and identifies the exact operational scope being proposed. An exploratory implementation can test one mapping with an experimental label. Stabilizing it requires the recorded interpretation and architectural decision; implementation convenience does not supply the missing conceptual argument.

B.5 Unresolved matters

OPEN ISSUE Committee appointments, accepted work items, domain-review capacity, actual independent implementers, and real institutional pilot mandates remain unassigned or unapproved. An exercise against this draft does not fill those roles.

OPEN ISSUE Property/Attribute interpretation, manuscript version precedence, and the relation between fixed-carrier semantics and broader emergence remain source questions. Their resolution is separate from the constitution of the committee.

Bibliography

Source and interpretation: Programme Brief, version 0.4; comprehensive development plan, cross-domain programme, protocol plan, and foundation traceability map in `docs/planning/`. These establish the local mission and proposed work architecture.

Source and interpretation: Foundation orientation: FM-001, Chapter 1, section 1.14, pp. 79–83; FM-003, Chapter 3, section 3.12, pp. 129–132; FM-005, Chapter 5, section 5.18, pp. 150–153. Exact files and unresolved source chronology are indexed in `foundation_manuscripts/MANIFEST.md`.

Source and interpretation: ITU-T Recommendation A.1 (09/2019), Working methods for study groups of the ITU Telecommunication Standardization Sector. Official edition and status page, consulted 22 September 2026: https://www.itu.int/itu-t/recommendations/rec.aspx?rec=a.1. The source concerns meetings, study management, coordination, rapporteurs, and contributions. It informs comparison of functional responsibilities; its membership and approval authority are not imported.

Source and interpretation: United Nations, National Quality Assurance Frameworks Manual for Official Statistics, 2019. Official publication overview, consulted 22 September 2026: https://desapublications.un.org/publications/united-nations-quality-assurance-frameworks-manual. It addresses assurance across national statistical systems and different data sources. This committee uses a narrower local comparison: quality questions belong throughout the development process and cannot be reduced to artifact syntax. No official-statistics mandate or UN endorsement is inferred.

Source and interpretation: ISO, Model International Standard, third edition, 2023, https://www.iso.org/iso/model_document-rice_model.pdf; IEEE SA policy comparisons and source-edition limits recorded in `docs/planning/standards_development_comparison.md`. Structural adaptation is separate from adopting those organizations' procedures.

GENERATIVITY STANDARDS PROGRAM

Ethics and IP Policy

Governance Working Draft

Version 0.2 2026-09-22

Ethics, Conflict-of-Interest, and Contribution Rights Policy

WORKING DRAFT FOR REVIEW

This document contains proposed provisions for technical and institutional review. It is not an adopted Standard or an operative governance instrument. Its scope, application conditions and publication status are specified in the text.

Prepared by the Generativity Standards Program. Reference to external publications does not imply endorsement by ISO, IEC, IEEE or any United Nations body.

Foreword

This document specifies proposed programme requirements for conduct, conflict management, ethical impact assessment, contribution rights, and implementation-rights concerns. It is a Governance Working Draft. Version 0.2 preserves the EIP identifiers from version 0.1, clarifies the distinction between the mandatory acknowledgement period and extendible determination target in EIP-014, and adds operational handling, assessment, and evidence requirements.

Responsible editor: `UNASSIGNED`. Canonical source: `governance/ethics_ip_policy.tex`. Intended readers are contributors, affected people, ethics and rights reviewers, project leads, custodians, and the programme decision authority.

Adoption requires the programme's actual authority and recorded procedure. This text is not a licence offer, copyright transfer, patent assurance, or legal determination. The specific organizational and jurisdictional context remains to be established for commitments that depend on it.

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Introduction

The infrastructure being developed can affect whose experience becomes visible, whose evidence receives consideration, and who can challenge an authoritative account. Programme participation can reproduce unequal access, while publication and preservation can expose people or depend on rights the programme does not hold. Ethical assessment therefore concerns both development conduct and the effects of proposed practices.

This policy separates four inquiries: whether programme conduct meets its rules; whether an interest impairs a particular role; whether a design or pilot has unacceptable or unresolved effects; and whether a proposed use of material has an established basis. Evidence of one does not resolve another. A well-attributed contribution can remain inaccurate; an ethically desirable publication can lack distribution permission; and a contribution from an interested person can still contain relevant evidence.

The policy supplies procedures and records rather than a universal score of ethical adequacy or generativity. It retains value disagreement, limitations of inquiry, and the distinction between internal programme remedies and external legal proceedings.

1 Scope

1.1 Subjects and application

This policy applies to participants acting in programme functions, programme decisions about conduct and conflicts, impact review of work items and pilots, and intake or distribution of contributed material. Its assessed subject is a specified activity, decision, contribution, or handling process under a declared edition.

1.2 Authority boundary

Internal corrective measures concern participation, assigned functions, programme access, and programme publications. Financial compensation, enforceable legal duties, jurisdiction, and findings of legal liability require separately established authority. Contribution rights and legal applicability remain subject to their actual context.

2 Normative references

2.1 Internal provisions

The following Governance Working Drafts, version 0.2, supply provisions needed by this policy. Exact operative editions are fixed through recorded adoption.

Standards Programme Charter. `governance/standards_programme_charter.tex`; appointments, decision authority, participation, resources, reserved powers, and neutral review.

Directives Part 1. `governance/directives_part_1.tex`; handling periods, appeal, emergency measures, release, retention, and maintenance.

Directives Part 2. `governance/directives_part_2.tex`; source discipline, publication claims, dependencies, evidence, and production.

GR/TC 1 Charter. `governance/technical_committee_charter.tex`; domain review, pilot authorization, findings, and progression evidence.

2.2 Application of timing and sources

The mandatory acknowledgement period and the initial-determination target cited in EIP-014 apply the specified Directives provisions to conduct handling without changing its substantive route. Only the initial-determination target has the cited reasoned-extension provision. External sources in the bibliography are informative; no external treaty, recommendation, statute, or institutional policy is incorporated as a generally applicable legal obligation.

EIP-041 The responsible handler shall identify the operative policy and procedure editions for each matter and record any conflict affecting authority, timing, protection, or available remedy. A consequential dependent determination shall await resolution of a material conflict within actual authority.

3 Terms and definitions

3.1 Material interest

A financial, institutional, personal, authorship, funding, or infrastructure-control interest relevant to impartial performance of a specified programme function.

3.2 Conflict-management decision

A reasoned determination of whether an interest affects a particular function and what disclosure, oversight, separation, recusal, replacement, or deferral is required.

3.3 Report

Information submitted concerning possible conduct, protection, conflict, or rights problems. Receipt does not establish the allegation.

3.4 Reported person

A person whose programme conduct is the subject of a report or inquiry. The term does not imply a concluded finding.

3.5 Protective measure

A temporary action intended to limit an identified immediate risk while fair consideration remains incomplete. It is distinct from a final conduct finding or sanction.

3.6 Rights clearance

A scoped programme determination that an identified use of particular material is supported by recorded permissions or another reviewed basis, subject to stated limitations.

3.7 Contribution

Material submitted for a stated programme purpose, including prose, comments, schemas, software, examples, data, or source materials. Submission alone does not establish ownership or a licence for further uses.

3.8 Impact finding

An assessed actual or anticipated consequence of a proposed practice, identifying affected interests, evidence, uncertainty, values, alternatives, and proposed response.

3.9 Retaliation

Adverse programme treatment because a person raised a concern, gave relevant evidence, participated in review, or exercised a permitted challenge route. A reasoned response to independently established misconduct is assessed separately.

4 Responsibilities and readiness

4.1 Assignment and independence

EIP-001 The programme shall identify the adopted edition, effective scope, responsible ethics contact and alternate, protected reporting route, decision authority, and neutral-review route before treating this policy as operational. Until then it shall retain Governance Working Draft status.

EIP-002 The programme shall assess conduct, conflicts, substantive impacts, and contribution rights through distinguishable findings. A favorable finding in one area shall not be represented as clearance in

another.

EIP-042 The governance authority shall assign an ethics contact, an alternate, conflict-decision responsibility, competent rights review, record custody, and neutral procedural review before relying on those functions. Each holder shall accept a bounded mandate and declare interests; an unassigned function shall remain visibly unavailable.

EIP-043 The ethics contact shall receive and triage reports, arrange appropriate consideration, communicate status, and protect access. The investigator or assessor shall examine the stated question; the authorized decision maker shall determine programme findings and remedies. Where functions are combined, the record shall identify resulting limits and independent review needed.

EIP-044 Before opening a protected reporting route, the custodian shall verify restricted access, a safe alternate contact, retention arrangements, incident handling, and the information provided to reporters about confidentiality limits. If the route fails, the custodian shall publish or directly provide a safe alternative and prevent further avoidable disclosure.

4.2 Capacity and access to assistance

EIP-045 The responsible authority shall provide information on feasible assistance with language, access, or submission format and shall record unmet needs and their effect on fair consideration. A person shall not be required to expose protected information publicly to obtain assistance.

EIP-046 A material capacity gap in impartial handling, rights competence, or protection shall be reported to the governance authority with a proposed reassignment, narrower scope, or deferral. Continued drafting within existing permission shall remain distinct from approval of the affected use or finding.

5 Conduct and evidential integrity

5.1 Participation and attribution

EIP-003 Participants acting in programme roles shall not engage in harassment, threats, retaliation, discriminatory exclusion, or coercive disclosure of protected information. Critical disagreement about sources, methods, policy, and requirements shall remain eligible for reasoned consideration.

EIP-004 A participant presenting a factual or source-based claim shall distinguish observation, quotation, interpretation, inference, and proposal where that distinction affects review. Known material errors, fabricated evidence, or falsely attributed sources shall not be retained as support after discovery without correction or explicit disputed status.

EIP-005 Editors shall preserve attribution of material contributions and competing positions within actual permissions and protection needs. Authorship, acknowledgement, evidential reliability, ownership, and decision authority shall remain distinct.

EIP-047 A participant identifying a material error in their earlier contribution shall notify the responsible editor and supply the correction or known uncertainty. The editor shall assess affected arguments, decisions, and artifacts and retain an attributable correction record.

EIP-048 A claim that a contribution was deliberately fabricated or knowingly misattributed shall be assessed through the conduct procedure. A disputed interpretation, incomplete evidence, ordinary error, or unsubstantiated report shall not by itself establish intentional misconduct.

5.2 AI and external processing

EIP-006 A participant using AI assistance for a material draft, analysis, evidence synthesis, or disposition proposal shall identify the consequential assistance and the responsible human reviewer in the development record. The reviewer shall verify material sources and conclusions before relying on them.

EIP-007 Participants shall not submit protected, confidential, or third-party material to a tool or service without an established basis for that disclosure. Uncertainty about such a basis shall be resolved before the disclosure.

EIP-049 A consequential AI-use record shall identify the task, material source categories, transformations relied on, responsible human reviewer, verification performed, and known limits relevant to the resulting claim. Protected prompts or source contents shall not be exposed solely to demonstrate that assistance occurred.

EIP-050 When external processing terms or data handling change materially, the responsible user shall reassess permitted disclosure and reliance before further affected use. A tool's technical availability shall not establish permission to disclose material or confidence in its output.

6 Interests and influence

6.1 Disclosure and assessment

EIP-008 Before accepting a decision or review role and when relevant circumstances change, a participant shall disclose interests that could materially affect, or reasonably call into question, their impartial performance of that role. The disclosure shall include relevant financial, employment, funding, authorship, institutional, personal, and infrastructural-control interests.

EIP-009 The responsible coordinator shall record a conflict assessment, its author, the affected decision, the disclosed interest, protection limits, and the selected management action. Disclosure alone shall not be treated as resolving a conflict.

EIP-010 A person shall not determine the disposition of a complaint against themselves, act as neutral reviewer of their own decision, or independently assess a rights clearance in which they have an unresolved material interest. The alternate route shall be used.

EIP-011 Conflict management shall identify whether disclosure with oversight, separation of roles, partial recusal, replacement, or deferral is required. A recusal shall identify the decision scope and substitute authority without suppressing relevant technical evidence from the recused contributor.

EIP-012 The decision authority shall examine material concentration of funding, affiliation, available unpaid labor, infrastructure access, and agenda control when assessing fair consideration. If the concentration impairs review, it shall record corrective measures and reassess progression.

EIP-051 An interest disclosure shall identify the affected role or decision, nature and duration of the interest, relevant relationships, and protection needs. The conflict assessor shall distinguish an actual conflict, a reasonably perceived conflict needing management, and an interest not material to the stated role, with reasons.

EIP-052 Before the affected decision proceeds, the conflict assessor shall communicate the management decision to the role holder and responsible chair and record any objection. A challenged assessment involving the assessor's own interests shall be referred to the alternate or neutral route.

6.2 Recusal and control measures

EIP-053 A recusal arrangement shall identify prohibited decision participation, permitted factual or technical contribution, access limitations where justified, substitute authority, duration, and reconsideration trigger. The chair shall verify that the recusal was applied and record its consequence for eligibility or quorum.

EIP-054 If an undisclosed material interest is discovered after a decision, the governance authority shall assess the affected procedure and outcome, obtain independent consideration where needed, and record whether disclosure, renewed review, repeated decision, or another remedy is required. Retrospective disclosure shall not alone cure a defective process.

EIP-055 Measures addressing concentrated influence shall identify the actual mechanism, such as agenda control, dependence on one host, repeated affiliations, or unequal time resources, and the proposed response. The assessment shall not treat head count alone as evidence of balanced influence or stigmatize a contributor solely for an affiliation.

7 Report intake and triage

7.1 Receipt and route

EIP-013 The programme shall provide a reporting route to an ethics contact and an alternate independent of a reported person. Its notice shall explain receipt handling, who can access material, limits on confidentiality, possible outcomes, record retention, and the procedural-review route.

EIP-014 A report shall receive acknowledgement, triage, status communication, and a reasoned disposition. The seven-calendar-day acknowledgement requirement in D1-035 and the 30-calendar-day initial-determination target, with reasoned extensions notified before expiry, in D1-036 shall apply to report handling without converting the report into a procedural appeal. An extension of the determination target shall not extend the acknowledgement requirement. Triage shall distinguish immediate protection needs, conduct issues, procedural appeals, substantive technical objections, and record-specific correction or access requests.

EIP-015 A report shall not be rejected solely because its author requests protected handling or lacks a formal role. The reviewer shall record whether limited identity or unavailable evidence constrains investigation and what fair assessment remains possible.

EIP-056 At intake, the ethics contact shall assign a stable identifier, record the reported concern and relevant programme connection, acknowledge the requested protection, identify immediate risk, and explain the next handling step. Requests for additional information shall be limited to what is needed for that step.

EIP-057 Triage shall identify scope, required authority and competence, potential conflicts, available evidence, immediate protection needs, and whether another programme or external route is relevant. A referral shall preserve the original receipt history and explain what the programme will and will not determine.

EIP-058 When a report contains both a technical objection and a conduct allegation, the handler shall provide linked but distinct handling records. The technical concern shall not lose consideration because the conduct allegation is unsubstantiated, and a conduct concern shall not be dismissed solely because the technical proposal is accepted.

7.2 Protected, anonymous, and repeated submissions

EIP-059 The handler shall assess an anonymous or partly identified report to the extent supported by available information and record limits on verification, reply, and remedy. Identity disclosure shall not be demanded without a stated handling need and consideration of a less intrusive alternative.

EIP-060 A repeated submission shall be linked to earlier handling and assessed for new evidence, unaddressed grounds, or changed circumstances. Limits on repetitive or abusive contact shall state the conduct basis, safe route for materially new information, scope, review date, and challenge route. Mere persistence in disagreement shall not establish abuse.

8 Inquiry and fair response

8.1 Scope and evidence plan

EIP-016 Before an adverse conduct finding, the responsible reviewer shall provide the affected person a sufficient account of the concern and an opportunity to respond, using redaction or a protected intermediary when necessary. Where protection prevents a fair determination, that limitation shall remain explicit.

EIP-061 Before a substantive inquiry, the appointed assessor shall state the questions, applicable programme rules, scope, evidence sources, access arrangements, opportunities to respond, intended timetable, and decision authority. A material expansion shall be notified to affected participants with an adequate response opportunity.

EIP-062 The assessor shall distinguish direct information, testimony, contemporaneous records, inference, hearsay, and disputed interpretation where that distinction affects the finding. Relevant contrary evidence and plausible alternative explanations shall be examined; source status alone shall not determine credibility.

EIP-063 The assessor shall document evidential gaps and the reasons material may be unavailable, including protection, loss, or lack of access. An unavailable record or a person's inability to participate shall not automatically be treated as proof of the alleged conduct or its absence.

8.2 Opportunity to respond and protection

EIP-064 A response invitation shall identify the material concern and grounds sufficiently for a meaningful reply, the response route and deadline, available assistance, and the proposed decision scope. If safe disclosure cannot support a fair finding, the limitation shall prevent an unsupported adverse determination.

EIP-065 The assessor shall avoid unnecessary repeated disclosure of sensitive experiences and shall record how protected testimony can be tested fairly through safe summaries, questions, or an authorized intermediary. A summary materially interpreted by another person shall retain that mediation and any confirmation or dispute by its source.

EIP-066 The handler shall obtain an appropriate rights and protection assessment before disclosing case material to an external institution. A claimed obligation to disclose shall identify the competent authority, context, basis, and unresolved questions; the policy itself shall not be treated as creating that obligation.

9 Protective measures and determinations

9.1 Interim action

EIP-017 A temporary protective measure shall identify the immediate risk, authority, limited scope, review point, and route to challenge. It shall be distinguished from a concluded misconduct finding.

EIP-067 The authority issuing a protective measure shall identify less restrictive feasible alternatives, the effect on participation and evidence access, the person responsible for review, and the conditions for ending or modifying the measure. The D1-050 controls shall apply to temporary protective measures under this policy, including participation restrictions: independent review within seven calendar days and expiry within 30 calendar days unless the governance authority records a justified extension, next review date, and remedy plan. Continued restriction shall retain renewed reasons and an available challenge route; temporary protection shall not become a permanent sanction through elapsed time alone. These controls shall not expand the programme's substantive authority.

EIP-068 A person subject to a protective measure shall receive its scope, safe reasons, duration or review point, and challenge route to the extent consistent with immediate protection. Any delayed notice shall be justified and reviewed rather than omitted indefinitely.

9.2 Findings and evidential criterion

EIP-018 A final conduct disposition shall identify the applicable rule, assessed evidence and limits, conflicts and recusals, finding, reasons, proportionate remedy, responsible implementer, and review route. Available programme remedies include correction, facilitated participation, role reassignment, limited access, suspension, or removal under the Charter.

EIP-020 If a fair, sufficiently independent review cannot be provided, the programme shall record that limitation, preserve appropriate protections, and defer the affected consequential determination. It shall not represent inability to investigate as proof that a report is false or established.

EIP-069 For an internal conduct finding, the decision maker shall distinguish substantiated, not substantiated on available evidence, outside mandate, and resolved by an agreed measure without a conduct finding. A substantiated finding shall explain why the alleged conduct is more likely than not on the assessed evidence, address material contrary information and plausible alternatives, and identify limits. A numerical probability shall not be required. Where the assessment does not favor the alleged conduct over its non-occurrence, including an unresolved balance, the allegation shall not be classified as substantiated. This criterion shall not override EIP-016, EIP-020, or EIP-064 concerning fair response and sufficiently independent consideration, and shall not be represented as an external legal finding or burden of proof.

EIP-070 The decision maker shall distinguish the conduct established, any intention or effect separately supported, the rule engaged, and the resulting programme consequence. A serious remedy shall be supported by reasons addressing severity, impact, recurrence, context, and feasible alternatives within programme authority.

EIP-071 A disposition based on an agreed measure shall record the actual agreement, its scope, responsible parties, review point, and treatment of unresolved allegations. Agreement shall not be presumed from silence or obtained by making access to the ordinary complaint route conditional on acceptance.

9.3 Remedies and review

EIP-019 The programme shall monitor agreed remedies and potential retaliation and shall publish a non-sensitive account sufficient to inspect procedural handling. Confidential material shall not be published merely to demonstrate transparency.

EIP-072 A remedy plan shall identify required actions, owners, practical resources, dates or triggers, completion evidence, and consequences of non-performance. Correcting a record, restoring participation, changing a role, and addressing downstream effects shall be distinguished.

EIP-073 The disposition notice shall explain the finding and safe reasons, the operative procedure, available procedural review, and the basis for any restricted evidence. A request concerning substantive reconsideration shall be distinguished from an appeal alleging procedural failure.

EIP-074 A material new fact or demonstrated handling error shall trigger an assessment of reopening, revised remedy, or referral. The record shall retain the original determination and reasons for changed status; reopening shall not silently erase prior reliance or its consequences.

EIP-075 Monitoring for retaliation shall identify a safe contact and review trigger without imposing unnecessary surveillance on participants. A reported adverse response shall receive separate assessment of its connection to protected participation and any independently stated reason.

9.4 Scoped substantive reconsideration

EIP-099 A reporter or reported person may request substantive reconsideration through the ethics contact or non-conflicted alternate on grounds of material new evidence, an identified material error in assessment or application of the conduct criterion, or a remedy materially unsupported by the stated findings. The request shall identify the disposition, grounds, available evidence, and requested change. Mere repetition without identified grounds may receive a reasoned refusal; disagreement shall not itself constitute misconduct. The disposition notice shall explain this scoped route separately from the procedural appeal route.

EIP-100 The ordinary filing period for substantive reconsideration shall be 30 calendar days after accessible notice of the disposition. The non-conflicted reconsideration reviewer may extend that period with recorded reasons for ineffective notice, newly available material evidence, or a previously concealed assessment defect. The ethics contact shall acknowledge receipt within seven calendar days and arrange an initial admissibility or substantive determination targeted within 30 calendar days of receipt, with reasoned extensions and revised dates notified before expiry. Silence shall not constitute rejection.

EIP-101 The governance authority shall assign substantive reconsideration to a competent person or function that did not determine the challenged finding and has no unresolved material conflict, with a mandate identifying the issues and available programme remedies. The reviewer shall give an admissibility decision with reasons and provide affected parties an opportunity to respond to material new grounds before a consequential outcome. An admitted request shall have a notified timetable for replies and reasoned disposition; a change shall have reasons and notice before the affected target expires. If sufficiently independent competence is unavailable, EIP-020 shall govern deferral; reassessment by the original decision maker shall not be presented as independent reconsideration.

EIP-102 The reconsideration reviewer shall identify the record examined, grounds admitted, evidence and replies considered, criterion applied, reasons, outcome, and implementation responsibility. Within the recorded mandate, the reviewer may uphold, qualify, set aside, or remit a conduct finding or remedy for renewed consideration; a remedy outside that mandate shall be referred to its authorized decision maker. The record shall preserve the earlier finding and explain any changed effect, notice, or practical action. Substantive reconsideration shall not determine external legal liability or replace access to procedural appeal under Directives Part 1.

EIP-103 On a substantive reconsideration request, the responsible authority shall record whether an existing remedy requires a stay, modification, or continued operation within programme powers, considering protection, participation, evidence, and consequences. The decision shall have reasons, a review point, and permitted notice. Neither an automatic stay nor automatic continuation shall be inferred solely from the request. Any temporary restriction retained shall remain subject to EIP-067, and implementation of a reconsideration remedy shall be monitored under EIP-072.

10 Ethical impact assessment

10.1 Question, affected interests, and alternatives

EIP-021 Each work item shall assess whose experiences become visible, who can challenge classifications, who bears recording and review burdens, and who gains control or access through the proposed infrastructure. Assessment shall consider relevant alternatives, evidence, and residual uncertainty.

EIP-022 An impact assessment shall distinguish observed effects, predicted effects, value commitments, and institutional choices. It shall identify material tradeoffs involving recognition, privacy, autonomy, unequal participation, maintenance labor, ecological conditions, and future capacities where relevant to the use case.

EIP-024 A proposal involving contribution or generativity return shall distinguish descriptive attribution, normative evaluation, and any proposed allocation of benefits or responsibilities. It shall not infer a monetary amount, entitlement, or contractual obligation solely from a generativity record.

EIP-076 The impact reviewer shall identify the proposed use, affected interests and absent perspectives, decision context, baseline, foreseeable benefits and harms, evidence and uncertainty, and alternatives including reduced collection, restricted access, different institutional arrangements, or deferral where relevant.

EIP-077 Where values conflict, the assessment shall state the values and affected people, reasons for the proposed priority, alternatives rejected, expected distribution of benefits and burdens, and conditions requiring reconsideration. A single aggregate score shall not replace those reasons.

EIP-078 A participation or recognition proposal shall assess whether people can refuse optional recording, challenge an attribution, or obtain an explanation without disproportionate burden. A claimed exception shall identify its actual institutional basis and consequences rather than present coercion as technical necessity.

10.2 Authorization, monitoring, and intervention

EIP-023 Before a real pilot or consequential expansion, the responsible authority shall record its purpose, actual participants and mandate, permitted material, accessible notice and challenge routes, protection measures, monitoring, stop conditions, and capacity to implement correction or repair.

EIP-025 A material unresolved ethical or participation finding shall receive a recorded disposition before the affected publication or pilot decision. Completion of a form shall not alone establish that an impact is acceptable or a remedy effective.

EIP-079 Before relying on mitigation to authorize a pilot or use, the responsible authority shall verify its owner, resources, operational status, and assessment method. Unimplemented mitigation shall remain a condition or limitation and shall not be counted as an achieved safeguard.

EIP-080 Monitoring shall identify observations capable of challenging the intervention rationale, emerging burdens or exclusions, and stopping or revision triggers. Findings shall distinguish absence of observed harm from evidence of absence of harm within a sufficiently examined scope.

EIP-081 After a material protection or ethical failure, the responsible authority shall assess immediate containment, affected people and uses, correction or repair, continued-use conditions, and lessons for requirements. Restart shall depend on recorded evidence addressing the failure, not solely on a revised description.

11 Contribution intake and permission

11.1 Artifact identity and intended uses

EIP-026 For contributed material proposed for incorporation or distribution, the rights register shall identify the artifact and version, contributor and stated capacity, claimed rights holder, source, intended uses, asserted permission or licence, restrictions, third-party components, evidence of authority, and unresolved questions.

EIP-027 A contribution record shall distinguish permission to examine material from permission to incorporate, edit, redistribute, sublicense, or publish it. Repository access, submission of comments, acknowledgement, or the absence of a licence notice shall not alone be treated as permission for those further uses.

EIP-028 The programme shall keep terms for prose, schemas, software, examples, datasets, and foundation manuscripts separately identifiable. A licence applying to one artifact class shall not be presumed to cover the others.

EIP-029 Foundation manuscripts and third-party sources shall retain their recorded source terms. Incorporating a source in the foundation manifest, citing it, extracting concepts from it, or placing it in the repository shall not be represented as relicensing the source.

EIP-082 The contribution handler shall identify the submitted version, source and included components, contributor's stated capacity, intended examination or incorporation, and the scope of any assertion about rights. A claim of ownership or permission shall retain its source and verification status.

EIP-083 Before incorporating material, the editor shall determine whether its intended modification, combination, publication, implementation, or retention is within the reviewed basis. New uses or components shall receive renewed clearance rather than inherit approval from an earlier narrower purpose.

11.2 Clearance and unresolved rights

EIP-030 Before public distribution of an artifact, the designated rights reviewer shall record that the intended distribution and included material are covered by identified permissions or another reviewed basis. Unclear rights shall block the affected distribution, while drafting and review within established permissions may continue.

EIP-031 Where an intended use exceeds available permission, the editor shall obtain suitable permission, replace or remove the material, narrow the use, or retain the affected artifact as restricted. The disposition shall preserve the source and reason without exposing restricted content.

EIP-032 A change in contribution or publication terms shall identify the artifacts and versions affected, authority for the change, contributor acceptance needed, and transition treatment. A new licence shall not be represented as retrospectively covering existing contributions without an established basis.

EIP-084 A clearance decision shall identify the artifact and exact intended use, claimed rights holder and authority evidence, applicable terms and version, third-party components, review competence, restrictions, unresolved issues, and expiry or reconsideration triggers. Clearance shall be limited to that recorded use.

EIP-085 If a rights claim or permission dispute arises after incorporation, the rights contact shall record affected material and uses, preserve appropriate evidence, seek competent assessment, and notify the authorized release holder of any needed restriction or correction. The programme shall not declare the claim valid or invalid solely from its receipt.

EIP-086 A contributor's request to withdraw or change permission shall be assessed against the actual terms, prior uses, downstream distributions, protection concerns, and relevant authority. The response

shall distinguish feasible programme action from uses or rights outside programme control.

12 Terms, implementation rights, and publication

12.1 Selection and acceptance of terms

EIP-033 Before offering contribution terms or choosing publication licences, the programme shall record its organizational and jurisdictional context, intended rights and obligations, artifact classes, alternatives, implementation consequences, and review by a person competent for the relevant rights questions.

EIP-034 The programme shall make operative contribution terms available before requesting assent to them and shall retain the accepted version and scope. A record of assent shall not assert that the contributor holds rights that remain unverified.

EIP-087 The terms-selection record shall compare rights needed for the intended artifact use, contributor interests, implementation and redistribution conditions, attribution, modified versions, translation, dependency compatibility, and maintenance. Prose, code, schemas, datasets, examples, and manuscripts shall receive distinct treatment where their requirements differ.

EIP-088 An acceptance record shall identify who assented, their stated authority, the exact terms and covered contribution, date, and evidence of assent. A form submission or repository action shall count as assent only where the announced process clearly established that meaning and actual acceptance is evidenced.

12.2 Implementation-rights concerns

EIP-035 A participant aware of a potentially material rights obstacle to implementing a proposed requirement shall report the known concern and its basis to the designated rights contact. The report shall distinguish actual knowledge, an asserted claim, and unresolved inference; it shall not be presented as a legal determination.

EIP-036 The programme shall record a material implementation-rights concern, affected requirements, available public information, review competence needed, feasible alternatives, and its disposition before approving an implementation claim that depends on the concern.

EIP-037 No programme participant shall make a licensing promise, patent assurance, rights waiver, or financial commitment on behalf of another person or institution without documented authority. A declaration under another organization's process shall not be represented as a programme agreement without review of its actual scope.

EIP-038 Where implementation rights remain materially unresolved, the responsible decision authority shall narrow the claim, select a reviewed alternative, or defer the affected normative adoption. An empty concerns register shall not be described as proof that implementation is free of third-party rights.

EIP-089 The handling of a potential essential-rights concern shall distinguish notification, factual clarification, specialist assessment, exploration of alternatives, and an authorized decision. A request for information shall not be phrased as a programme licensing commitment or as a determination of validity or essentiality.

EIP-090 Where a technical alternative is proposed to address a rights concern, the committee shall assess whether it satisfies the affected requirement and whether it introduces other material constraints. Selecting an alternative shall not be reported as resolving all implementation rights without the corresponding evidence.

13 Records, oversight, and assessment

13.1 Custody and publication of case information

EIP-039 Ethics, conflict, and rights records shall identify an accountable custodian, access rules, retention or review basis, correction route, and treatment of protected information. Public decision evidence shall avoid unnecessary disclosure while making authority, procedure, and unresolved limits inspectable.

EIP-091 The custodian shall separate public disposition information from protected evidence, restrict access to accepted roles with a handling need, and retain access and disclosure decisions. Changes in custodianship shall verify transfer of restrictions and pending response or retention duties.

EIP-092 Before releasing a case summary, the responsible handler shall assess whether combinations of facts disclose protected identity, existence, or content. The summary shall state material limits on public inspection without creating a false impression that an allegation or rights assertion was conclusively established.

13.2 Review and performance

EIP-040 The programme shall review this policy with the governance review cycle and after a material complaint, rights dispute, change of legal or organizational context, or change in publication arrangements. A revision shall preserve the prior edition and unresolved cases' transition treatment.

EIP-093 An assessment against this policy shall identify the subject, period, edition, assessor and interests, applicable EIP requirements, evidence, and results as fulfilled, not fulfilled, not assessed, or not applicable. Unperformed handling steps and blank templates shall not demonstrate fulfillment.

EIP-094 The governance authority shall review repeated complaints, unresolved conflicts, rights-clearance delays, protection failures, unequal burdens, and remedy effectiveness using protected or aggregated information as appropriate. Corrective actions shall have owners, review points, and evidence of completion.

Annex A

(normative)

Handling records and state transitions

A.1 Minimum case record

EIP-095 A case record shall contain identifier, scope and applicable editions, receipt history, requested protection, roles and conflicts, alleged issue distinguished from findings, evidence and limits, notices and replies, interim measures, decision and reasons, remedy, review route, access and retention basis, and current state. Changes of state shall identify their actor, date, grounds, and linked evidence.

A.2 Case states

EIP-096 The handler shall use the case states in Table A.1, or an explicitly mapped equivalent, so that receipt, examination, pending capacity, determination, remedy, and closure remain distinguishable. A transition shall preserve linked prior states and shall not imply completion of an unperformed step.

Table A.1 – Case state meanings and transition evidence

State	Meaning	Evidence supporting a transition
Received	Submission logged; no finding.	Receipt identifier, safe contact, requested protection, acknowledgement.
Triaged	Scope and route assessed.	Authority, conflicts, immediate risk, referral or inquiry decision.
Under consideration	Evidence and replies being assessed.	Questions, responsible assessor, evidence plan, notices, replies.
Pending capacity or information	A stated limitation prevents the next step.	Missing item or role, action owner, review date, protection retained.
Determined	Authorized finding or scoped disposition recorded.	Reasons, evidence limits, response consideration, remedy and review route.
Remedy under implementation	Agreed or directed action remains open.	Owners, resources, deadlines or triggers, follow-up evidence.
Closed or referred	Programme handling completed or assigned elsewhere.	Closure grounds or referral acceptance, residual limits, reopening/contact route.

A.3 Conflict and impact records

EIP-097 A conflict record shall identify the interest, affected function, assessor and independence, materiality reasons, management action, objection and response, implementation evidence, and review trigger. An impact record shall identify affected interests, evidence, values, alternatives, distributional effects, safeguards, authority, monitoring, and unresolved limitations.

A.4 Rights decision and acceptance records

EIP-098 A rights record shall identify artifact and version, source and components, contributor and asserted authority, intended uses, terms or other reviewed basis, competent assessment, restrictions, decision, acceptance where needed, and reconsideration triggers. Public licence statements shall be checked against that record before release.

A.5 Assessment of timing, findings, and reconsideration

EIP-104 An assessment claiming fulfillment of conduct-handling procedure requirements shall exercise the applicable conditions in Table A.2, identify the tested edition, input and expected outcome, and record performed actions, results, and limitations. A documentary assessment shall distinguish a complete specimen record from evidence that acknowledgement, independent consideration, notice, or remedy actually occurred. Unobserved performance shall remain not assessed rather than fulfilled.

Table A.2 – Conduct-review assessment conditions and limits

Condition	Relevant provisions and evidence	Discriminating result
Receipt and extended inquiry	EIP-014; actual receipt and acknowledgement, determination target, extension reason and notice.	A timely determination extension does not turn an acknowledgement later than seven days into timely performance.
Temporary participation restriction	EIP-017, EIP-067/068; authority, alternatives, independent review, expiry or justified extension and next review.	A restriction cannot continue indefinitely through a missing expiry or be relabelled a final sanction without determination.
Unresolved evidential balance	EIP-016/020/064/069; assessed grounds, contrary material, response opportunity and competence.	An unresolved balance does not substantiate the allegation; a numerical score is unnecessary; the outcome does not assert that the report was false.
Material reassessment request	EIP-099–102; identified grounds, receipt, admissibility, independent assignment, timetable, response and outcome.	A reasoned finding can change within mandate; the original decision maker is not described as independent; mere silence does not reject the request.
Unavailable reviewer or continuing action	EIP-020, EIP-072, EIP-101/103; capacity gap, stay assessment, protection, remedy ownership and verification.	Missing capacity remains visible and the consequential determination deferred; a planned remedy is not reported as completed.

Annex B

(informative)

Worked applications and unresolved choices

B.1 Interested expertise and neutral decision

An implementer funds an editor who proposes an exchange feature. The editor's evidence remains relevant, while the funding and implementation interest require assessment against the decision role. Oversight or separation can preserve the contribution while preventing the editor from determining a complaint about suppression of alternatives. The record shows which capacities were retained and which decisions were reassigned.

B.2 Protected testimony and limited finding

A participant reports exclusion but cannot safely publish identifying details. Intake records the protection need and available evidence. A neutral assessor considers whether a safe summary permits a meaningful reply. If the material cannot be tested sufficiently for an adverse finding, the result remains limited; it is not converted into a conclusion that the account is false. Feasible access improvements can still be considered without pretending that an allegation was proved.

B.3 Rights to read and rights to publish

A manuscript is available to project members for background reading. An editor proposes attaching it to a public package. The contribution record distinguishes examination from redistribution. The proposed attachment awaits a reviewed basis; source interpretation and new drafting continue within actual permission. A licence selected for the new programme prose does not automatically cover the manuscript.

B.4 Record correction and consequential repair

A synthetic pilot corrects an inaccurate attribution after a challenge. The correction record establishes that the current account changed. A separate remedy record asks whether excluded participation, lost access, or other practical consequences were addressed. Where those effects were not examined, the report states the limitation rather than claiming that the corrected text restored the affected person's position.

B.5 Local choices requiring review

The internal evidential criterion for conduct findings is a programme proposal that makes decisions reviewable; it does not purport to prescribe a court's procedure. Remedies remain bounded by actual programme authority. Different organizational contexts could justify revised procedures through the governance amendment process.

The proposed criterion requires a reasoned comparison of the assessed grounds, not a compulsory probability calculation. Alternatives include a more demanding internal threshold for particular findings or leaving the criterion to case-specific choice. The present draft selects an explicit common criterion, alongside fair-response and independence conditions, so that participants can examine its application and request scoped reconsideration. The choice, its error and participation risks, and the local reconsideration periods require review before governance adoption; see `decisions/ADR-0005-expanded-drafts-and-source-models.md`. No finding becomes valid merely because its author asserts that the threshold was met.

OPEN ISSUE Organizational and jurisdictional context, operative contribution agreements, publication licences, patent policy, named contacts, protected infrastructure, and specialist rights-review capacity remain unresolved. The policy supplies conditions for reviewing those choices without making the commitments itself.

OPEN ISSUE Procedural rehearsal needs to test handling burden, neutral-review availability, language and disability access, protected evidence, recusal, rights disputes, and remedy follow-up. Synthetic success does not establish capacity for a live consequential case.

Bibliography

Source and interpretation: Foundation manuscripts: FM-005, Chapter 5, section 5.18, pp. 150–153, on evidential capacity, epistemic justice, and risks of visibility; FM-001, Chapter 1, section 1.14, pp. 79–83, on representational instability, reliance, and control of verification infrastructure. Exact source files and status are indexed in `foundation_manuscripts/MANIFEST.md`.

Source and interpretation: Local programme basis: Programme Brief, version 0.4; `docs/planning/cross_domain_programme.md`, particularly sections 3.4–3.7; and `docs/planning/standards_development_comparison.md`. The operational requirements in this policy are programme proposals.

Source and interpretation: UNESCO, Recommendation on the Ethics of Artificial Intelligence, adopted 23 November 2021. Official text consulted 22 September 2026: https://www.unesco.org/en/legal-affairs/recommendation-ethics-artificial-intelligence. Its attention to impact assessment, plural values, inclusion, oversight, and consequences across an AI life cycle informs review questions for AI-mediated programme work. It does not provide the complete ethics of every generativity use or establish this programme's legal duties.

Source and interpretation: IEEE SA Standards Board Operations Manual, clause 6, official online text consulted 22 September 2026: https://standards.ieee.org/about/policies/opman/sect6/. Separate treatment of contributions, patent matters, and open-source artifacts informs the distinction among rights questions. No IEEE agreement or assurance is adopted by citation.

Source and interpretation: ISO Standards and Patents, official resources consulted 22 September 2026: https://www.iso.org/iso-standards-and-patents.html. The linked policy and declaration resources are comparison material; they establish no permission to implement a particular technology in this programme.

GENERATIVITY STANDARDS PROGRAM

GR-100

Standards-track Working Draft

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Foundations and Vocabulary

WORKING DRAFT FOR REVIEW

This document contains proposed provisions for technical and institutional review. It is not an adopted Standard or an operative governance instrument. Its scope, application conditions and publication status are specified in the text.

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Foreword

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This document is a standards-track Working Draft of the Generativity Standards Program. Its maturity is **PREPARATORY; PROVISIONAL**. It is available for substantive review and experimental assessment. It is not an adopted Standard, evidence of formal project initiation, or approval of GR/NWIP-001. Appointment of an editor, adoption of the governance instruments, work-item approval, review and final adoption require their own recorded decisions. Draft requirement language has no programme adoption or independent legal effect.

Edition 0.2 replaces edition 0.1 as the active authoring text; the earlier edition remains historical material. Existing requirement identifiers V100-001 to V100-012 retain their meanings. The body supplies candidate normative definitions and requirements. Annex A is a normative assessment schedule. The remaining annexes and bibliography are informative. No informative example or note adds a requirement.

The publication structure separates scope, dated references, numbered terms, requirements, conformance and annexes. Structural resemblance to another organization's publications establishes no affiliation, endorsement or compliance with its development procedures. Foundation manuscripts provide conceptual sources rather than adopted normative authorities.

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Introduction

The programme responds to instability in the connection between representations, their targets, institutional classifications and practical trust. An authentic or fluent account can be mistaken for a warranted account of what happened. Correction can also erase the history of an earlier claim's influence. Inspectable recording requires these differences to remain expressible before a technical model standardizes interchange.

Reality is not reduced to what a recording institution recognizes. Manifestations, traces, accounts and judgments can disclose a target partially; they can also enter subsequent action and change conditions of further generation. A mistaken classification can remain historically important after its evidential warrant has been rejected. Its occurrence, interpretation and practical effects require distinguishable descriptions.

The foundation manuscripts distinguish abstract metamodel concepts from richer analytical categories and distinguish ontological questions from evidential access. This document uses those distinctions without turning six record roles into ultimate kinds of being. Its operational definitions do not exhaust GR theory. They support partial knowledge, contested identity, overlapping roles, changing categories and revisable interpretation.

Interoperability requires more than shared spelling. One institution can use evidence for an accepted document, another for material bearing on a claim and another for a procedural exhibit. Similarly, a numerical property can be a category code, an ordinal rating or a measurement. A common format does not make their operations equivalent. Vocabulary application therefore includes scope, source, transformation and assessment duties.

1 Scope

1.1 General

This document supplies a bounded operational vocabulary for recording and examining claims about generative histories. It addresses a practical problem: a record can accurately preserve an assertion while the assertion is mistaken, an authentic document can contain an unsupported inference, and a later correction can conceal the historical consequences of an earlier judgment. Inspectable practice requires distinctions among what is claimed to have happened, how it became accessible, what was recorded, what was inferred, and how the account was used.

The scope includes vocabulary use, the separation of levels of description, identity and temporal distinctions, and a candidate description of six record roles. It does not define truth, a complete metaphysics, a universal theory of evidence, legal validity, a universal generativity score, or a machine-readable schema. Domain methods can provide stronger criteria within a declared scope.

GR-110 develops trajectory recording requirements. GR-200 develops the epistemic record package. GR-120 and associated Specifications are intended to resolve technical representation after requirements and cases expose a reusable need. GR-210 is intended to address assessment and contestation procedures. References to these publications identify coordinated draft work; none is an adopted normative dependency.

2 Normative references

2.1 General

There are no external normative references in this edition. All requirements needed for assessment are contained in its body and Annex A. Foundation manuscripts and programme documents in the bibliography are informative sources for interpretation and drafting rationale, not supplementary conformance requirements.

2.2 Dated applications and mappings

An application can identify an additional dated domain vocabulary or profile in its declaration. That source becomes part of the application's own commitments, not a normative dependency of GR-100. The assessment distinguishes fulfillment of this document from fulfillment of that additional source. A current online resource does not silently update the meaning used in an assessed edition.

3 Terms and definitions

3.1 General

The following definitions apply within this document's recording scope. Capitalized Entity, State, Event, Process, Relation and Property name the operational record roles in Clause 5. Lowercase ordinary uses remain possible when their meaning is evident. Terms concerning uncertainty and missingness describe an inquiry rather than settle the truth values of the underlying world.

These definitions support linked descriptions, not a mandatory class hierarchy. Several terms can concern one activity: observation can involve interpretation and inference, and its result can become evidence for another claim. The application identifies these functions rather than treating their coexistence as an error.

3.2 Target

That about which a claim is made.

NOTE 1 A target can be a situation, participant, occurrence, relation, condition, possibility, record, or another claim. Its identification can remain partial or contested. A target reference is an act of reference; it does not establish existence or identity.

3.3 Manifestation

For recording purposes, an identified way in which a difference becomes available to encounter, registration, measurement, expression, or classification under specified conditions.

NOTE 2 This is a limited operational use informed by FM-004; it does not exhaust that manuscript's account of manifestation.

3.4 Representation

A description or arrangement of signs used to describe, classify, model, or otherwise stand for a target.

NOTE 3 Representations can themselves become targets of inquiry and participants in later action.

3.5 Record

An identified retained representation, together with the context needed to interpret its declared recording purpose.

NOTE 4 A record can contain several claims, and several records can concern one target. Retention need not mean public disclosure or indefinite preservation.

3.6 Record package

A declared collection of records and contextual references presented together for a specified purpose and version.

NOTE 5 A package can contain protected components and a restricted or public view. A view's limitations are part of its declared scope.

3.7 Claim

An attributed assertion with identifiable content and target, expressed under a stated scope.

NOTE 6 The assertion can concern an occurrence, a possibility, an interpretation, a value judgment, or institutional or legal status. Recording it does not endorse it. Several parties can assert the same content with different grounds.

3.8 Attribution

A recorded association between a claim or activity and the person, institution, system, or source represented as originating or performing it.

NOTE 7 Attribution can be pseudonymous, unknown, disputed, or mediated through another source.

3.9 Observation

A situated activity of attending to or registering a manifestation through a stated method.

NOTE 8 An observation report is a claim about that activity or its result; "direct" does not mean free of mediation or interpretation.

3.10 Inference

A step that relates identified premises or material to a conclusion under a stated method or reasoning.

NOTE 9 An inferred claim has a different epistemic role from the claim that its premises were recorded.

3.11 Interpretation

An attributed assignment of meaning, classification, or significance within a stated context.

NOTE 10 Interpretation can participate in observation and inference; these terms do not partition human or machine activities into exclusive kinds.

3.12 Judgment

An attributed assessment or determination made using identified grounds and criteria.

NOTE 11 A judgment can assess evidential warrant, ethical acceptability, legal status, or institutional action. These functions carry different bases of authority.

3.13 Assessment

A recorded examination of a specified question using identified criteria and material, with a result and limitations.

NOTE 12 In GR-200 an evidence assessment concerns a claim-relative evidential role. A syntax check concerns a different assessment target.

3.14 Uncertainty

Specified unresolved limitations or alternatives affecting a claim's content, identification, observation, method, interpretation, timing, boundary, or warrant.

NOTE 13 An uncertainty description is itself attributed and scoped. A numerical quantity is one possible representation, not a mandatory universal measure.

3.15 Trace

Material, behavior, testimony, inscription, or another manifestation identified as a remainder or consequence relevant to a target inquiry.

NOTE 14 The proposed connection to its generative conditions is a claim with its own grounds; calling an item a trace does not establish the proposed origin.

3.16 Evidence

A role assigned to identified material in assessing a specified claim, with an account of relevance, reliability, and alternative explanation.

NOTE 15 The material can support, challenge, limit, or fail to discriminate the claim. Evidence is not an intrinsic status permanently attached to a file or person.

3.17 Evidential warrant

The grounds offered for accepting, qualifying, or rejecting a specified claim under stated methods, assumptions, and scope.

NOTE 16 This draft records those grounds without imposing one universal sufficiency rule.

3.18 Provenance

A recorded account of origins, attribution, derivation, custody, or transformations of an identified item.

NOTE 17 Provenance can be incomplete or disputed. Provenance of a claim's expression differs from evidence for the claim's content.

3.19 Authenticity assessment

An assessment of whether an item is what it is represented to be, within a specified question and method.

NOTE 18 Authenticity of an utterance or document does not establish truth of its substantive claims.

3.20 Missingness

A stated condition in which information sought for a recording purpose is absent or unavailable.

NOTE 19 Not observed, not recorded, lost, withheld, unknown, inapplicable, and disputed describe different conditions and are not interchangeable with a zero, false value, or non-occurrence claim.

3.21 Record reference

A designation sufficient to distinguish a record or a particular version within a declared context.

NOTE 20 A reference scheme does not itself determine the identity of the represented target.

3.22 Identity criterion

A stated basis for treating two appearances or descriptions as concerning the same target within an inquiry.

NOTE 21 Identity claims can be contested and criterion-dependent. Similar behavior, equal content, shared names, and common descendants do not alone establish target identity.

3.23 Lineage

A directed account of derivation, succession, or continuation.

NOTE 22 Lineage can branch or merge. Its use does not automatically assert that predecessors and successors are one identical target.

3.24 Target time

The time or interval a claim concerns, including an explicitly unknown or uncertain temporal location.

3.25 Observation time

The time at which an observation or acquisition is represented as occurring.

NOTE 23 It can differ from target time and recording time.

3.26 Recording time

The time at which a record or identified version was made or entered into a recording context.

NOTE 24 It does not automatically date the target occurrence.

3.27 Assessment time

The time of a stated assessment or judgment, distinct from the time to which that judgment applies.

3.28 Descriptive regime

The declared categories, definitions, methods, scales, or boundary choices used to describe a target within an inquiry.

NOTE 25 This is an operational term; it does not require a fixed family of regimes or a particular mathematical construction.

3.29 Revision

An identified change to a representation, claim, assessment, or descriptive regime, with its relationship to an earlier formulation and the stated reason.

NOTE 26 Revision of an account of the past does not itself change the past occurrence.

3.30 Trajectory

A scoped account linking conditions, occurrences, continuations, alternatives, and consequences over a declared temporal or ordering frame.

NOTE 27 A reconstructed trajectory can remain partial and contested; it need not be a single fully ordered sequence.

3.31 Generativity-related claim

In this operational vocabulary, a claim about how relations, conditions, or activity generate, sustain, transform, restrict, or destroy subsequent states, capacities, relations, distinctions, or possibilities.

NOTE 28 This defines the programme's recording subject; it is not a comprehensive definition of GR generativity.

3.32 Generative condition

A condition claimed to enable, constrain, or shape a specified trajectory or possibility.

NOTE 29 Its role needs attribution and grounds; contemporaneous presence alone does not establish contribution.

3.33 Possibility claim

A scoped claim that a continuation was or is available, feasible, blocked, lost, or conjectured under identified conditions.

NOTE 30 An unchosen proposal differs from an evidenced feasible alternative, and each differs from a later imagined counterfactual.

3.34 Contribution

An attributed participation or influence in a specified trajectory or outcome.

NOTE 31 Contribution, credit, causal responsibility, entitlement, and legal liability remain distinct questions.

3.35 Practical uptake

An identified use of a representation or judgment in action, classification, allocation, or institutional decision.

NOTE 32 Its consequences can become new recording targets.

3.36 Generativity return

A research and recording topic concerning claimed return pathways through which generated effects alter conditions of further generation.

NOTE 33 Its operational measurement, evaluative meaning, and any allocation rule remain **OPEN**; no universal quantity or entitlement is defined here.

3.37 Vocabulary application

A named and versioned use of specified terms within a declared document, record package, profile, register or implementation description.

NOTE 34 Its boundary identifies which uses are claimed to follow this document and which belong to external or ordinary-language vocabularies.

3.38 Vocabulary extension

An additional term, narrower operational meaning or application-specific relationship introduced for a declared purpose.

NOTE 35 An extension does not change the meaning of this document's terms in other applications or become a programme term merely through local use.

3.39 Term correspondence

An attributed and scoped relationship between meanings in identified vocabularies or editions.

NOTE 36 Correspondence can be equivalent for a particular use, narrower, broader, overlapping, conditional or unresolved. Similar labels do not establish equivalent meanings.

3.40 Record-role correspondence

An explicit relationship between descriptions using different record roles or different boundaries within one role.

NOTE 37 It identifies which targets or occurrences the descriptions concern and which information is retained, added, omitted or unresolved.

3.41 Actuality or modality statement

A statement of whether a target is claimed as actual, attempted, planned, possible, hypothetical, counterfactual, unrealized or unresolved within a specified frame.

NOTE 38 These qualifications are not a universal exclusive enumeration. An attempted action can have occurred while its intended result remained unrealized.

3.42 Epistemic mode

The way a claim is presented as known, reported, inferred, interpreted, reconstructed, hypothesized or stipulated.

NOTE 39 Epistemic mode differs from actuality or modality and from assessed warrant. An inference can concern an actual occurrence; a direct observation report can be disputed.

3.43 Definedness condition

A condition determining whether a characteristic, classification or operation has an applicable value for a subject under its definition.

NOTE 40 Inapplicability differs from unavailable evidence about an applicable value. A representation can require both a definedness condition and a missingness reason.

4 Vocabulary application and semantic safeguards

4.1 General

V100-001 A vocabulary application shall identify this document and version, its own boundary and version, the terms it uses, and any local extensions or narrower domain meanings. It shall describe departures explicitly and shall not claim unqualified GR-100 vocabulary conformity for a conflicting use of a defined term.

4.2 Reality, manifestation, and representation

The foundation's ontological, relational, and manifestational registers concern different analytical questions. They are not exclusive categories of objects or a mandatory temporal sequence. A practice can operate before its recognition, and a classification can subsequently change the practice. This document does not require every target to receive a philosophical register label.

V100-002 A vocabulary application shall distinguish a represented target, an identified manifestation or trace, a retained record, and a claim wherever it uses those roles. It shall not treat a record identifier, representation, or manifestation as establishing the existence, complete nature, or identity of its target solely by being recorded.

4.3 Claim, observation, inference, and judgment

V100-003 A vocabulary application shall distinguish assertion, observation report, inference, interpretation, and assessment where those functions occur. Where one item performs several functions, it shall identify the functions and their scopes rather than infer one function's warrant from another.

4.4 Trace, evidence, and provenance

V100-004 A vocabulary application shall represent an evidential role relative to an identified claim. It shall keep provenance or authenticity results, evidential assessments, technical conformance, institutional acceptance, and normative or legal judgments distinguishable. It shall not describe success in one of these assessments as success in another without a separately stated argument.

4.5 Identity, time, and history

V100-005 A vocabulary application shall distinguish record reference, target identity, and lineage. A stated identification of targets across appearances shall identify its criterion and the scope in which it is used. Unresolved identity shall remain expressible without forced merger.

V100-006 A vocabulary application shall distinguish target, observation, recording, and assessment times wherever it uses them. It shall preserve uncertainty about time or order rather than derive occurrence order solely from record entry order.

V100-007 An application that represents revision shall distinguish change in the target situation, change in evidence or assessment, and change in the descriptive regime. It shall allow more than one reason to apply and shall not silently replace the earlier formulation with a later one. Where earlier content cannot be retained or disclosed, it shall identify the resulting limit on historical reconstruction.

These are three linked histories rather than three mutually exclusive event types. Publication of a revised classification can change a target situation as well as its description. A later assertion that the earlier situation differed is an epistemic revision; it does not backdate the physical act of correction.

4.6 Generativity and practical consequences

V100-008 An application using generativity-related terms shall identify the claimed change or continuation, affected target or participants, relevant conditions, and scope. It shall distinguish a generative attribution from a value judgment and shall not infer beneficialness, entitlement, or legitimacy from the term “generative” alone.

5 Six operational record roles

5.1 General

These role descriptions are standards-specific proposals, informed by FM-007 and earlier programme vocabulary. They describe how a target is represented for an inquiry. They neither exhaust reality nor require exclusive schema classes. The term Property is retained from the programme; FM-007 uses Attribute. No equivalence between them is asserted.

In the descriptions below, *minimum metadata* means the information required when the role is applied under V100-009. V100-025 distinguishes structural designations and criteria from contextual factual values that permit an explicit unknown or restriction. Common metadata means record reference and version, role, described target, recording responsibility and time, and links to relevant claims and their epistemic context. Referenced context can be shared across a package without duplication.

V100-009 An application of a six-role description shall identify the applied role, its admissibility and identity criteria, the common metadata, and the role’s minimum metadata below. It shall disclose unresolved boundaries and use the temporal meaning associated with the role. Missing information shall retain its stated reason rather than be converted to a substantive negative claim.

V100-010 An application shall allow a target to be described through more than one applicable record role without treating role overlap as evidence of inconsistency. A restriction in an application profile shall state its recording purpose and information limits. A Relation whose own identity, state, properties, or history matters to the declared inquiry shall remain independently referenceable.

V100-025 The application shall supply its reference and version, applied term labels and definition locators. Each applied role shall have an identified role, record reference and version, target designation and responsible recording role; an unresolved target designation shall state the target question or description. These structural designations shall not be replaced by an unknown value. An unavailable contextual factual value may be represented by an explicit unknown, disputed, lost or restricted state, with the stated reason, attributing role and assessment limitation. Required admissibility or identity criteria shall be stated; a provisional assignment with unresolved criteria shall not receive a fulfilled result for a criterion-dependent obligation.

A target designation can identify an unresolved historical subject without establishing its identity. An accountable role can use a protected reference without public disclosure of a person's name. These are supplied designations with declared limits, not empty values. Conversely, a known absence of a required criterion is a recording defect; unavailable evidence for deciding whether an identified criterion is met is an assessment limitation. A fulfilled declaration of unknown context does not resolve the underlying fact.

5.2 Entity

Definition and admissibility. A record role for a focal subject tracked across appearances under a declared continuity criterion. Admissible when the inquiry needs cross-context or cross-time reference; use does not require an unchanging substance.

Identity. The stated reidentification criterion and evidence determine the claim of continuity. A database key identifies a record, not automatically the represented subject. A disputed criterion can remain unresolved.

Temporal behavior. Properties, membership, and relations can change while continuity is asserted. Formation, dissolution, replacement, or uncertain duration can be recorded separately.

Relations to other roles. Participation in Events and Processes; possession of described States or Properties; participation in Relations; lineage links to other Entity descriptions. These are candidate meaningful links, not an exhaustive edge schema.

Minimum metadata. Focal subject and appearances in scope; continuity criterion; temporal scope; attributed identity judgment or unresolved status.

Optional metadata. Names, identifiers assigned by other systems, formation history, known predecessors and successors.

Example and counterexample. An association tracked across a change of premises under a stated organizational continuity criterion. Two unrelated associations sharing a name are not thereby one Entity.

OPEN edge. A split into two successors can preserve lineage while leaving continuity with the predecessor disputed.

5.3 State

Definition and admissibility. A record role for a scoped description of conditions of a target at a stated time or interval. Admissible when the question concerns those conditions rather than an exhaustive inventory of reality.

Identity. Same target, temporal scope, and descriptive regime identify the intended condition description; record versions and conflicting accounts remain distinct. Equality of observed values alone does not establish equality of target conditions.

Temporal behavior. A condition can persist over an interval or be known only at an observation time. Persistence between observations requires a claim. Predictive sufficiency is relative to specified questions and continuations.

Relations to other roles. Conditions of Entities or Relations; preconditions and results of Events; intermediate descriptions in Processes; values articulated through Properties.

Minimum metadata. Target; time or interval; description boundary and regime; conditions described; observation or inferential basis.

Optional metadata. Supported queries, omitted conditions, comparison horizon, warranted persistence interval.

Example and counterexample. A committee's recorded membership on a given date. A timestamped snapshot alone does not establish every member's continuing participation throughout a month.

OPEN edge. A reduced state adequate for a current report can omit historical memory needed for a later operation.

5.4 Event

Definition and admissibility. A record role for an individuated happening or attempted happening under a declared occurrence criterion. Hypothetical, planned, or reconstructed events remain admissible as explicitly qualified targets of claims.

Identity. An occurrence criterion distinguishes event tokens; a description can refer to one event in several records. Repetition of the same operation or outcome does not merge occurrences.

Temporal behavior. Duration, boundaries, sequence, or overlap can be exact, interval-based, partial, or unknown. Failure or interruption does not imply non-occurrence of an attempt.

Relations to other roles. Participants represented as Entities or Relations; changes between States; steps of Processes; Properties of the occurrence.

Minimum metadata. Proposed happening; occurrence and individuation criteria; claimed actuality or modality, such as occurred, attempted, planned, hypothetical, or unresolved; separate epistemic basis, such as reported, observed, or retrospectively inferred; temporal scope; participating targets where known. A retrospectively inferred event can be claimed to have actually occurred.

Optional metadata. Place, before/after conditions, attempted purpose, completion status, links to repeated occurrences.

Example and counterexample. Two separately evidenced permission issuances with the same final status. A formula for the effect of an issuance does not establish that either occurred.

OPEN edge. Different temporal resolutions can treat one prolonged happening as an Event, Process, or several Events; the segmentation rationale matters.

5.5 Process

Definition and admissibility. A record role for activity linked by a declared ordering and criterion of unity. Admissible for goal-directed, recurrent, interrupted, branching, or otherwise connected activity; achievement of an intended endpoint is not required.

Identity. The stated grouping and boundary criterion individuates the process. Equal endpoints or equal modeled composite effects do not establish the same process history.

Temporal behavior. Ordering can be partial; duration and completion can be uncertain. Alternative possible paths remain distinct from the reconstructed actual path.

Relations to other roles. Comprises or links Events and intermediate States; involves Entities and Relations; has scoped Properties; connects to dependent Processes.

Minimum metadata. Unity and boundary criterion; activity in scope; supported ordering; claimed actuality or modality, distinguished from its observational or reconstructive basis; time scope and completion/continuation status.

Optional metadata. Intended purpose, branches, interruptions, excluded steps, retained intermediate conditions.

Example and counterexample. A proposal–revision–authorization sequence with a recorded failed earlier attempt. A factorization of an outcome into mathematically possible operations is not evidence of that history.

OPEN edge. Overlapping practices can belong to several processes; no universal segmentation rule is proposed.

5.6 Relation

Definition and admissibility. A record role for an identified connection, arrangement, or dependence among specified targets or conditions within a stated context. Admissible when its incidence, formation, continuity, or effects are relevant. Potential efficacy requires a further claim.

Identity. A stated criterion distinguishes a continuing arrangement from a renewed or separate one. Equal participants and equal current effects do not alone establish the same relation.

Temporal behavior. Formation, persistence, dormancy, change of terms, and ending are separately attributable. A relation can change while participants remain identified.

Relations to other roles. Participants can be targets described by any relevant role, including other Relations; Events can form or change it; Processes describe its history; States and Properties describe its conditions.

Minimum metadata. Relation reference; participant or condition references with roles; context; relation criterion and temporal scope; stated identity basis.

Optional metadata. Formation history, dependency claims, terms, changing states, prospective effect comparisons.

Example and counterexample. Two separately identified agreements between the same parties, each with its own renewal history. Co-occurrence in a table alone does not establish cooperation, trust, or dependence.

OPEN edge. Uncertain or changing participants can prevent a complete incidence description without eliminating the recorded relation claim.

5.7 Property

Definition and admissibility. Provisionally, a record role for an attributed characteristic or value of a specified subject under a stated definition, time, and context. Admissible when the meaning and subject of the attribution are explicit. This operational use does not resolve the broader Property/Attribute relationship.

Identity. A property assertion is distinguished by subject, characteristic definition, contextual and temporal scope, attribution, and version. A type of characteristic differs from a particular assignment of its value.

Temporal behavior. A value can change with the subject; a later correction can instead revise knowledge of an earlier value. The two histories remain distinguishable.

Relations to other roles. Describes a target represented through any role; measurement or classification can be linked to an Event or Process; multiple conflicting assignments can concern one subject.

Minimum metadata. Subject; characteristic definition; value or explicit missingness state; time and context; method or attribution; scale and unit when used.

Optional metadata. Measurement uncertainty, valid domain, derivation, calibration reference, alternatives.

Example and counterexample. A reported resource quantity for an organization at a specified time. A numbered nominal category is not a measurement permitting arithmetic solely because its code is numeric.

OPEN edge. FM-007's Attribute has explicit domain, interpretation, scale, and definedness conditions. Equivalence to Property, separation, or renaming needs source comparison and a recorded decision.

5.8 Role boundaries and admissibility decisions

Admissibility concerns whether a description can perform the stated recording role. It does not establish the claim about its target. A proposed historical Entity can be admissible as the subject of inquiry while its identity is contested. A hypothetical Event can support counterfactual analysis while its modality excludes it from the asserted actual history. Role metadata and epistemic context preserve both distinctions.

A role's minimum metadata is semantic information, not a prescribed collection of database columns. Shared references can supply context when their version and scope are clear. A narrative dossier can supply information through identified passages. An empty field, unexplained code or link to a changing resource does not necessarily supply an inspectable meaning.

An unknown value can satisfy a duty to disclose unavailable context where a requirement permits it. It does not satisfy a duty to demonstrate continuity, observed occurrence or contribution. A protected identity can use a stable reference without publishing a name; protection does not establish that two references identify one person.

An agreement can be a Relation while tracked as an Entity for continuity. Its negotiation can be a Process; its signing an Event; its operative terms at a time a State described through Properties. These descriptions coordinate different questions. They need not assert six independently existing objects or duplicate a single occurrence six times. A technical profile that restricts overlap needs a route for retaining the distinctions relevant to its declared use.

6 Boundaries between layers

6.1 General

V100-011 A vocabulary application shall distinguish operational record roles from metamodel concepts. It shall not identify a formal carrier state with a record State, a mechanism with a Process, or formal change with an Event without an explicit scoped mapping and argument.

V100-012 A vocabulary application shall keep descriptive, epistemic, evaluative, legal, institutional, and technical assertions distinguishable by their stated question and grounds. It shall not represent technical conformance as automatically creating factual truth, rights, duties, liability, admissibility, jurisdiction, or institutional authority.

The same dossier can connect these assertions. For example, an institutional decision can cite an evidential assessment and an asserted rule, while each remains separately attributable and open to the appropriate

form of review. This is separation of questions and authority, not a requirement for independent databases.

7 Vocabulary management and correspondences

7.1 General

Vocabulary management concerns inspectable meaning across local uses, languages, profiles and versions. A register can be a small table or a documented specification mapping. It need not duplicate a dictionary, but an exact definition and its application scope need to be recoverable. When a source is unavailable, the adopted local wording and that limitation remain visible.

7.2 Terms, sources and local extensions

V100-013 The application shall maintain a term-use register identifying the terms used, their definitions or dated definition references, their recording scope, their source status and the role responsible for interpreting local use. An imported label shall not establish equivalence without an identified correspondence and rationale.

V100-014 A local extension shall identify its purpose, definition, admissibility conditions, relation to existing terms, affected uses and limitations. A conflicting meaning shall use a distinct qualification or label and shall not be presented as an unchanged GR-100 definition.

An extension can address a specialized institutional process without claiming that its categories are universal. For example, a profile can define a reviewed submission within its own procedure. It identifies the relationship to Record and Claim, the criterion for entering the review category and the information the category omits. The label does not imply that the submission is true or that every recording context has the same procedure.

7.3 Languages, editions and mapping

V100-015 A term correspondence across languages, domains or editions shall identify the source and target meanings, direction, scope, responsible attribution and known non-equivalence. A narrower, broader, partial or conditional correspondence shall not be represented as unrestricted equivalence.

A translation can preserve an operational distinction even when ordinary words carry additional meanings in one language. The operational definition travels with the label. Where a translation is contested, alternative formulations and grounds remain available. A terminology register need not require every language to borrow the same word or every application to create a universal dictionary.

Renaming a field does not by itself change meaning. Retaining the same label while changing its definition can change the descriptive regime. The register identifies both situations. A mapping that loses information describes the uses for which the mapped representation remains adequate and the uses it no longer supports. Switching to a finer vocabulary does not recreate distinctions absent from the source material.

7.4 Modality, epistemic function and status expressions

V100-016 An application describing an occurrence or possibility shall distinguish its asserted actuality or modality, the epistemic mode of the assertion and the assessment disposition. It shall preserve combinations such as an actual occurrence inferred retrospectively and a directly reported observation whose accuracy is disputed.

V100-017 Where an application uses fact, verified, valid, confirmed or an equivalent status expression, it shall state the question resolved, applicable criterion, attributed assessor and grounds or assessment

reference. An unspecified status expression shall not erase known uncertainty, an unresolved identity question or the limited scope of a check.

Recorded fact can mean a statement treated as settled by an institution, an asserted occurrence, or a database entry. This document does not make these meanings interchangeable. A historical account can preserve that a claim was institutionally accepted without endorsing its substantive content. Similarly, a valid structure can contain a false claim; a verified signature can authenticate a mistaken statement.

7.5 Correspondence between roles and levels

V100-018 A relied-on correspondence between record roles or descriptive levels shall identify the linked descriptions, intended relationship and use, retained distinctions and known losses or unresolved links. A transformation shall not silently create target identity, occurrence multiplicity or historical detail unsupported by its source.

Table 1 – Role correspondences and distinctions requiring attention

Correspondence	Recording question	Distinction at risk
Event–Process	One prolonged occurrence examined through internal activity; a process treated as a bounded episode	Segmentation, attempts, partial order and intermediate conditions.
Relation–Entity	An agreement or dependence tracked across renewal	Continuity criterion, incidence context and whether renewal creates a separate arrangement.
State–Property	Conditions described through characteristic assignments	Domain, time, omitted conditions and observational or inferential basis.
Process–State	Activity summarized by a resulting condition	Different histories can share an endpoint; the endpoint does not establish the path.
Entity–type	Subjects classified by a shared characteristic	Type equality does not establish token identity or continuity.
Record–target	Several reports linked to a proposed occurrence	Record multiplicity differs from occurrence multiplicity; linkage can remain disputed.

Table 1 is a boundary guide, not an exhaustive allowed-edge schema. A profile can add relationships with stated meanings. An Event description can aggregate several occurrences only when that aggregation is explicit and does not purport to preserve individual occurrence counts or intermediate history. Conversely, decomposing an Event into a possible Process does not establish that the proposed steps occurred.

7.6 Missingness and definedness

V100-019 An application shall distinguish missingness and definedness states material to its use, including zero or false values, unknown values, non-observation, non-collection, inapplicability, disputed assignment and restricted access where present. A mapping that combines these states shall state the loss and shall not infer a substantive negative claim from the combined code.

Unknown is an epistemic condition rather than a third truth value imposed on the world. Inapplicable means the stated characteristic lacks an applicable value under its definition. Not measured means an

applicable measurement was not performed. Withheld concerns access and can coexist with a known value in a protected view. Disputed can describe incompatible assignments with available evidence. These differences affect later counting, assessment and revision.

An application need not claim knowledge of why a value is absent. Unknown reason is legitimate when supported. It also need not reveal protected material's existence to an unauthorized audience. A reduced view can state its collection and access scope while a protected accountable record retains a more specific explanation where permitted.

7.7 Properties, scales and aggregates

V100-020 A numerical Property description shall identify its characteristic definition, applicable domain, scale meaning and unit where relevant. Any arithmetic, weighting or aggregation relied on shall state its interpretation, included population or components and material limitations. Numerical labels alone shall not establish the validity of the operation.

A nominal code supports differentiation, not automatically addition. An ordinal rating supports ordering under its interpretation, not automatically meaningful distances or averages. A measurement with a unit still depends on an instrument, boundary and procedure. The distinctions remain relevant when values have the same software numeric datatype.

An aggregate can change because underlying values change, because composition or weights change, or because a classification rule changes. These are different interpretive questions. A rate can require its numerator, denominator, inclusion criteria and period for interpretation. A pooled increase does not establish improvement for every group; a pooled decrease does not by itself establish causal deterioration in practice. The inference needs its own grounds.

7.8 State sufficiency and retained history

V100-021 An assertion that a State description is sufficient shall identify the question or operation family, comparison horizon, relevant observations, assumptions and known omitted distinctions. Sufficiency for a current report or specified prediction shall not be represented as historical completeness or sufficiency for undeclared continuations.

Two subjects can have the same current reported flag while retaining different conditions that affect a future response. Conversely, a reduced description can predict a selected response while omitting whether the condition arose by agreement or imposition. Predictive and historical purposes need different evidence. A statement of adequacy identifies the question answered, rather than converting that question into a universal account of the subject.

7.9 Identity decisions

V100-022 A relied-on identity judgment shall state whether the proposed relation is identity, similarity, identifier correspondence, succession or another defined relation, and shall preserve material competing criteria and unresolved cases. Automated matching or shared lineage shall not be promoted to target identity without the stated criterion and its supporting attribution.

Organizational registration, membership continuity, operational practice and historical self-description can support different identity inquiries. Agreement under one criterion need not resolve another. A split or merger can be represented by directed lineage without identifying each successor with every predecessor. A shared name does not decide which relation is intended.

Identity also differs from access. Redaction can hide information needed to assess a match while a custodian retains it. A public view can report a scoped assertion and its limits without claiming independent external verification. Lack of disclosure does not justify inventing either identity or non-identity.

8 Conformance

8.1 General

The conformance subject is a declared vocabulary application at an identified edition and boundary. Requirements concerning extensions, numerical Properties, transformations or particular roles are conditional on those features being present. An absent feature can make its specific requirement not applicable. It does not exempt a general safeguard already used elsewhere in the application.

8.2 Declaration and assessment boundary

V100-023 A conformance statement shall identify the application, edition, boundary, GR-100 edition, applied terms, applicable requirements, assessor and evidence. It shall distinguish full fulfillment of applicable requirements from partial assessment and shall not imply assessment of excluded uses or unavailable evidence.

A scope can be small without being vague. A short profile using only Record, Claim, Trace and Evidence identifies those uses and definitions. It does not need examples for an unused Process role. A profile using a numerical Property and an aggregate triggers V100-020 even when its label is score rather than Property. Applicability follows meaning and use, not convenient field spelling.

8.3 Results and mandatory schedule

Fulfilled means that the required evidence was examined and met the check within scope. Not fulfilled means examined evidence demonstrates a failure. Not assessed means necessary evidence, access or method was unavailable or the check was not performed. Not applicable means the triggering feature is absent, with a documented reason. Lack of access is not non-applicability.

V100-024 The assessment shall follow Annex A and retain a result, evidence locator, assessor and reason for every requirement. A failed or unassessed applicable requirement shall prevent an unqualified conformity claim for the declared application. Each not-applicable result shall identify the absent trigger.

V100-026 Where one requirement groups obligations whose results can differ materially, the assessment shall retain a result and evidence for each such component. The overall requirement shall be fulfilled only when every applicable component is fulfilled. A failed or unassessed component shall remain visible in the requirement-level and overall application result.

A vocabulary result does not establish factual truth, philosophical exhaustiveness, effective institutional participation or legal validity. Syntactic checking can assist assessment, but cannot determine whether a term is coherently applied to a contested case. The report distinguishes automatic checks from substantive examination of meaning.

8.4 Maintenance of an assessment

A change in definition, scope, role criterion, correspondence or assessment-relevant use changes the assessed subject. The application identifies the affected edition and results requiring review. Correcting spelling alone need not change semantics; an unchanged label does not prove semantic stability.

An implementation can retain multiple vocabulary editions for historical records. Assessment identifies which meaning governed each record and which mappings support a combined view. A later interpretation does not retrospectively give earlier actors access to the newer vocabulary. If the historical definition cannot be recovered, that is a reconstruction limitation rather than permission to silently substitute the current one.

Annex A

(normative)

Vocabulary assessment schedule

A.1 General

This schedule specifies required assessment checks for applicable features; it does not report executed tests. The assessor examines the declared subject and reports fulfilled, not fulfilled, not assessed or not applicable for each requirement, with an evidence locator. Not applicable requires an absent trigger, not an inconvenient result. Unavailable examination evidence or an unperformed check receives a not-assessed result. A review cannot establish an external fact merely from compliant vocabulary.

Table A.1 – Vocabulary assessment checks

Requirement	Evidence and discriminating check
V100-001	Declaration names version, boundary, terms, extensions. Compare a local "fact" label against its stated meaning; detect an undisclosed conflicting use.
V100-002	Trace a target, manifestation, record, and claim in the subject. An authentic but incorrect report remains representable.
V100-003	Inspect a summary combining observation and inference. Recover which content was registered and which was inferred, by whom.
V100-004	Inspect one material item used differently for two claims. A successful authenticity check does not become a truth result.
V100-005	Inspect a merger, split, or disputed identification. Recover identity criterion and directed lineage without an automatic merger of targets.
V100-006	Inspect a late-entered report. Target time, observation time, recording time, and review time remain distinguishable or explicitly unknown.
V100-007	Compare target change, corrected report, and changed category. Prior meaning and reasons remain recoverable to the declared retention/access extent.
V100-008	Inspect a generative attribution. Scope and affected targets are present; description of expanded capacity is separate from its evaluation.
V100-009	For each applied role, locate admissibility, identity, temporal meaning, and required metadata; inspect a missing value's explicit reason.
V100-010	Inspect a relation with changing terms and an event analyzed as a process. Relevant identity/history and overlapping views remain expressible.
V100-011	Inspect any metamodel mapping. Identify additional premises; absence of a mapping means the conditional check is not applicable.
V100-012	Compare event report, institutional determination, legal assertion, ethical judgment, and technical check. Their distinct grounds remain visible.
V100-013	Inspect the term-use register, source status and dated definitions; a reused label has an argued correspondence.
V100-014	Examine a local extension's definition, admissibility, scope and limits; it does not silently replace a core meaning.
V100-015	Examine an inter-language or inter-edition mapping; partial correspondence is not represented as unrestricted equivalence.

Requirement	Evidence and discriminating check
V100-016	Compare actuality/modality, epistemic mode and assessment disposition, including an actual but retrospectively inferred occurrence.
V100-017	Inspect uses of fact, verified, valid and confirmed; recover the question, criterion, assessor and grounds.
V100-018	Inspect a correspondence between roles; retained references and stated losses prevent invented identity or occurrence detail.
V100-019	Compare zero, false, unknown, disputed, withheld and inapplicable values before and after a mapping.
V100-020	Examine numerical meaning, units, scale and aggregation; recover included population and weighting interpretation.
V100-021	Examine a sufficiency claim; recover the supported question, operations, horizon and omitted history.
V100-022	Examine an identity decision with alternative criteria; distinguish identifier matching, similarity, lineage and identity.
V100-023	Check the conformance statement's edition, boundary, terms and evidence; excluded uses do not acquire a result.
V100-024	Check the complete assessment register; every exclusion has an absent-trigger reason and every fulfilled result has evidence.
V100-025	Check mandatory designations and criteria separately from unavailable contextual facts; an unknown declaration does not resolve a criterion or replace a reference.
V100-026	Inspect a grouped requirement with one unassessed or failed component; its other fulfilled components do not produce an overall fulfilled result.

A.2 Execution and evidence record

The assessor first identifies the application and term-use register, then the feature-triggered requirements. For an applicable check, the evidence includes the definition or dated reference and an actual use. A boundary case is included when needed to distinguish alternative meanings. A documented equivalent case is acceptable when it tests the same distinction in the application's domain. An empty template or undocumented expert understanding is insufficient evidence of actual vocabulary use.

The register records subject version, requirement identifier, applicability, evidence locator, observed result, assessor, date and unresolved limitation. Component results follow V100-026. One evidence item can support several requirements, but their results remain separate. Assessor disagreement identifies whether it concerns meaning, factual material, scope or the assessment method. Restricted evidence receives a scope statement; unavailable required examination evidence receives a not-assessed result rather than an inferred pass. Assessment of an allowed unknown-context declaration follows V100-025 and remains separate from assessment of the unresolved fact.

Annex B

(informative)

Worked vocabulary cases

B.1 Initial distinction cases

1. A clerk records that a request arrived late. An attributed entry record can support a reported recording time, subject to the relevant clock, integrity and acquisition-context checks. Whether the request itself arrived late requires identifying the receipt-time source, applicable deadline and inference. The record, target event and deadline assessment remain distinguishable.
2. A later witness report changes the assessment of the arrival time. That is a revision of the account. A later extension of the deadline changes a governing condition. A new definition of "arrival" changes the descriptive or institutional rule. One dossier can contain all three histories without conflating them.
3. Two administrations reuse an office name. An application follows their records under the same catalogue heading while recording replacement and disputed institutional continuity. Shared cataloguing does not decide Entity identity.
4. A new procedure reduces review time and makes some participants unable to contest an error. A generativity record can preserve both the increased processing capacity and the restricted capacity for correction; an ethical judgment states its own affected parties and criteria.

B.2 One agreement and several roles

A fictional agreement links a cooperative and a laboratory. It is a Relation for questions of commitments and access and is tracked as an Entity for continuity after personnel changes. Negotiation and amendment form a Process, signing is an Event, operative terms on a date form a State description and a reported access limit is a Property assignment. These descriptions need not compete for a single exclusive class.

Renewal creates a boundary question. The parties and title continue while terms change substantially. Participants can describe the same agreement, an archive can retain a new document and a legal analyst can ask a separate continuity question. The application retains the criteria and their grounds rather than deriving a universal identity resolution from the shared title. A technical edge that records only an active connection can support a current-status query while losing formation and dispute history.

B.3 Changing composition in an aggregate

A programme reports participation rates for two groups. Both groups improve in a later period, while the population contains a larger share of the initially lower-rate group. The pooled rate can decline despite each group's improvement. This is a stipulated comparison problem, not evidence about a real programme.

The Property description retains population, denominator, definitions, weights and periods. A question about the same people over time additionally needs identity linkage. A question about institutional composition can instead treat entry and exit as part of the process. The scalar alone does not establish which question is relevant or whether the outcome is fair.

B.4 Missing, withheld and inapplicable

One form records a zero reading, another says no measurement was performed, another withholds an existing value, and another concerns a subject for which the characteristic is inapplicable. A conversion maps every case to an empty cell. That table can have a limited use, but it cannot claim preservation of the distinctions or support a count of zero readings.

A finer vocabulary can recover an omitted value only where retained or newly obtained evidence supports it. Changing notation does not create missing observations. Authorized examination can use a protected source while a public view remains incomplete. The correspondence records the different routes and resulting limitations.

Annex C

(informative)

Foundation trace and drafting rationale

C.1 General

Page numbers below are one-based pages in the supplied PDFs. FM identifiers are those in `foundation_manuscripts/MANIFEST.md`. The definitions here are operational proposals rather than quotations or claims that the manuscripts prescribe this recording model.

Table C.1 – Foundation passages and operational decisions

Source	Preserved distinction and draft application
FM-004, §4.2, pp. 11–14; §4.6, pp. 43–45	Registers answer different questions; manifestation is broader than representation, and recognition need not precede relational reality. Basis for V100-002; no exclusive philosophical register schema.
FM-005, §5.4, pp. 28–31	Trace, target relation, and evidence differ; evidential force is target-relative. Basis for V100-003/004 and GR-200 evidence-role requirements.
FM-005, §5.17, pp. 141–142	Uncertainty concerns several dimensions and need not have one scalar measure. Basis for the uncertainty definition and GR-200.
FM-005, §5.20, pp. 168–174	New evidence, intervention, historical revision, and category revision differ. Basis for V100-006/007; three linked histories are an operational organizing proposal.
FM-007, p. 2; §7, pp. 26–29; §8, pp. 32–33	Roles overlap; identity criterion, lineage, participant incidence, and relation continuity require distinct information. Basis for V100-005/009/010 and Entity/Relation proposals.
FM-007, §9, pp. 37–38, 43; §12, pp. 56–57	Occurrence differs from effect; histories differ from endpoints and possible factorizations. Basis for Event/Process proposals.
FM-007, §10, pp. 43–44; §11, pp. 52–53, 56	Attribute domain/scale and State sufficiency are scoped. Basis for Property/State proposals, with Property/Attribute unresolved.
FM-003, §3.10.9, p. 115; §3.13, pp. 141–142	Generativity has no fixed normative sign; effects vary across subjects and time. Basis for V100-008, without a universal measure. Both Chapter 3 variants remain independently preserved.

The main alternatives were a complete philosophical definition, an exclusive six-class schema, or a limited operational vocabulary. This draft selects the third provisionally because initial cases need distinguishable claims and histories before a technical model can be justified. A programme decision record accompanies this drafting choice; adoption and technical realization remain separate decisions.

C.2 Additional analysis in edition 0.2

FM-007, sections 10.4–10.10, PDF pages 45–50, distinguishes partial definedness, overlapping classifications, scale interpretation, aggregate behavior and changing composition. V100-019/020 preserve these meanings without importing the formal constructions or equating Attribute with Property. The manuscript's arithmetic examples are stipulated constructions, not empirical validation of this vocabulary.

FM-007, sections 17.1–17.2, PDF pages 78–80, distinguishes within-regime consistency from cross-regime alignment and explains the inability of a coarse description to recover omitted distinctions by relabeling. V100-015/018 preserve correspondence limits without claiming that a fixed regime catalogue anticipates every future distinction.

FM-005, sections 5.4.4–5.4.8, PDF pages 32–35, distinguishes observation, inference, latency, hiddenness and negative evidential warrant. V100-016 distinguishes a target's claimed actuality from its inferential accessibility. Missing evidence is not proof of concealment, and inference is not a weaker kind of reality. Sections 5.18.1–5.18.5, pages 152–156, examine visibility, classification power and institutional legibility. The extension requirements make classifications inspectable without assuming that maximal visibility is desirable.

The provisional term Generativity return identifies a programme recording topic, not an asserted equivalence with a manuscript-defined quantity. FM-005, section 5.17.3, PDF page 145, discusses uncertainty in recirculation claims, including conversion or transfer, return pathways and effects on later generative conditions. That passage supports questions to record, while the terminology's wider definition, measurement and evaluative interpretation remain unresolved.

Annex D

(informative)

Unresolved issues and development evidence

D.1 General

- **OPEN — Property/Attribute.** Compare FM-007 with sustained programme usage and test conflicting value assignments, undefined values, and nominal scales before deciding equivalence, separation, or a terminology change.
- **OPEN — Claim representation.** Compare independently identified claims, attributed assertions within records, and hybrids using disagreement, revision, restricted access, and round-trip examples. This draft requires distinguishability, not a seventh ontology class.
- **OPEN — Role overlap and profiles.** Test overlapping Event/Process and Entity/Relation descriptions. No exclusive schema typing or full cross-role relation vocabulary has been adopted.
- **OPEN — Identity.** Domain-specific criteria and disputed linkage need examples beyond names and administrative identifiers; branching continuity does not have a universal resolution.
- **OPEN — Generativity and return.** Test possibility, foreclosure, contribution, and return pathways without presuming a universal metric or a normative entitlement.
- **OPEN — Source chronology.** Chapter 3 editorial precedence remains unresolved. This draft cites particular passages without declaring one variant authoritative over the other.

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7. ITU-T, *Author's Guide for drafting ITU-T Recommendations*, June 2023, https://www.itu.int/dms_pub/itu-t/oth/0a/0f/T0A0F0000040005PDFE.pdf. Informative drafting model; no claim of institutional affiliation.

GENERATIVITY STANDARDS PROGRAM

GR-110

Standards-track Working Draft

Version 0.2 2026-09-22

Generativity Recording Requirements

WORKING DRAFT FOR REVIEW

This document contains proposed provisions for technical and institutional review. It is not an adopted Standard or an operative governance instrument. Its scope, application conditions and publication status are specified in the text.

Prepared by the Generativity Standards Program. Reference to external publications does not imply endorsement by ISO, IEC, IEEE or any United Nations body.

Foreword

This document specifies proposed requirements for generativity record packages and the practices that create, use, and maintain them. It is a preparatory Standards-track Working Draft. It is not an adopted Standard and does not establish that a formal standards project has been initiated.

Responsible editor: `UNASSIGNED`. Canonical source: `standards/GR-110-recording-requirements/GR-110.tex`. Intended readers are recording practitioners, participants in inquiry, record custodians, institutional users, implementers, and assessors.

Version 0.2 retains R110-001 through R110-034 and updates their dated draft dependency to GR-200 version 0.2. It develops operational planning, capture, attribution, alternatives, practical response, custody, presentation, and assessment. Normative annexes specify semantic information and assessment schedules. Informative annexes provide authored examples and a source-to-proposal explanation.

The proposed requirements are available for review and controlled exercises while programme governance develops. Their fulfillment concerns the stated recording practice and evidence. It does not certify factual truth, beneficial generativity, complete history, or external legal validity.

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Introduction

A final output can survive while the relations, judgments, alternatives, and conditions that made it possible become inaccessible. An account of a current result can also conceal mistaken assessments, changing categories, unrecognized contributions, or the loss of capacities elsewhere. This document addresses those problems through bounded and revisable recording.

A generativity package connects three distinguishable histories: changes in the situation being investigated; changes in evidence, interpretation, and judgment; and changes in categories, methods, or institutional recognition. A classification can enter the situation and alter access or action. Its practical effect does not establish that its description was warranted, and its later correction does not demonstrate repair of earlier consequences.

The recording objective is therefore more specific than accumulating observations. A reader needs to identify the asserted transformation, whose account it is, how earlier conditions are said to connect to it, which grounds support that connection, and what remains unavailable or disputed. A practice needs arrangements for proportionate collection, protection, challenge, correction, custody, and intelligible presentation.

The foundations support several forms of generative inquiry. A relation can enable, constrain, maintain, amplify, mediate, or stabilize an effect, and its role can change over time. A generative trajectory can cross several relations and carriers rather than follow one persistent object. The clauses below operationalize the recording of such accounts; they do not impose one causal theory, universal measurement scale, or exhaustive graph of possible futures.

1 Scope

1.1 Included subjects

This document specifies requirements for an identified generativity record package and the responsible recording practice. It covers purpose and boundary, material claims, record identity, time, generative accounts, contributions, alternatives, changes in distinctions, practical uptake, revision, protection, custody, and presentation.

The package contains the retained representation and its declared limits. The practice includes people or institutions, methods, assigned responsibility, collection and review actions, custody, and user-facing behavior. Full assessment of the declared scope examines both documentary material and applicable practice obligations. A package-only examination is a partial assessment under this edition; no reduced package-conformance profile is defined.

1.2 Excluded claims and implementations

The document does not require an exhaustive world history, unrestricted observation, a particular database, cryptographic mechanism, interchange format, common metric, or mandatory category-theoretic semantics. Narrative dossiers, tables, and technical systems can satisfy the same semantic obligations where the required distinctions and behavior remain inspectable.

It does not establish ownership, a compensation entitlement, a legal duty to disclose, or the authority of an external institution. Contextual legal and policy assertions are recorded with their grounds and status. Full GR-120, GR-130, GR-140, GR-150, GR-160, and GR-400 publications are not prerequisites for applying the bounded manual assessment in this draft.

2 Normative references

2.1 Dated draft dependencies

The following Standards-track Working Drafts supply provisions invoked by this document:

GR-100, Foundations and Vocabulary, version 0.2. `standards/GR-100-foundations-vocabulary/GR-100.tex`. The incorporated scope is Clause 3's terms, Clause 5's record-role meanings when used, and the result-category meanings in 8.3. This reference does not impose a separate claim of GR-100 vocabulary-application conformity.

GR-200, Epistemic Recording Framework, version 0.2. `standards/GR-200-epistemic-recording/GR-200.tex`. Provides the applicable requirements for the bounded epistemic record package required by R110-005, including package-level obligations.

These are draft dependencies, not adopted Standards. An assessment identifies their exact versions and the incorporated requirements. A later change requires dependency review.

2.2 Related documents

GR-210, Evidence, Interpretation, and Contestation, version 0.2, provides a complementary procedural draft. It is not a blanket dependency of this document. A claim to fulfill a GR-210 procedure requires a separate assessment. Programme governance controls publication development and adoption; it does not automatically supply the mandate of an institution using a package.

3 Terms and definitions

3.1 Generativity record package

An identified collection assembled for a stated inquiry or practical purpose, with a scope, inventory, responsible recording practice, attributable material claims, and history relevant to that purpose.

3.2 Recording practice

The responsible people or organization, methods, decisions, and custody arrangements used to assemble, assess, present, and maintain a package.

3.3 Material claim

An assertion relied on to explain a consequential relation, generative effect, decision, classification, assessment, or revision within the declared purpose. Materiality is determined by that reliance and the selection rationale; it is not a truth status.

3.4 Generative account

An attributed account of how conditions or relations enabled, maintained, transformed, or constrained subsequent capacities, relations, distinctions, constraints, or possibilities. This operational term permits recording an account whose substantive warrant remains disputed.

3.5 Generative contribution role

The asserted target-relative function of a relation, actor, or configuration in an account, such as enabling, triggering, mediating, amplifying, stabilizing, substituting, or constraining. Roles can overlap and change; they are not new record-ontology classes.

3.6 Generative carrier account

An account of a persisting or transmitted condition through which an earlier contribution is connected to a later effect, including any transformation of that condition. This is a recording expression informed by FM-005, Definition 5.100, rather than a new mandatory class.

3.7 Possibility-field account

A bounded account of the alternatives or pathways represented as accessible, constrained, opened, or foreclosed for specified subjects under stated conditions. It does not claim to enumerate the complete possibility field of reality.

3.8 Practical uptake

Reliance on an identified claim, classification, or assessment in a stated action or decision, distinguished from mere receipt or availability of the information.

3.9 Recording horizon

The period covered by collection or reconstruction. It can differ from the period over which a claimed effect is expected or assessed.

3.10 View

A selected or transformed presentation of package content for an identified purpose and audience, with declared relation to source versions and material limitations.

3.11 Declared limitation

An explicit account of a collection, knowledge, access, method, temporal, or assessment constraint. Declaring a limitation does not automatically satisfy an obligation requiring evidence that remains missing.

4 Planning and responsibility

4.1 Purpose, boundary, and selection

R110-001 A package shall identify its purpose, intended users, subject matter, boundary, relevant time horizon, recording practice and package version.

R110-002 The recording practice shall state the selection criteria for included material and identify known omissions material to the purpose, including unavailable perspectives, uncollected information and limits of reconstruction.

R110-003 The package shall distinguish an inventory of retained records from an assertion that the underlying history is complete. The existence of a record shall not be used as proof of its represented content.

R110-035 Before systematic capture or reconstruction, the recording practice shall identify the questions the package is intended to support, the decisions or uses anticipated, and the information needed to examine them. The collection plan shall distinguish necessary detail, conditional detail, and material excluded from collection with reasons.

R110-036 The plan shall identify temporal horizon and resolution, observational boundary and scale, included perspectives, source types, expected gaps, and relevant relations outside the boundary treated as context. A change of boundary or scale material to interpretation shall be versioned and explained.

R110-037 The practice shall assess feasible recording, assessment, protection, and participation effort for the declared purpose. If essential work exceeds available capacity, it shall narrow the scope, obtain capacity, or report an unmet requirement; resource limits shall not justify invented content or an unqualified assessment claim.

The selection plan makes the account usable and bounded. An inquiry into a maintenance collaboration can require the work that sustained access without documenting every interaction among its participants. Selection becomes misleading when exclusions material to the stated account disappear from view.

4.2 Responsible functions and operating conditions

R110-004 The recording practice shall assign responsibility for capture, assessment, custody, access decisions and correction, recording combined roles and relevant conflicts. An automated component shall not substitute for an unassigned responsibility.

R110-038 Each assigned function shall identify the responsible person or organization, accepted task, authority and access needed, relevant interests, and a contact or continuity arrangement. Where a function cannot be performed, the practice shall record the limitation and its consequence for current use or assessment.

R110-039 The recording plan shall identify when capture is contemporaneous, retrospective, automated, or assisted and how consequential selections or transformations will be checked. Automated output shall retain its relationship to source material and accountable review.

R110-040 A material expansion of purpose, audience, source collection, or practical use shall receive renewed scope and protection assessment before the affected activity begins. The package shall identify the change and distinguish earlier permission and evidence from authority for the new use.

R110-041 The practice shall maintain the package inventory, current responsible functions, known dependencies, and active review or correction routes through the declared maintenance period. A decision to stop maintenance shall identify its date, reason, custodial disposition, and consequences for users.

5 Capture, identity, and epistemic integration

5.1 Intake and trace preservation

R110-042 On incorporating material, the practice shall record its source, acquisition or creation time, received version or identifying characteristics, method of capture, relevant production context, and permitted use. Unverified source assertions shall remain attributed rather than represented as established provenance.

R110-043 A transcription, translation, summary, selection, annotation, or reconstruction shall identify the source material, responsible transformer or method, material changes, and known loss or uncertainty. A derived account shall remain distinguishable from its source.

R110-044 When several materials derive from a common source, the package shall retain known derivation relationships relevant to evidential independence. Multiple copies or repeated citations shall not be presented as independent corroboration without additional grounds.

R110-045 The practice shall identify collection or extraction errors that can materially affect interpretation, including temporal aggregation, omitted context, unresolved attribution, and unsupported precision. Correction of an extraction shall not silently alter the underlying source record.

5.2 Package and claim dependency

R110-005 The package shall identify its material claims and assessments as a bounded epistemic record package assessed against GR-200 Working Draft 0.2, including that draft's package-level obligations. It shall identify the assessed claim set, dependency versions, applicable requirements, evidence, exceptions and results; a claim-level check alone shall not establish fulfillment of the package dependency.

R110-046 The assessed material-claim set shall include claims relied on for generative connections, identity, alternatives, category change, and practical consequences, not only claims supported by convenient evidence. Exclusion of a relied-on claim shall be identified as a limitation of the assessment rather than omitted from the declared set.

R110-047 The package shall link each material claim and relevant assessment to the applicable GR-200 records and results. The dependency assessment shall cover all applicable obligations for that bounded epistemic package; successful individual claim checks shall not substitute for package-level evaluation.

5.3 Identity and temporal meaning

R110-006 Each retained record and version shall be distinguishable within the package, and a reference shall identify its intended target sufficiently for the declared use. A record identifier shall not itself establish identity of the represented person, event or relation.

R110-007 A continuity or identity judgment material to the trajectory shall identify its criterion, responsible source, supporting grounds and known dispute. Merger, succession and common labels shall not silently be treated as identity.

R110-008 The package shall distinguish the represented occurrence or validity time from observation, recording and later assessment times when their difference is relevant. Uncertain intervals and unsupported ordering shall remain explicit.

R110-009 Represented observations, actions, relations, states and properties shall retain the information needed to distinguish their operational roles. A relation with a material history, status or properties of its own shall be identifiable as a recordable subject.

R110-048 A disputed identification, apparent duplicate, split, merger, or succession shall retain the alternative interpretation and the decision or uncertainty governing linkage. The practice shall distinguish correction of a record identifier from revision of a judgment about the represented subject.

R110-049 The temporal account shall identify relevant ordering, interval, resolution, and uncertainty, including where observations leave gaps. A claimed continuous relation shall state its continuity criterion and evidence; continuity of a label, manifestation, or file shall not alone establish continuity of the relation.

R110-050 When a reconstruction uses categories or evidence unavailable to earlier actors, it shall identify that retrospective basis and retain the earlier terminology or a supported account of it where material. The reconstruction shall not attribute later knowledge or intended outcomes to earlier actors without grounds.

6 Generative accounts and attribution

6.1 Target and connection

R110-010 For each generative account, the package shall identify the target capacity, relation, constraint, distinction or possibility; the relevant actors or configuration; the comparison or earlier condition; and the temporal and contextual scope.

R110-011 The account shall state how the proposed enabling, maintaining, transforming or constraining contribution connects earlier conditions to the target, with grounds, method and limitations. Temporal precedence or a diagram edge alone shall not be presented as establishing that connection.

R110-012 An account shall distinguish the asserted occurrence or modality of an effect, such as realized, intended, possible, unrealized or disputed, from its epistemic basis, such as observed, reported, inferred or reconstructed. A realized past effect can be retrospectively inferred. The recording practice shall not manufacture an observed outcome where follow-up evidence is absent.

R110-014 When an enabling encounter, decision or judgment is material to the account, the package shall identify its represented role, relevant conditions and the claim connecting it to subsequent developments.

R110-051 A generative account shall distinguish the existence or occurrence claim about its target from the attribution claim connecting candidate contributors to that target. The role, boundary, scale, time horizon, and evidential limits of the attribution shall remain inspectable even when the target change is well supported.

R110-052 Where association, sequence, or co-occurrence is used as support, the account shall state that evidential role and assess material alternative explanations, such as selection, common conditions, reverse influence, or changing definitions, or identify their unresolved status. Association shall not be relabelled as a demonstrated mechanism.

R110-053 A mechanism account shall identify the intermediate changes proposed to carry the contribution, their connection to available evidence, and any unobserved or assumed link. Restating the final

outcome as an intermediate step shall not be presented as additional evidence.

The meaning of a contribution depends on the target. A network can be associated with income while the stated generative question concerns access to knowledge or a new collaboration. The account identifies the level at which the asserted contribution operates. Different methods can provide different kinds of support without being reduced to one confidence number.

6.2 Alternative contributors and counterfactual reasoning

R110-054 When a counterfactual supports attribution, the account shall identify the focal change, connected conditions allowed to vary, background conditions provisionally held stable, target comparison, time horizon, evidence for plausibility, and material uncertainty. A modeled counterfactual shall remain distinguishable from an observed comparison.

R110-055 Where multiple or distributed contribution is material, the account shall identify the supported roles or organizational pattern, relevant complementarities, substitutions, or feedback, and the limits of allocating effects among participants. Failure to isolate a single contributor shall not force an unsupported sole attribution.

R110-056 A claim of emergent or configurational contribution shall identify the interaction, organization, or dependency said to matter and the evidence supporting its relevance to the target. The label emergent or systemic shall not replace the account of the proposed connection.

6.3 Carriers, delay, and long trajectories

R110-057 For a delayed contribution, the account shall identify the persisting or transmitted condition proposed to connect the earlier relation to the later effect, known transformations of that condition, intervening influences, and the limit of useful attribution. A long interval alone shall not establish either continuity or disconnection.

R110-058 A trajectory containing several generative links shall preserve link-specific contributors, target, grounds, modality, and uncertainty where these differ materially. Evidence supporting one link shall not automatically validate downstream links or the whole trajectory.

R110-059 Where available evidence ceases to support a downstream attribution, the account shall identify that boundary and classify further development as unassessed, conjectured, or separately supported as appropriate. A diagram or narrative shall not hide that change of status.

R110-060 A path-dependence or lock-in claim shall identify the sequence-sensitive condition said to alter later alternatives, its carrier or feedback, and grounds distinguishing historical dependence from persistence under current conditions. Claimed irreversibility shall state the relevant horizon and alternatives considered.

6.4 Branches and contributions

R110-013 Material participants and contributions shall be attributed with their basis and uncertainty. The recording practice shall provide a means to record disputed, collective, indirect or unknown contribution without forcing attribution to one actor.

R110-061 An account of branching shall distinguish opening or constraining a pathway, selecting a branch, and stabilizing a later outcome when those contributions differ. Earlier enabling conditions shall not receive the whole realized history's attribution solely because they preceded it.

R110-062 A contribution record shall distinguish descriptive attribution from acknowledgement, authorship, compensation, ownership, institutional credit, or legal responsibility. Any asserted entitlement or

allocation shall identify its separate source, authority, evaluative basis, and disputed or operative status.

7 Alternatives, distinctions, maintenance, and loss

7.1 Alternative and possibility accounts

R110-015 A recorded alternative shall state whether it was considered at the time, inferred retrospectively, modeled or merely proposed, and identify the grounds for any claim of feasibility. Recorded alternatives shall not be presented as exhaustive or equally feasible without supporting grounds.

R110-063 A historical alternative shall identify whether it was evidenced as available to relevant actors at the time, proposed then but infeasible under identified conditions, or introduced retrospectively for analysis. A later technology, category, or institutional option shall not be represented as historically available without grounds.

R110-064 A possibility-field account shall identify the subjects or positions concerned, the selected pathways, the relevant conditions and horizon, and the change alleged in accessibility, cost, probability, or viability. Unenumerated possibilities and limits of comparison shall remain explicit; a bounded list shall not imply exhaustion.

R110-065 Where an option is represented as available, the account shall distinguish formal availability from practical access under material resources, authority, knowledge, timing, or participation conditions. A declared permission alone shall not establish that the affected person could exercise the option.

R110-066 A comparison of earlier and later possibilities shall state whether the compared categories, boundaries, and subjects remain sufficiently consistent for the claimed comparison. If the process generating change or the available distinctions changed, that change shall be represented rather than forced into an unchanged scale.

Alternatives are recorded for their relevance to the inquiry. No branch tree is required. A package can retain evidence of one abandoned option and explicitly state that other pathways were not reconstructed. A possibility claim is stronger than a statement that an observer imagined an option, and its grounds are recorded accordingly.

7.2 Categories and historical reinterpretation

R110-016 A material change in categories, available distinctions or methods shall identify the earlier and later formulation, the reason for change and its effect on interpretation. A new description shall not automatically be represented as a newly existing underlying object.

R110-067 A material classification or method change shall identify its responsible source, effective or asserted period, definitions or rules changed, and consequences for reading earlier records. A later harmonized dataset or view shall preserve a route to the distinctions lost or identify that loss.

R110-068 A retrospective interpretation shall distinguish correction of an earlier error, expansion using later evidence or categories, and subsequent transformation of the represented relation. Where more than one applies, the package shall preserve their separate grounds rather than choose one merely for a simpler history.

The same word can refer to changing institutional arrangements, and different words can describe related practices. A genealogy can therefore connect heterogeneous predecessors without claiming one continuous identity. The package identifies the type of historical account and the limits of the continuity or formation claim.

7.3 Maintenance, depletion, and restriction

R110-017 Known maintenance, depletion, restriction, exclusion or loss material to the declared generative account shall be recorded alongside creation or expansion, or have an explicit collection or protection limitation under R110-002 and R110-026. The account shall distinguish descriptive effects from their evaluation for particular people or values.

R110-069 Where maintaining a capacity or relation is material, the account shall identify the recurring work or conditions asserted to sustain it, the relevant period, and evidence or uncertainty about deterioration in their absence. Lack of a novel final output shall not be used to omit a supported maintenance contribution.

R110-070 A loss account shall distinguish loss in the represented situation from loss of records, visibility, access, institutional recognition, or interpretability. The package shall identify which kind is asserted, its basis and affected subject, without inferring one solely from another.

R110-071 An enabling or constraining effect that differs by participant, position, scale, or horizon shall be scoped accordingly. A short-term benefit shall not erase a recorded longer-term dependency or cost, and a loss to one participant shall not be concealed by aggregate expansion.

R110-072 A normative evaluation of maintained, created, or lost conditions shall identify the evaluator, relevant values, affected interests, grounds, and disagreement. Descriptive generativity and the desirability of its consequences shall remain distinguishable.

7.4 Generativity return

R110-018 Where generativity return is assessed or proposed, the package shall identify the asserted concept, intended recipients, scope, grounds and evaluative basis. Where it is not assessed, that limitation shall be stated without inventing a quantity or entitlement.

R110-073 A generativity-return account shall distinguish the proposed concept and evaluation from any observed transfer, practical response, or legally asserted entitlement. If a quantity is used, the account shall state its meaning, units or scale, calculation or judgment method, horizon, assumptions, and limits on comparability.

An account can state that generativity return was not assessed. The record of that limitation is assessed separately from any substantive claim about return. No universal distribution rule or monetary equivalent is prescribed.

8 Practical uptake, feedback, and revision

8.1 Decision and intervention accounts

R110-019 When a represented claim or classification informs a decision within scope, the package shall identify the claim version relied on, the decision, the asserted decision authority, its stated grounds and known subsequent response.

R110-074 A practical-uptake record shall distinguish availability or receipt of a claim from actual reliance, the decision communicated, and the action implemented. Each asserted step shall identify its source and evidence or uncertainty; a delivery acknowledgement shall not establish that a judgment was accepted.

R110-075 When an intervention rationale is within scope, the package shall identify the immediate action, intended generative effect, target relations or conditions, relevant assumptions, beneficiaries and affected interests, and evidence expected to support or challenge the rationale. It shall identify the asserted authority rather than derive that authority from the recording Standard.

R110-076 Where monitoring or feedback is part of the assessed practice, the practice shall identify questions, observations, review points or triggers, responsible recipients, and the decisions that feedback can inform. A collection schedule without a route to consideration shall not be represented as an operative feedback arrangement.

The practical sequence depends on context. A retrospective archive need not operate the intervention it describes. Its package can record an institution's asserted action and the evidence available about it. A practice claiming to provide an operational feedback route needs evidence that the route works within its authority.

8.2 Learning and consequences

R110-077 The package shall distinguish evidence that an action was implemented as intended from evidence that the anticipated transformation followed. Unexpected, delayed, mixed, or unobserved effects shall retain those statuses rather than being treated as success or failure solely from implementation completion.

R110-078 A material feedback record shall identify the observation or testimony, its relation to the intervention rationale, the person or function considering it, and any maintained or revised action with reasons. Where the practice cannot observe consideration or action, that limit shall be reported.

R110-079 When feedback leads to a changed target, method, boundary, objective, or evaluative criterion, the package shall preserve the change and its rationale. Later success criteria shall not be presented as though they governed the original action unless that earlier status is evidenced.

R110-080 An account of withdrawal, reversal, or repair shall distinguish ending an activity, attempting to restore an earlier condition, and addressing residual consequences. It shall identify responsible authority, planned and performed actions, observed effects, and known limits; restoring a rule shall not alone establish restoration of the prior situation.

R110-081 Where a corrective decision has known downstream consequences within the declared scope, the practice shall record follow-up evidence or its absence, including whether affected access, participation, capacity, or dependence changed. A corrected description alone shall not be reported as completed practical repair.

8.3 Revision and challenge

R110-020 A revision shall identify its actor or responsible source, time, target, reason and affected records, distinguishing a change in the represented situation, evidence or interpretation, and descriptive regime. More than one reason can apply.

R110-021 The recording practice shall preserve the intelligible relationship between earlier and later accounts, subject to stated retention and access rules. It shall not retrospectively present earlier actors as possessing evidence or categories first available later.

R110-022 A correction shall identify dependent records or presentations known to the practice, actions taken to correct them and any limits on propagation. The practice shall not assert that uncontrolled external copies were corrected or deleted without evidence.

R110-023 The practice shall provide a declared route for questions, contested attribution and correction requests, identify the responsible recipient and maintain permitted request/disposition records. Availability of the route shall not imply a legal entitlement or a promise of agreement.

R110-082 The declared correction route shall explain how to identify the disputed material, contact the responsible function, request protected handling, and learn the status or disposition. The practice shall test the route within its claimed operating conditions and record failures and remedies.

R110-083 Conflicting correction requests shall remain separately attributable and linked to the affected versions. The practice shall record the responsible determination or unresolved disagreement and shall not silently overwrite one account merely because another was received later.

9 Protection, custody, and preservation

9.1 Authority and proportionate collection

R110-024 The recording practice shall declare the purpose and authority basis for collecting, retaining, accessing and disclosing material within the package, including the applicable policy or institutional context and unresolved constraints. It shall limit collected detail to that justified by the declared purpose.

R110-025 Access and retention decisions shall distinguish content, metadata, derived views and audit traces. Preservation of history shall not automatically require public disclosure or indefinite retention of sensitive material.

R110-084 Before collecting or disclosing sensitive material, the practice shall identify the intended use, actual authority or permission basis, audience, relevant restrictions, and feasible less intrusive information sufficient for the purpose. If the intended use lacks an established basis, that use shall not proceed merely to complete the package.

R110-085 Protection decisions shall consider whether identifiers, relationships, timing, summaries, or combinations of metadata disclose restricted identity, existence, or content. The resulting access arrangement shall distinguish material that can be retained, examined by authorized reviewers, or presented to a particular audience.

9.2 Unavailable information and retention

R110-026 Where material is unavailable, the package shall distinguish known non-collection, loss, destruction, restriction and an unknown reason to the extent that doing so is supported and permitted. It shall not disclose a protected fact merely to label an absence.

R110-086 An unavailable-information declaration shall state only what is supported and permitted, identify its effect on interpretation or assessment, and indicate a review or future-access route where one exists. A protected omission shall not be filled with a false factual explanation.

R110-087 The practice shall identify the custodian, retention period or event-based trigger, access-review point, and authorized disposition for material whose retention or disclosure is controlled. Expiry or withdrawal of access shall trigger review of affected claims, views, and assessment limitations.

R110-088 When interpretability depends on a vocabulary, method, software environment, codebook, or external resource, the package shall identify the relevant version and preservation or availability arrangement. A broken reference or obsolete tool shall be assessed for semantic loss rather than treated only as a display defect.

9.3 Transfer and migration

R110-027 A transfer, migration or custody change performed by the practice shall identify the source and destination versions or custodians, its authority, relevant transformation and known information loss. Unsupported finer distinctions shall not be invented during conversion.

R110-089 Before a transfer or migration, the responsible custodian shall identify the authorized source and destination, material and versions in scope, rights and restrictions to carry forward, transformation rules, expected losses, acceptance criteria, and responsibility if the operation fails.

R110-090 After a transfer or migration, the practice shall compare the resulting material against the declared acceptance criteria, including identity, attribution, versions, temporal distinctions, generative links, uncertainty, access restrictions, and known losses. A successful byte transfer shall not alone demonstrate preservation of meaning.

R110-091 An interrupted or unsuccessful custody operation shall retain a record of completed and incomplete steps, authoritative copies, protection status, recovery actions, and unresolved loss. The practice shall not claim that destination custody is complete before acceptance is evidenced.

9.4 Correction, restriction, and disposal

R110-028 An authorized correction, restriction, retention or disposal action shall have a scoped disposition and an accountable executor. The practice shall record permitted evidence of its result and known limitations without retaining prohibited content solely to prove deletion.

R110-092 An authorized restriction or disposal shall identify the affected content and derived views, permitted evidence of execution, known copies or dependents, and limits of control. The practice shall review public statements and assessment claims that relied on material no longer available, without retaining prohibited information merely to document the action.

10 Presentation and accessible examination

10.1 View identity and mediation

R110-029 A presentation supplied as part of the assessed practice shall identify its source package/version and disclose material selection, reconstruction, uncertainty, disagreement and restriction within the permitted audience. It shall distinguish an attributed claim, an assessment and an institutional determination.

R110-030 A public or reduced view shall not imply that it contains the entire retained package. A validation or provenance result shall state what was checked and shall not be presented as certification of substantive truth or normative legitimacy.

R110-093 Each supplied view shall identify its audience and purpose, source package and version, generation or preparation method, material selection and transformations, and update status. A cached or exported view shall not imply that it reflects later corrections without evidence of refresh.

R110-094 A view of a generative account shall distinguish the status of the asserted effect, the evidential basis for it, and the evaluation of its desirability. A visual edge, color, badge, or position shall not be the sole means of expressing a distinction necessary for interpretation.

R110-095 Navigation from a public or reduced view shall respect the access limits of linked evidence and metadata. Where a material link cannot be exposed, the view shall communicate the permitted limitation without suggesting that the source does not exist or that unrestricted inspection is available.

10.2 User tasks and support

R110-031 The practice shall provide enough accessible explanation for intended users to locate the grounds of a material claim and the relevant review route. A practical assessment shall record observed comprehension barriers and the alternatives or limitations offered.

R110-096 The practice shall assess whether intended users can identify a material claim and its source, distinguish assessment from institutional decision, find relevant uncertainty or alternatives, recognize

revision and view limits, and locate the permitted challenge route. Assessment shall record tasks, users or representative role, observed barriers, assistance, and limits.

R110-097 Where a presentation fails a material intended task, the practice shall provide an accessible alternative, correct the presentation, narrow the supported use, or report an unresolved limitation. Successful file rendering or text extraction shall not be reported as demonstrated user comprehension.

11 Assessment and claims

11.1 Declaration and subject coverage

R110-032 A report shall identify the assessed subject, versions of this draft and its dependencies, purpose/profile, applicable requirements, assessor, method, evidence, results and unresolved limitations. Package-only results shall not be presented as assessment of unobserved practice.

R110-033 The report shall distinguish fulfilled, not fulfilled, not assessed and not applicable results for each requirement, with reasons for exclusions. A failed or unassessed applicable requirement shall prevent an unqualified claim that the declared scope satisfies this draft.

R110-034 The report shall distinguish structural or documentary checks from tests of understanding, evidential warrant and institutional performance. It shall not infer truth, complete historical recovery, beneficial generativity or legal validity from structural fulfillment.

R110-098 Before assessment, the assessor shall identify the package baseline, recording practice, purpose, period and environment, applicable requirements, incorporated GR-100 and GR-200 versions, protection limits, assessor competence and interests, and the methods in Annex B to be used. The declaration shall distinguish planned from completed assessment.

R110-099 An unqualified claim for the declared GR-110 scope shall require evidence for all applicable package and practice obligations, including the full applicable GR-200 package dependency. A successful documentary subset or absence of reported failures shall not establish that unobserved practice was performed.

R110-100 A package-only or otherwise partial assessment shall identify the exact assessed subset, methods and evidence, excluded practice claims, and dependency limitations. It shall not use an unqualified label suggesting that the complete recording practice or a reduced conformance profile was assessed.

11.2 Methods and result rules

R110-101 The assessor shall use requirement-level evidence and discriminating cases under Annex B. Where one identifier contains materially distinct obligations, component results shall be retained so that a fulfilled component does not conceal failure or non-assessment of another. A requirement shall be fulfilled only if every applicable component is fulfilled; any failed or unassessed applicable component shall prevent overall fulfillment of that requirement.

R110-102 Fulfillment shall require evidence of the stated obligation under its applicability condition. A missing required declaration shall be reported as not fulfilled; inability to examine whether a represented action occurred shall be reported as not assessed unless adequate permitted evidence supports a result. Non-applicability shall identify the absent trigger.

R110-103 Where assessment uses sampling, the report shall identify the population, selection method, covered risks, excluded cases, and limits on extension of the findings. Cases selected only because they already appear complete shall not support a general claim about an unexamined practice.

R110-104 A dependency mismatch, unavailable required evidence, or unresolved interpretation affecting the result shall be recorded with the affected requirements and claim consequence. The assessor shall not substitute a newer dependency silently or count an unsupported exception as fulfillment.

11.3 Reassessment and change

R110-105 A material change to purpose, claim set, generative account, category, protection, custody, presentation, or dependency shall trigger review of affected assessment results. The new report shall identify what was reassessed, what remains supported by prior evidence, and what can no longer be claimed.

The assessment concerns the declared scope. It does not establish that the package contains every important historical fact or that every recorded interpretation is correct. A requirement to preserve uncertainty can be fulfilled while the underlying generative attribution remains contested.

Annex A

(normative)

Semantic information schedule

A.1 Application

R110-106 The recording practice shall provide the semantic information in Table A.1 when its stated trigger applies, by content in the package or a permitted reference to identified material. The schedule shall be implemented without treating its labels as mandatory serialization field names or ontology classes.

R110-107 For each scheduled information group, the package shall identify its applicable subject, version, source or responsible actor, temporal scope where relevant, access status, and relationship to the material claims it supports. Information shared across records may be referenced when the intended scope and target remain unambiguous.

A.2 Information groups

The table specifies semantic content rather than a database schema. An embedded document can supply several groups, but their meanings and responsible sources remain distinguishable.

Table A.1 – Semantic information and applicability

Group	Trigger and subject	Required meaning and relationships
Package context	Each package.	Identity/version; purpose and intended users; subject and boundary; horizon; inventory; selection and omissions; responsible practice; declared dependencies and assessment status.
Source and capture	Material incorporated or transformed.	Source and received form/version; acquisition or creation; capture method; production context; derivation; transformation and known loss; permitted use and verification limits.
Material claim	Reliance within the declared purpose.	Attributed assertion, target, scope and status; grounds, method, alternatives, uncertainty and revision through the applicable GR-200 package; link to the relied-on version.
Identity and time	Identity or timing material to interpretation.	Record/version identity separate from subject identity; continuity criterion and grounds; competing identification; occurrence, observation, capture and assessment times with supported resolution and uncertainty.
Generative account	A generative connection is represented.	Target; candidate configuration and contribution role; earlier or comparison condition; proposed link and grounds; scale/horizon; modality; alternative contributors; known unobserved links and limits.

Group	Trigger and subject	Required meaning and relationships
Carrier and branch	Delay, transmission, or branching is material.	Carrier or persisting condition and transformations; intervening influences; pathway opening, selection and stabilization where distinct; branch-specific evidence and uncertainty.
Alternative and possibility	Alternative or changed accessibility asserted.	Whose option; relevant period and conditions; contemporaneous, retrospective or modeled basis; feasibility grounds; changes in access, cost or viability; unexamined options and comparison limits.
Category or method change	A change alters interpretation.	Earlier/later formulations, author or authority, effective period, rationale, correspondence and loss; distinction among new knowledge, revised description and a changed situation.
Maintenance and loss	Material sustaining work or loss within scope.	Capacity or relation sustained/depleted; continuing conditions/work; affected subjects and horizon; kind and evidence of loss; permitted collection limits; evaluation separately attributed.
Practical uptake	Decision or action relies on represented material.	Relied-on version; receipt versus reliance; authority assertion; decision and reasons; intended versus implemented action; anticipated versus observed effects; feedback and disposition.
Revision and challenge	Correction, reinterpretation or request occurs.	Target and prior version; actor/time; reason; permitted request and reply; revised or maintained assessment; known dependents; notification/propagation limits; separate practical remedy.
Protection and custody	Each maintained package and controlled operation.	Purpose and authority basis; custodian; content/metadata/view controls; retention/review triggers; unavailable-information status; transfers, losses, disposal and permitted execution evidence.
View and assessment	A view or assessment is supplied.	Source baseline; audience and purpose; selection/mediation; limits and update status; assessor/method; applicable requirement and component results; dependency status; excluded claims.

A.3 Absence, uncertainty, and restrictions

R110-108 An absent scheduled element shall be distinguished as not applicable with a trigger-based reason, unknown, not collected, lost, destroyed, restricted, or otherwise unavailable only where that status is supported and permitted. An unavailable contextual factual value, including historical capture time or source-production context, may be represented by such a typed declaration identifying the responsible or attributing role, known reason, and effect on interpretation or assessment. Package and record references

and versions, purpose and scope, accountable recording role, and relationship locators needed to identify asserted claims, contributions, assessments, and revisions shall not be replaced by unknown values. Required reasoning, criteria, and results of the package's own assessment shall remain explicit. Fulfillment of a contextual declaration obligation shall not establish the unavailable fact or fulfillment of an examination or action that could not be performed.

Annex B

(normative)

Requirement assessment schedule

B.1 Method and evidence register

R110-109 The assessor shall maintain a register for every applicable requirement, including R110-106 through R110-111, with subject/version, trigger, method, evidence locator, assessor and competence, component results, overall result, limitations, and needed action. The register shall use the discriminating assessment families in Table B.1 and identify any justified equivalent method.

Inspection examines the actual package and controlled records. A competent content review examines the grounds and distinctions asserted; it does not certify all historical truth. An observed task tests what the practice or user actually does under identified conditions. A lifecycle exercise uses authorized fixtures to assess access, revision, transfer, or disposal. Synthetic exercise results remain separate from evidence of live institutional action.

B.2 Assessment families

Table B.1 – Assessment families and discriminating outcomes

Requirements	Method and evidence	Outcome distinguishing fulfillment from failure
001–004, 035–041	Inspect scope, selection, inventory, accepted roles, resources, and maintenance record.	Boundary and omissions are explicit; no complete-history claim or automated substitute for missing responsibility.
042–045	Trace captured and derived material to its source and inspect transformations.	A summary and repeated copies remain distinguishable from the source and independent corroboration.
005, 046–047	Reconcile material-claim inventory with the complete applicable GR-200 package assessment.	Relied-on claims and package obligations are covered; isolated claim checks do not stand for the dependency.
006–009, 048–050	Compare disputed identity, an uncertain interval, and a historical category against their records.	Record identity, continuity judgment, time uncertainty and retrospective interpretation remain distinct.
010–012, 014, 051–056	Review a target and attributed contribution with an alternative explanation or unobserved link.	Occurrence, mechanism, association, counterfactual and model-based grounds retain their respective strength and limits.
057–060	Follow a delayed or multi-link account and examine a claimed persistence mechanism.	Uncertain carriers or downstream links remain uncertain; persistence alone does not establish lock-in.
013, 061–062	Examine collective/disputed attribution, branch contributions, and a separate credit or rights claim.	No forced sole attribution or automatic ownership/entitlement; branch formation and realization remain distinct.

Requirements	Method and evidence	Outcome distinguishing fulfillment from failure
015, 063–066	Compare a contemporaneous alternative and a retrospective proposal, including practical access.	Historical availability, imagination, permission and feasible access are not conflated.
016, 067–068	Reconstruct a change of category and an earlier account under its original information.	A revised description does not silently create a past object or erase the prior semantics.
017, 069–072	Review sustained capacity, record loss, and different effects across groups or horizons.	Maintenance remains visible; loss kinds and normative evaluations are separately grounded.
018, 073	Inspect any return account and its measurement or entitlement basis.	Concept, observed transfer, evaluation and legal assertion remain distinct; non-assessment is explicit.
019, 074–081	Trace decision, implementation, intended effects, feedback and a corrective action.	Receipt is not reliance; implementation is not beneficial effect; record correction is not completed repair.
020–023, 082–083	Exercise the permitted challenge route and inspect linked revisions and requests.	Earlier grounds survive within retention limits; conflicting requests remain attributable; propagation claims have evidence.
024–026, 084–088	Inspect authority, purpose, permissions, protected views, retention and unavailable information.	Required distinctions remain interpretable without disclosing protected content or inventing an absence reason.
027–028, 089–092	Exercise an authorized migration or lifecycle action and compare source/destination meaning.	Loss, failed steps, access control, disposal evidence and uncontrolled copies are correctly reported.
029–031, 093–097	Perform stated reader tasks using the actual view and available assistance.	Users can locate grounds and challenge routes; untested comprehension and inaccessible features remain limitations.
032–034, 098–111	Inspect the scope, complete result register, dependencies, methods and change review.	Failed/unassessed obligations prevent an unqualified claim; package-only and synthetic evidence remain bounded.

B.3 Execution and result integrity

R110-110 An exercised assessment shall record initial conditions, input and output versions, relevant permissions, performed steps, expected discriminating outcome, observed result, interruptions, and limitations. A described fixture or expected outcome without execution shall be recorded as a planned test rather than observed fulfillment.

R110-111 The assessor shall state the requirement-level consequence of each material failed task, inconsistent record, unavailable evidence item, or unresolved dependency. A remedied result shall retain the earlier finding, corrective action, new evidence, and remaining limit; a favorable summary shall not

conceal it.

Annex C

(informative)

Worked recording cases

C.1 Contested funding decision

This synthetic case concerns a public research fund that rejects an application after an AI-assisted summary treats missing calibration metadata as evidence that calibration did not occur. The community applicants later provide testimony and a restricted maintenance log. The package contains the initial claim and its grounds, the inference from missing information, the decision that relied on it, the challenge, authorized examination of the log, and the subsequent assessment.

The revised factual assessment is distinct from the institution's decision whether to reconsider funding. A separate classification review examines whether the original scoring categories excluded relevant knowledge. The public view identifies permitted limits on the log without publishing protected content. A reader can distinguish the old judgment, current assessment, policy question, and pending practical response.

A documentary check can assess these distinctions in an authored package. Testing the practice additionally requires observing the contact route, authorized access, notifications, and reader tasks. The synthetic case does not establish that a real institution changed its decision or that interrupted research capacity was restored. The existing fixture is `examples/p1-contested-decision.md`.

C.2 Maintenance, delay, and distributed contribution

A synthetic laboratory collaboration produces little new output during a year of instrument maintenance, training, and preserving shared access. A later discovery relies partly on those capacities. The account separates evidence that the maintenance occurred, its role in sustained capacity, the later discovery, and the attributed connection between them.

Training, functioning equipment, and retained procedures are possible carriers in the account. Their supported roles can differ, and the discovery can also depend on later collaborators or changed methods. No mandatory percentage allocation follows. An earlier contributor's loss of access remains visible even if the aggregate output increases. Recognition or compensation proposals require their own evaluative and institutional grounds.

C.3 An alternative that became visible later

An archive contains a proposal rejected under historical eligibility rules. Years later, a new category makes its significance easier to recognize. The reconstruction preserves the earlier categories and decision context, the later interpretive method, and evidence concerning options actually available at the earlier time.

The new account can be better supported without implying that the earlier actors possessed the later concept. An alternative technologically imaginable today is labelled retrospective unless period-specific evidence supports historical availability. A claim that the original choice caused lock-in needs evidence of changed transition conditions, such as accumulated dependencies or switching costs, rather than the persistence of the chosen arrangement alone.

C.4 Migration and loss of interpretation

A synthetic custodian exports a package into a format that preserves current claims but omits former versions and uncertainty in temporal ordering. The files transfer successfully. Assessment nevertheless

identifies loss relevant to reconstruction and treats the destination as a reduced representation.

A repair can preserve the missing relationships in an accompanying dossier without requiring one prescribed schema. The migration record identifies the source, transformed representation, remaining loss, and accepted custody. If the earlier source cannot be retained under applicable permission, the package states the resulting limitation rather than implying lossless preservation.

Annex D

(informative)

Foundation interpretation and unresolved issues

D.1 Source-to-proposal relationship

FM-005 section 5.13, pp. 105–113, develops target-relative generative attribution through association, mechanism, counterfactual reasoning, multiple contribution, distributed organization, delay, branching, and emergence. R110-051–R110-062 translate this into attributable recording of a proposed connection and its limits. The standard does not turn every account into a warranted attribution merely because the required information is present.

FM-005 section 5.14, pp. 113–122, distinguishes relational continuity from chains of generative contribution and treats path dependence, genealogy, historical evidence, alternatives, and re-epistemization. R110-049–R110-050, R110-057–R110-060, and R110-063–R110-071 preserve those distinctions operationally. The term possibility-field account denotes a bounded representation; it does not redefine the broader theoretical possibility field.

FM-003 section 3.12, pp. 129–141, treats praxis through diagnosis, enabling and constraining conditions, intervention, downstream tracing, feedback, adaptation, withdrawal, reversal, and repair. R110-074–R110-081 record the corresponding distinctions where they occur within scope. The source's sequence is heuristic; this draft does not impose one intervention lifecycle on every archive or practice.

D.2 Open conceptual and implementation questions

OPEN ISSUE The programme has not established a universal measure of generativity or generativity return, a mandatory causal-identification method, or exhaustive minimum historical coverage. Purpose-specific burden and usefulness require pilot evidence.

OPEN ISSUE The relation of Property to the metamodel manuscript's Attribute and the chronology of the two Chapter 3 files remain unresolved. This draft retains operational terminology without claiming that the variants are identical or that one supersedes the other.

OPEN ISSUE No common serialization, permanent identifier service, certification scheme, or full presentation/access profile is selected here. Reusable implementation needs enter separate Specification work items; limited assessment does not acquire full conformance by naming a future profile.

OPEN ISSUE The required evidence for effective practical repair, independent implementation, and sustained human comprehension remains use-context dependent. An initial synthetic exercise can expose missing procedures but cannot demonstrate those outcomes generally.

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[3] FM-005. *Epistemology of Generative Relational Economics*, sections 5.13–5.14, pp. 105–122, directly examined for this edition. `foundation_manuscripts/GRE_Chapter_05_Complete_First_Draft.pdf`. Its formulations of attribution, contribution roles, carriers, trajectories, historical evidence, and re-epistemization inform the scoped operational proposals.

[4] FM-003. *Constitution and Research Programme of Generative Relational Economics*, section 3.12, pp. 129–141, directly examined for this edition. `foundation_manuscripts/GRE_Chapter_03.pdf`. FM-002 is the separately retained complete-first-draft variant; precedence is not inferred.

[5] ISO. *Model International Standard*, third edition, 2023. https://www.iso.org/iso/model_document-rice_model.pdf. Informative structural model only.

[6] United Nations. *National Quality Assurance Frameworks Manual for Official Statistics*, 2019. https://desapublications.un.org/publications/united-nations-quality-assurance-frameworks-manual. Informative comparison for assurance across processes and outputs; official-statistics authority and requirements are not incorporated.

GENERATIVITY STANDARDS PROGRAM

GR-200

Standards-track Working Draft

Version 0.2 2026-09-22

Epistemic Recording Framework

WORKING DRAFT FOR REVIEW

This document contains proposed provisions for technical and institutional review. It is not an adopted Standard or an operative governance instrument. Its scope, application conditions and publication status are specified in the text.

Prepared by the Generativity Standards Program. Reference to external publications does not imply endorsement by ISO, IEC, IEEE or any United Nations body.

Foreword

Responsible editor: UNASSIGNED.
Canonical source: `standards/GR-200-epistemic-recording/GR-200.tex`

This document is a standards-track Working Draft of the Generativity Standards Program. Its maturity is **PREPARATORY; PROVISIONAL**. It contains proposed requirements for review and experimental assessment, not an adopted Standard, a formally initiated project or an institutional or legal authorization. Governance adoption, editor appointment, work-item approval, review and final publication require separate recorded decisions.

Edition 0.2 develops the initial framework into a fuller requirements document. Existing identifiers E200-001 to E200-026 retain their meanings; additional requirements specify claim structure, evidential context, uncertainty, revision, mediated use and assessment. Annexes A and B are normative within the proposed draft. The remaining annexes and bibliography are informative. Historical edition 0.1 is preserved rather than rewritten.

The publication follows a structured requirements format with scope, dated references, numbered terms, operational requirements, conformance and annexes. It does not claim ISO, IEEE, ITU or United Nations approval or affiliation. Conceptual sources inform the distinctions; resemblance of publication structure does not establish conformance with another body's development procedure.

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Introduction

A representation can be authentic while its substantive content is mistaken. A classification can be applied consistently while failing to represent the situation relevant to a decision. A corrected record can improve current knowledge while leaving practical consequences of the earlier judgment unresolved. These are different problems, and a single verified-fact status cannot preserve their differences.

This document addresses the recording conditions for examining such problems. The epistemic record package links assertions, attributed sources, observations and reasoning, material, evidence roles, assessments, uncertainty, challenges and revisions. It supports inquiry into actual, possible, hypothetical and disputed targets without assigning all of them the same epistemic status. It records grounds for an assessment without prescribing one universal method of reaching substantive truth.

The programme's wider purpose concerns generativity: how relations and activity create, maintain, transform or restrict subsequent conditions and possibilities. The existence of a relation and an outcome does not establish the contribution linking them. Similarly, institutional uptake does not establish evidential warrant, and the ability to record a challenge does not establish effective access to review. Requirements for representation and requirements for institutional practice therefore remain connected but distinct.

The framework is deliberately independent of serialization. A small narrative dossier can distinguish claim versions and evidential roles through stable local references. A larger implementation can use structured objects or qualified statements. Choosing an encoding does not justify erasing an alternative, merging an unresolved identity or hiding an assumption. Specifications are developed when reusable implementation needs emerge from these requirements.

1 Scope

1.1 General

This draft defines the minimum information needed to examine who asserts what about a target, through which observations and reasoning, on which material, within what scope, with what uncertainty, and with what history of assessment and revision. Its organizing problem is the separation of a convincing or authentic representation from a warranted account of the represented situation.

The requirements concern a declared *epistemic record package*, which can include records, claim references, source locators, assessments, and protected components. The package can be textual, tabular, or implemented in software. This draft does not choose between claims as separate objects, attributed assertions within records, or a hybrid. A claim reference can be a local label and locator; it need not be a globally registered identifier.

GR-100 version 0.2 supplies the draft vocabulary. GR-110 adds requirements for generative trajectories and practical consequences. GR-210 is intended to govern the practice of assessment, challenge, and disposition. This document records those activities when present; it does not substitute a complete adjudication process, guarantee an appeal right, or set an evidential sufficiency threshold for every domain. GR-160 and GR-400 are intended to elaborate protection and institutional use. None of these drafts creates jurisdiction, a legal duty, or factual certainty.

2 Normative references

2.1 Dated draft reference

The following referenced document supplies this edition's operational meanings: Generativity Standards Program, *GR-100 — Foundations and Vocabulary*, Standards-track Working Draft, version 0.2, available at `standards/GR-100-foundations-vocabulary/GR-100.tex`. The incorporated scope is Clause 3's terms, Clause 5's record-role meanings when used, and the result-category meanings in 8.3. This reference does not impose a separate claim of GR-100 vocabulary-application conformity. It is a dated draft dependency, not an adopted Standard. If an incorporated meaning is unavailable or incompatible, the affected assessment is not assessed until the dependency is resolved. A later GR-100 edition does not silently change the meanings used here.

2.2 Other publications

There are no external normative references. GR-110 and GR-210 identify coordinated recording and procedural work, but their requirements are not imported into GR-200. A report claiming conformity to more than one publication identifies and assesses each dependency separately. Foundation manuscripts and external drafting models in the bibliography are informative.

3 Terms and definitions

3.1 General

The terms in GR-100 Working Draft 0.2 apply. The following terms specify their use for this document. These information structures are semantic recording units; they do not introduce new metaphysical classes or determine whether an implementation uses objects, wrappers or attributed statements.

3.2 Epistemic record package

An identified and versioned collection of claim content and linked context assembled for a declared inquiry, practical use and collection boundary, with an inventory or selection rule, responsible role and access scope.

3.3 Included claim

A claim designated as part of the assessed package, rather than merely occurring within an external source cited by it.

NOTE 1 Assertions attributed to another source remain assertions to be examined, not endorsements by the package owner.

3.4 Material information

Information capable of changing a reasonable examination of the declared claim, its warrant or its consequential use.

NOTE 2 Materiality is relative to the declared purpose; its selection rationale is inspectable and does not establish truth.

3.5 Claim reference

A designation that distinguishes an assertion and its version within the package.

NOTE 3 It supports links to evidence and assessment without itself establishing target identity or prescribing a globally registered identifier.

3.6 Material item

An identified source, portion, pattern or result proposed for use in an inquiry.

NOTE 4 It can be a trace, testimony, observation, record, comparison or intervention result. Its inclusion does not establish an accepted evidential role.

3.7 Evidence-role assignment

An attributed relationship between identified material and a specified claim, together with an assessment of relevance, limitations and alternatives.

NOTE 5 Supporting, challenging, qualifying and non-discriminating roles concern that relationship rather than an intrinsic status of the material.

3.8 Assessment record

An identified account of a question examined, the criteria and material used, the responsible assessor, timing, result, uncertainty and limitations.

NOTE 6 An assessment record can itself become a target of a later claim or challenge.

3.9 Dependency

A stated relationship through which a claim, assessment, representation or action relies on another identified item or version.

NOTE 7 Derivation, inferential reliance, shared-source dependence and practical uptake have different meanings and are identified separately where material.

3.10 Coverage statement

An account of the scope within which observation, collection, source examination or assessment was performed, including known omissions and exclusions.

NOTE 8 Coverage does not necessarily coincide with the scope of a substantive target claim.

3.11 Negative-evidence claim

A claim whose grounds include nonappearance of an expected trace.

NOTE 9 Its warrant depends on stated production, detection, coverage and preservation conditions; a missing value alone does not establish non-occurrence.

3.12 Transformation record

An account of a material change between a source representation and a resulting representation, identifying the input, output, operation, responsible role and known preservation or loss of meaning.

3.13 Released view

A representation selected from a package for a specified audience and purpose under stated access and disclosure conditions.

NOTE 10 Its completeness and inspectability are assessed against its declared boundary, not assumed from its source package.

3.14 Epistemic context

The attributed observations, methods, assumptions, evidential roles, uncertainty, perspective and temporal and descriptive scope required to interpret a claim.

NOTE 11 Shared context can apply to several claims when the inheritance and any exceptions are explicit.

4 Package declaration and recording boundary

4.1 General

The conformance subject is one named, versioned epistemic record package within a declared purpose, collection boundary, and access scope. Requirements apply to its included claims and assessments, with conditional requirements triggered by the relevant activity. An external source is not required to satisfy these rules merely because it is cited; the package's assertions about it and uses of it are within scope.

E200-001 The package shall declare its reference and version, responsible recording role, intended use, target and collection boundary, included claim set or selection rule, access scope, relevant descriptive regime, and the GR-200 draft version used. It shall identify exclusions and limits that materially affect interpretation.

E200-002 The package shall associate every requirement with an assessment result and an evidence locator. A claim of conformity to this draft shall identify its package boundary and applicable requirement set, and shall disclose failures, unassessed requirements, and restrictions that prevent assessment. It shall

not represent technical or recording conformity as proof of factual truth, evidential sufficiency, ethical acceptability, or legal validity.

An assessment result is fulfilled, not fulfilled, not assessed or not applicable with a reason. Only requirements whose stated trigger is absent can be marked not applicable. A package with failures or unassessed applicable requirements can report partial assessment, but not full conformity. This draft has no certification or accreditation scheme.

"Material" in this document means capable of changing a reasonable examination of the declared claim, its warrant, or its consequential use. The package's selection rule states how materiality was judged. Unknown, not collected, withheld, lost, and inapplicable can be explicit informational states where a value is unavailable. They disclose a limitation rather than establish the unavailable value or a substantive negative conclusion.

4.2 Semantic units and shared context

E200-027 The package shall provide the applicable information in Annex A for its declaration, included claims, material items, evidence-role assignments and assessments. Information supplied through shared context shall have an identifiable scope and version, with claim-specific exceptions explicit. A reference shall resolve within the declared assessment arrangement or carry an availability limitation.

These units need not be separate software objects. A table row can contain a claim and refer to shared acquisition context; a narrative passage can identify an assessment and its sources. E200-027 requires an inspectable association without reliance on undocumented assumptions. Reusing one context statement is acceptable when it actually applies to the linked claims. A package-wide uncertainty statement cannot conceal a material difference between a direct observation and a distant reconstruction.

External sources do not enter the assessed claim set merely because every sentence in them is quoted or stored. The package distinguishes the source material, the claim that the source contains a statement and any adopted substantive assertion. The resulting collection boundary is finite and declared. It is not a requirement to reproduce or assess every upstream publication, every possible objection or the entire history of an institution.

An assessment of this document can be recorded in a linked report outside the substantive claim set under examination. The report identifies the exact subject package and edition. Its statements about conformity do not automatically become evidence for the package's substantive claims.

5 Claim content, attribution and method

5.1 Claim identity and content

E200-003 Each included claim shall have a reference that distinguishes its content and version within the package, stated assertion content, an identifiable target or an explicit unresolved target description, and a link to its recording context. Different assertions or versions shall remain separately referenceable where their attribution, grounds, or disposition differ.

5.2 Attribution

E200-004 Each claim shall identify its represented originating actor or source and the role responsible for entering it into the package. Where these differ, the attribution chain shall distinguish origin from transcription, quotation, translation, summary, or adoption. Unknown, pseudonymous, restricted, or disputed attribution shall be explicit.

5.3 Modes and modality

E200-005 Each claim shall state its epistemic mode and relevant perspective: for example observation report, testimony, inference, interpretation, retrospective reconstruction, hypothesis, simulation, or normative or institutional judgment. Combined modes shall identify the distinct contributions rather than present inferred content as directly observed. A claim about an occurrence or possibility shall distinguish its asserted actuality or modality from its epistemic basis; retrospective inference can concern an actual occurrence.

5.4 Method and reasoning

E200-006 Each claim shall identify its acquisition or reasoning method, material premises and assumptions, relevant method version when one is used, and known transformations from source material to assertion. Where this information is unavailable, the package shall state the limit and shall not claim reproducibility or direct observation on that basis.

5.5 Boundary and scale

E200-007 Each claim shall state the boundary, scale or level of aggregation, contextual conditions, and temporal horizon relevant to its interpretation. It shall identify known omissions or selection conditions that materially limit generalization. A narrowed scope shall not be silently presented as a claim about a broader target.

5.6 Temporal scope

E200-008 Each claim shall distinguish target time from the times of observation or source acquisition, recording, and assessment where applicable. Time values shall carry their applicable meaning and known uncertainty or resolution. Unknown order shall remain distinguishable from asserted simultaneity and from recording order.

5.7 Target identity

E200-009 A claim that reidentifies a target across appearances shall identify the identity criterion, the appearances linked, the responsible attribution, and the evidential basis or stipulation. A proposed split, merger, succession, or disputed match shall not silently merge record identity, target identity, and lineage.

NOTE 1 A testimony can be preserved without claiming its reporter is infallible. Requiring attribution does not require public disclosure of a protected person's name. A role or pseudonymous reference, its protection status, and an accountable custody arrangement can provide the appropriate recording context.

5.8 Compound claims and qualifiers

E200-028 Where one expression contains assertions with materially different targets, attribution, temporal scope, modality or evidential grounds, the package shall distinguish the components and their qualifications sufficiently for separate assessment and revision. A conjunction or summary shall not silently transfer warrant from one component to another.

The expression "the meeting occurred and secured lasting cooperation" contains an occurrence claim and a claim about a later relational effect. Evidence for attendance might support the first while leaving the second unresolved. The components can remain in one document if their references and qualifications are distinguishable. The requirement does not demand logical atomization of every sentence; it applies where shared wording would otherwise conceal a material difference.

5.9 Relayed speech, quotation and translation

E200-029 Where a claim is quoted, translated, paraphrased or relayed, the package shall distinguish the attributed source expression from the recorder's rendition or interpretation, identify the available source context and material transformations, and state uncertainty about attribution or meaning. A quotation's presence shall not be treated as endorsement by its recorder.

A testimony can identify an experience available to a situated participant while leaving causes or other participants' intentions unresolved. A summary can be accurate for one question while omitting qualifications needed for another. Selection, transcription, translation and interpretation can each affect the path from source to assertion. The package records the relevant path instead of claiming that the reported wording is an unmediated view of the target.

5.10 Observation and acquisition context

E200-030 For an observation or measurement claim, the package shall identify the observer or acquisition system, observed feature, method, relevant instrument or procedure version, observation window and conditions materially affecting recognition, detection or recording. Known limitations in coverage, resolution or calibration shall be stated where relevant to the claim.

This requirement is proportional to the claim. A report that an inscription was seen can cite the observer and inspection context without manufacturing a quantitative measurement protocol. A measurement claim can require units, resolution and an instrument procedure. The package does not imply that a larger dataset removes selection effects or that an automated observation lacks an observer position.

5.11 Inference and reconstruction

E200-031 For a material inference or reconstruction, the package shall distinguish its asserted premises, adopted assumptions, inferential steps needed to examine the conclusion and material unresolved alternatives. An assumed premise shall not be represented as an observed input, and a mathematically possible history shall not be presented as an evidenced occurrence sequence without additional grounds.

An inference can be qualitative, historical, comparative, statistical, computational or mixed. The requirement is an inspectable connection between premises and conclusion, not a universal proof calculus. A researcher can identify a plausible contribution while remaining unable to establish causal sufficiency. A formal model can show consistency under its assumptions without establishing that its stipulated subjects and operations describe the actual case.

6 Material, evidence and uncertainty

6.1 Material identification

E200-010 For each material item invoked in support of, against, or to qualify a claim, the package shall identify the item or pattern, its relevant portion, source or acquisition path, and availability status. It shall distinguish original material, copies, derived representations, and generated material where those differences affect the claimed use.

6.2 Claim-relative evidential roles

E200-011 Each assigned evidential role shall link the material to a specified claim and identify the assessor or attributing source, assessment time, role, and rationale addressing relevance, reliability limitations, and material alternative explanations. An item with no assessment shall be marked unassessed rather than silently represented as accepted support.

The role can be supportive, challenging, qualifying, non-discriminating, or another defined relationship. A single item can support one claim and challenge another. The package need not impose a ranking across all evidence forms.

6.3 Dependence and corroboration

E200-012 Where multiple items are used together as evidence, the assessment shall identify known material derivation or dependence among them and the basis for any asserted independence. Repeated copies, summaries, or citations of one source shall not be presented as independent corroboration solely by their count.

6.4 Absence and non-occurrence

E200-013 A claim of absence or non-occurrence inferred from missing observations or records shall identify the expected observation or recording opportunity, coverage, detection or preservation limitations, and reasoning from the missing material to the claim. If those conditions are not established, the package shall preserve the weaker missingness statement and shall not treat it as established non-occurrence.

6.5 Uncertainty

E200-014 Each claim assessment shall describe material uncertainty and its location, including relevant alternatives, assumptions, identification limits, measurement limits, temporal gaps, or boundary and model limitations. A numerical confidence quantity, if used, shall state what it measures, its method and assumptions, and the scope of its interpretation.

6.6 Competing explanations

E200-015 The package shall record material competing claims or explanations known within its declared collection boundary, their attribution, their relationship to the target claim, and any recorded grounds for excluding or preferring them. If alternatives were not examined, this limitation shall be explicit; silence shall not be presented as evidence that no alternative exists.

An alternative need not receive equal evidential weight merely because it is recorded. Recording a disagreement does not mean that it remains unresolved after a reasoned assessment. The disposition and its grounds remain visible, and an attributed rejected interpretation can remain historically consequential.

6.7 Formation, selection and survival of material

E200-032 Where the production, selection, custody or survival of material affects an assigned evidential role, the assessment shall record the relevant known conditions and gaps, including selective preservation or inaccessible channels. A hypothesis of concealment shall have stated grounds and shall not be inferred solely from missing evidence.

An archive contains what was produced, captured, retained, made accessible and recognized as relevant. Failure at any stage can alter the evidential field. A missing complaint has different implications when a reporting route was usable, when it was dangerous to use, or when submissions were not retained. The package records what is known about those conditions rather than assigning one universal evidential weight to silence.

6.8 Transformation and derived material

E200-033 A material transformation relied on in an assessment shall identify its source and output versions, operation, responsible role and known effects on meaning or inspectability. Extraction, redaction, normalization, deduplication, imputation and generation shall remain distinguishable where their differences affect the claim. Supplied or inferred values shall not be represented as original observations.

A copy can preserve substantive content while changing its custody context. A redaction can protect a person while removing context important to interpretation. A transcript can make a recording searchable while introducing uncertain wording. None of these operations is inherently disqualifying. Their role and limits need to be visible to the assessment that relies on them.

6.9 Combination, aggregation and independence

E200-034 Where a claim relies on combined or aggregated material, the assessment shall state the included units, inclusion and exclusion rules, relevant denominators or weights, and known changes of composition. A claim about independent corroboration, stable population or comparable periods shall identify its basis rather than follow solely from a count, common label or shared format.

Several individually weak traces can jointly constrain a claim when their production paths differ in relevant ways. The opposite is also possible: many records can reproduce the same source, coding rule or institutional selection effect. Neither volume nor diversity of file formats establishes independent evidential pathways. Known dependence remains visible even when its precise quantitative effect cannot be estimated.

6.10 Comparability of uncertainty statements

E200-035 A comparison, aggregation or transfer of confidence quantities or qualitative grades shall state the meanings, assessed claims, scopes, methods and assumptions that support comparability. Incomparable dimensions shall not be silently combined into a universal score. Strong warrant in one dimension shall not erase a material unresolved limitation in another.

Confidence in an occurrence can exceed confidence in a causal attribution or long-term consequence. A numeric model score can concern a prediction conditional on its training and observation regime, while an assessor's confidence concerns a broader institutional claim. Shared numerical range does not establish shared meaning. A package can retain dimensional qualitative assessments without inventing probabilities or forcing all disagreements onto one scale.

6.11 Alternatives and limits of examination

E200-036 The assessment shall distinguish an alternative examined and rejected with grounds, an alternative retained as plausible, and an alternative not examined. Where a conclusion depends materially on boundary, scale, population, method or descriptive-regime choice, the assessment shall identify that dependence and any comparison actually performed. An unperformed sensitivity or alternative analysis shall not be described as completed.

Alternatives can compete for the same explanatory role or concern different parts of a composite process. A rule, network and resource condition can each contribute without being interchangeable explanations. Recording them does not require equal weighting or an exhaustive catalogue. It requires the package to disclose the comparison it actually makes and where a claim exceeds that comparison.

7 Assessment, revision and practical use

7.1 Assessment questions and criteria

E200-016 Each assessment or determination shall identify its question, responsible assessor or decision role, criteria, material examined, result, date, limitations, and relationship to the assessed claim versions. Provenance/authenticity, factual warrant, institutional acceptance, normative evaluation, legal determination, and technical validation shall remain distinguishable assessment functions.

7.2 Substantive revision

E200-017 A substantive revision shall link the prior and revised claim or assessment versions and record who revised it, when, why, and which content or scope changed. The reasons shall distinguish target change, evidence or assessment change, and descriptive-regime change, allowing combined reasons. Historical access shall preserve earlier meaning to the declared retention and protection extent; any unavailable earlier content shall have an explicit reconstruction limitation.

7.3 Descriptive-regime change

E200-018 A change of descriptive regime shall identify the prior and new definitions or methods, grounds for change, affected claim set, and any mapping or transformation used. It shall identify known non-comparability, lost distinctions, or unresolvable mappings; finer classifications shall not be reconstructed from insufficient earlier material as if evidenced.

7.4 Dependent records and actions

E200-019 For a revised claim with known dependent assessments, claims, or consequential uses within the package boundary, the package shall identify those dependencies and record whether each was reviewed, updated, left unchanged with reason, or remains pending or unreachable. It shall not claim that external recipients or institutions have corrected their actions without evidence of that correction.

7.5 Practical uptake

E200-020 Where the package records practical uptake of a claim, it shall distinguish the claim, its assessment, the institutional or other action, the actor responsible, and the asserted basis for acting. Recorded consequences and proposed remedies shall remain separately attributable from the original grounds and intended effects.

7.6 Challenge and disposition records

E200-021 For a challenge received within the package's declared collection boundary, the package shall record the challenged claim version, challenger or protected source reference, grounds and submitted material, receipt context, and current status. A disposition shall record the responsible role, response, reasons, date, unresolved disagreement, and resulting changes or the reason for no change. A challenge without disposition shall remain visibly pending or otherwise explicitly unresolved.

This clause addresses the record of a challenge. Routes for submission, notification, review independence, timeliness, appeal and remedy are procedural matters addressed in the coordinated GR-210 draft and relevant institutional profiles. Their effectiveness requires separate assessment. Merely supplying challenge fields does not demonstrate that a person can effectively contest a decision.

7.7 Criteria, status and temporal validity of an assessment

E200-037 An assessment shall identify the version and scope of its criteria and distinguish the date of examination, the evidential state examined and any stated period or condition of applicability. A later change of criteria or available evidence shall not silently change the recorded meaning of an earlier result.

Supported, rejected, qualified, unresolved and not examined have different meanings when applied to a claim. A procedural status such as closed concerns the case process rather than the claim's truth. An institution's acceptance can authorize an internal action while the underlying evidential assessment remains qualified. The package records these distinctions instead of using one status field as a substitute for them.

7.8 Version identity and concurrent interpretation

E200-038 Where more than one revision or interpretation of the same earlier item is retained, the package shall identify their predecessor relationships, responsible sources and whether a preferred current version has been designated within a stated scope. It shall preserve material unresolved branches and shall not treat latest recording time alone as evidential precedence.

Version history can branch. Two reviewers can correct different parts of a description, or disagree about the interpretation of the same material. A later administrative designation can select one version for use without establishing that every competing claim has been factually disproved. The designation, its authority and its grounds remain separately identifiable.

An editorial correction that preserves meaning can be recorded as such. A changed target, evidential ground, qualification, criterion or scope requires the substantive revision context of E200-017. Replacing an artifact for formatting does not automatically create a new historical occurrence or erase the earlier asserted content.

7.9 Intervention and reflexive effects

E200-039 Where intervention, publication, observation or classification is claimed to have changed the target situation, the package shall distinguish pre-change observations, the intervention or uptake, subsequent observations and the claim connecting them. An improvement in observation shall not automatically be represented as creation of a new relation, and an intervention-produced change shall not automatically be used as evidence of the earlier unchanged situation.

Discovery and creation can coexist. A new reporting route can reveal previously unrecorded practice and alter that practice by making it visible. A revised eligibility category can change both available distinctions and subsequent access. The package can record combined reasons while preserving their different temporal and evidential bases. It does not require a counterfactual causal experiment where none exists; it records the stated method and limits of attribution.

8 Mediation, protection and layered assertions

8.1 Computational mediation

E200-022 Where computational mediation materially affects a claim's observation, classification, inference, reconstruction, or presentation, the package shall identify the system and available version, its task, supplied source material or its controlled reference, material transformations, output used, and the role responsible for uptake or review. Unavailable system details and resulting limits shall be stated. Generated output shall remain distinguishable from independent source evidence.

This requirement includes rules, statistical models, sensor processing, database transformations, and generative systems when material to the claim. It does not require exhaustive logs of unrelated operations

or disclosure of private credentials. A vendor confidence score does not automatically measure the warranted confidence in the package's substantive claim.

8.2 Protected material

E200-023 Where claim context or evidential material is restricted, the package shall identify the restriction and its asserted basis, responsible custodian or accountable role, assessment consequence, and any available route for authorized examination or challenge. A released view shall identify material omissions at a level permitted by the declared protection arrangement and shall not describe unavailable evidence as independently examined.

If even acknowledging an item is restricted, the released view can describe its assessed scope without exposing item-level existence. The protected package still needs an accountable restriction record. This clause supplies neither permission to disclose nor a legal retention rule. Where a reviewer cannot assess a required component, E200-002 requires an unassessed result; a protection reason does not turn missing verification into a pass.

8.3 Normative and ethical assertions

E200-024 A normative or ethical assertion shall identify the evaluative question, attributed evaluator, stated criteria or values, affected parties and scope, and material acknowledged tradeoffs or disagreements. It shall remain distinguishable from the descriptive claims on which it relies and shall not treat a claimed generative effect as inherently desirable.

8.4 Legal and jurisprudential assertions

E200-025 A legal or jurisprudential assertion shall identify the asserted legal concept, source or rule relied upon, relevant institutional or jurisdictional context, attributed authority, temporal applicability, and procedural status, or explicitly state which are unresolved. It shall distinguish a descriptive legal analysis, party allegation, institutional determination, model rule, and policy proposal where applicable. Recording the assertion shall not be represented as creating or confirming its legal effect.

8.5 Selected and transformed packages

E200-026 When a package is selected, summarized, exported, or transformed and the resulting package is claimed to conform to this draft, it shall preserve the attribution, claim-version relationships, epistemic qualifications, material disagreement, and access/reconstruction limits required within the resulting declared boundary. Omitted or transformed content and the resulting limits shall be identified; a partial view shall not imply completeness of the source package.

This is an implementation-neutral requirement on the resulting package. Format negotiation, transport, identifiers, validation vocabulary, and machine-readable exchange behavior belong in Specifications prompted by the demonstrated need.

8.6 Computational observation and inferred completion

E200-040 Where computational processing affects evidential coverage, identity, category assignment or missing values, the package shall identify the relevant selection, linkage, classification and completion operations and their known limitations. A generated or imputed relation shall not be presented as an independently observed relation solely because it appears in a structured output.

The term machine-mediated includes a rule-based pipeline or database transformation as well as a learned model. A system can record extensive interactions while excluding people or activities outside its infras-

tructure. A link-prediction result can be a useful candidate for inquiry while remaining an inference. An embedding similarity is not itself evidence that two people collaborated or that two records concern one target.

8.7 Reproduction and availability claims

E200-041 A claim that a material computational result is reproducible or independently reviewable shall identify the available inputs, system or method version, relevant configuration and output, and the procedure supporting that claim. Unavailable internals, changing services, inaccessible data or nondeterministic behavior shall be disclosed where they limit the asserted reproduction or examination.

This requirement does not demand secret credentials, unrelated conversation logs or an invented explanation of a model's internal reasoning. It requires a truthful account of what can be inspected and repeated. A person can review a generated summary against its cited documents without reconstructing every internal operation, but that limited review is described as such. Reproducing the same output does not by itself establish its factual warrant.

8.8 Protected context and accountability

E200-042 Where protected references or substitutes are used, the package shall state the examination they permit, the accountable custody or review role, and their known limits for source identification, context and challenge. A custodian's assurance, an assessor's direct examination and an unavailable source shall remain distinguishable.

Restricted evidence can be handled through an authorized reviewer, an excerpt or a statement of examined scope. Those arrangements can support different questions. A public summary cannot claim full independent inspectability when its readers cannot examine a decisive source. The protected package need not reveal a source's identity to every audience; the restriction and the resulting assessment limitation remain accountable within the authorized arrangement.

8.9 Loss of access and historical reconstruction

E200-043 Where deletion, restriction, loss or a failed reference materially affects later examination of a retained claim, the package shall record the known change, its scope, responsible role or explicit unknown, and the resulting assessment or reconstruction limit. Evidence of a permitted disposal action shall not retain prohibited content solely to prove its removal.

Historical assessment and present inspectability can diverge. An assessor might have examined a source that is no longer available to a later reader. The historical result can remain recorded with the evidence then cited, while the later reader's ability to reassess it is limited. Neither automatic erasure of the earlier examination nor an unsupported assertion of continuing inspectability follows.

8.10 Evaluative scope and policy proposals

E200-044 Where an ethical or policy assessment compares effects across people, groups or periods, it shall identify the compared effects, evaluative criteria, aggregation or tradeoff method if any, and material effects left outside the comparison. A recommendatory institutional or policy proposal shall remain distinguishable from an adopted requirement, an authorized decision and a descriptive finding.

The same intervention can expand one group's capacity while reducing another's access to review. An assessment can favor the intervention under stated values while preserving the adversely affected group's account. Describing a generative effect does not settle its normative sign. A proposal addressed to an international organization also requires a stated intended institution and mandate context when those affect its recommendation; technical recording conformity does not confer that mandate.

9 Conformance

9.1 General

The conformance subject is one declared epistemic record package at a fixed edition, purpose and boundary. This document specifies recording requirements, not proof that every described activity occurred or that an institution's procedure was fair. A package can faithfully record an unsupported or rejected claim when its attribution, status and grounds are clear. Whether a substantive inference is warranted remains an assessment question with its own scope.

9.2 Applicable requirements and information schedules

E200-045 A conformity assessment shall use the semantic schedules in Annex A and the checks in Annex B, documenting the applicable requirements, evidence, assessor, date, result and limitations. Each requirement shall receive a result; an omitted field or unavailable source shall not be treated as an absent trigger for a requirement whose subject is present.

E200-049 Where one requirement groups obligations whose results can differ materially, the assessment shall record the result and evidence for each such component. The requirement shall be fulfilled only if every applicable component is fulfilled. A failed or unassessed component shall remain visible in the requirement-level and overall package result.

General package requirements apply to every assessed package. Claim requirements apply to every included claim. Requirements concerning measurements, legal assertions, machine mediation, transformations, restrictions, revisions or practical uptake apply when those features occur within scope. A package without a legal assertion can mark E200-025 not applicable. A legal allegation lacking a known jurisdiction instead invokes that requirement and records the jurisdiction as unresolved.

9.3 Extent of examination

E200-046 The assessment shall state the extent of examination, including any sampling, inaccessible components and checks performed only automatically. A sampled or partial assessment shall not be represented as exhaustive examination of the package. An unqualified conformity claim shall require a supported fulfilled result for every applicable requirement throughout the declared subject.

Automatic checks can verify presence, reference integrity or structural combinations. They cannot alone establish appropriate inference, meaningful scope, adequacy of an explanation or the source of institutional authority. A larger assessment can use justified sampling to discover defects, but its report remains explicit about the claim that the sample supports. Narrowing the subject to examined cases does not justify describing the result as institutional assurance.

9.4 Result categories and reassessment

The result categories are fulfilled, not fulfilled, not assessed and not applicable with a reason. They have the meanings stated in GR-100, 8.3. A blocked review receives a limitation and an unassessed result; an authorized restriction is not itself evidence of fulfillment of an unexamined requirement.

E200-047 A change to an assessed package, its claimed scope or an applicable dated dependency shall identify the prior assessment, affected requirements and evidence, and any reassessment performed or pending. Previous results shall not silently transfer to materially changed claims, methods, access conditions or transformations.

A report identifies whether it concerns the retained protected package, a released view or both. A view can receive its own bounded assessment if it preserves the requirements applicable to that view and does not

imply access to withheld material. Where a required component cannot be examined, its result remains not assessed. No certification, accreditation or legal evidentiary status is created by these categories.

Annex A

(normative)

Semantic information schedules

A.1 General

This annex specifies the semantic information required by E200-027. It does not prescribe a serialization, field name, datatype or new ontology class. Information can be directly recorded or supplied by a stable contextual reference whose meaning and applicable edition are inspectable. E200-048 distinguishes mandatory structural information from unavailable contextual factual values and identifies the assessment consequence of the latter.

E200-048 The package shall supply its reference and version, declared purpose and boundary, included claim references and content, target designations, accountable recording role, and relationship locators needed to identify each asserted evidence role, assessment or revision. These structural components shall not be replaced by an unknown value. A required contextual factual value that is unavailable may be represented by a typed unknown, uncollected, lost, disputed or restricted declaration identifying the responsible or attributing role, known reason and assessment limit. Such a declaration shall not establish the unavailable fact, replace required reasoning or criteria for the package's own assessment, or produce a fulfilled result for an examination that could not be performed.

An unresolved target designation states what the claim concerns or the identification question under examination, as allowed by E200-003. It is not an invented identity. A protected actor or material can have a controlled reference whose disclosure scope is stated. The structural requirement is an identifiable relationship in the authorized arrangement, not publication of protected identifying information.

For the tables below, unknown contextual values include the actual source person's identity, target time, instrument details, an upstream actor's method, external legal context or unavailable historical content where these cannot be established. The package's own declared assessment method, criterion, inference and result describe what its assessor actually used or determined. An unperformed evidential examination is recorded as not examined; fulfillment of the duty to disclose that state remains separate from any claim that the examination occurred. A known omission of required structural content or assessment reasoning is a recording defect rather than an unknown-context exception.

A.2 Package, claim and material information

Table A.1 – Core semantic information and its governing requirements

Component	Required information when the component is present	Governing requirements
Package	Reference and version; purpose; recording responsibility; target and collection boundaries; included claims or selection rule; access scope; descriptive regime; exclusions; assessment results.	E200-001/002/027/045.
Claim	Distinguishable content/version and target; origin and recording attribution; epistemic mode and relevant modality; method; material assumptions; scope; temporal context; identified unavailable context.	E200-003–008/028–031.

Component	Required information when the component is present	Governing requirements
Identity assertion	Appearances linked; stated criterion; responsible attribution; grounds or explicit stipulation; material dispute; distinction from lineage and record references.	E200-009.
Material item	Reference or controlled locator; relevant portion or identified pattern; source/acquisition path; availability; distinction between original, copy and derived or generated representation.	E200-010/032/033.
Evidence-role assignment	Material and claim-version links; assessor/source; time; evidential role; relevance rationale; reliability limits; material alternatives and known dependence.	E200-011/012/034.
Assessment	Question; assessor or decision role; criteria and version; material examined; result; date; claim versions; uncertainty and limitations; available alternative analysis.	E200-014–016/035–037.

A.3 Conditional information

Table A.2 – Information activated by conditional recording subjects

Trigger	Information required for the triggered subject	Governing requirements
Negative evidence	Expected trace opportunity; production, detection, coverage and preservation conditions; inference and limitations.	E200-013/032.
Revision	Prior/resulting versions; responsible source; time and reasons; changed content/scope; history limits; known dependents and disposition.	E200-017–019/038.
Regime change	Earlier/new definitions or methods; reasons; affected claims; mapping used; non-comparability or lost distinctions.	E200-018.
Practical uptake	Relied-on claim/version; assessment; action and actor; asserted authority or grounds; intended effects; separately attributed consequences or remedy.	E200-020/039.
Challenge	Challenged version; protected or open source attribution; grounds/material; receipt context; status; disposition responsibility, reasons and resulting changes.	E200-021.
Machine mediation	System and available version; task; inputs and outputs used; material operations; uptake/review role; unavailable detail; limits on claimed reproduction.	E200-022/040/041.

Trigger	Information required for the triggered subject	Governing requirements
Protected or lost material	Restriction or loss; asserted basis; accountable role; examination route where available; effect on assessment and later reconstruction.	E200-023/042/043.
Ethical or policy assessment	Evaluative question; attribution; values/criteria; affected parties; comparisons and tradeoffs; limits; recommendatory or operative status.	E200-024/044.
Legal assertion	Legal concept; asserted source; institutional/jurisdictional context; authority; temporal applicability and procedural status, including explicit unresolved components.	E200-025.
Transformed view	Source/resulting versions; selection/transformation; retained attribution, qualification and history; omitted content and limitations; declared audience and boundary.	E200-026/033.

A.4 Link interpretation and unavailable context

A claim reference identifies the asserted version, not merely a mutable latest view. A material reference identifies the portion used where that distinction affects the inference. A criteria reference identifies the governing edition. A shared-context reference identifies which claims inherit it and which exceptions apply. An ambiguous reference does not provide an inspectable link merely because it opens a document.

If the package cannot determine a material value, it records whether the value is unknown, not collected, not applicable, disputed, lost or restricted to the extent supported and permitted. A reason recorded by another source remains attributed to that source. This annex does not require the package to accept an assertion of completeness or authority merely because a custodian supplied it.

Annex B

(normative)

Assessment schedule

B.1 General

This normative schedule specifies the minimum evidence methods for assessing this draft. They specify discriminating checks and failure cases; this draft does not claim these cases have been implemented or passed. Each applicable requirement needs its own result even where several use the same dossier. Human review is necessary for meaning, rationale, and sufficiency of disclosure; structural field validation alone is inadequate.

Table B.1 – Epistemic recording assessment schedule

Requirement	Required evidence and discriminating check
E200-001	Inspect package declaration and selected claim inventory. Check that a consequential excluded record is disclosed by the collection rule or limitation.
E200-002	Inspect result ledger and evidence locators. An inaccessible required component is not assessed; a syntax pass is not labeled a true fact.
E200-003	Retrieve two versions and two conflicting claims concerning Q. Their content and targets remain distinguishable.
E200-004	Follow testimony through a translator or summarizer. Originating source and recorder remain separate, including protected attribution.
E200-005	Inspect C1. Its late-arrival inference is not presented as direct observation merely because L1 was directly read.
E200-006	Recover the entry-time assumption and method for C1. A missing method produces a stated limit, not a reproducibility claim.
E200-007	Compare a single intake desk's coverage with an institution-wide assertion. A known unobserved delivery route remains a limitation.
E200-008	Recover receipt, acquisition, entry, and review times or their explicit uncertainty; out-of-order recording does not reorder events.
E200-009	Examine an organizational replacement using a reused name. An identity criterion and separate lineage prevent automatic merger.
E200-010	Locate the relevant L1 entry and R2 image or controlled locators; derived transcript and original are distinguished.
E200-011	Recover L1's separate evidential roles for entry time and delivery time, including rationale and assessor.
E200-012	Present three copies derived from L1. Assessment detects shared origin instead of counting three independent observations.
E200-013	Remove the log for one delivery channel. No receipt found remains distinct from evidence that no request arrived.
E200-014	Inspect uncertainty about queue delay and a confidence quantity if used. Its measured quantity and assumptions are explicit.
E200-015	Recover C2 and reasons for its disposition. If no alternative search occurred, the absence of search remains visible.
E200-016	Compare log authenticity check, receipt-time assessment, and D1 decision. Their questions, roles, criteria, and results are distinct.

Requirement	Required evidence and discriminating check
E200-017	Retrieve C1 versions and changed grounds. Target change, correction, and category change produce different stated reasons.
E200-018	Apply a category split to records lacking the finer information. Mapping records non-recoverability rather than invented categories.
E200-019	Follow C1 to D1. Pending action review is distinguishable from completed correction and from an unreachable external use.
E200-020	Recover D1, the claimed authority for action, and separately attributed consequences. No automatic remedy is inferred.
E200-021	Trace CH1 receipt through pending and disposed states. A closed status without response, responsible role, and reasons fails.
E200-022	Add a machine summary that invents a link. Recover input, system/version where available, output used, uptake role, and correction.
E200-023	Compare protected dossier and released view. Restriction basis and accountable route are recorded without unauthorized disclosure or a false independent-review claim.
E200-024	Inspect an assessment that exclusion was unfair. Criteria, affected parties, and descriptive premises are distinguishable.
E200-025	Inspect an allegation of unlawful exclusion. Asserted source, jurisdiction, authority, and procedural status are stated or unresolved; no legal effect follows from technical compliance.
E200-026	Examine a textual summary or exported dossier. Correction, dissent, attribution, scope, and protection limitations survive or omissions are explicit.
E200-027	Compare supplied semantic components with Annex A. Resolve shared context and exceptions without inferring undocumented values.
E200-028	Inspect a compound occurrence-and-effect claim. Separate components can receive different assessments and revisions.
E200-029	Follow a translated or relayed statement to its available source context; distinguish quoted content from the recorder's interpretation.
E200-030	Inspect an observation's window, method, observer and detection limits; a broader claim does not acquire unobserved coverage.
E200-031	Recover premises, assumptions and consequential inferential steps; a stipulated process is not mislabeled an observed history.
E200-032	Examine selective preservation and any concealment hypothesis. Missing evidence alone does not establish concealment.
E200-033	Trace an extraction, redaction or imputation to its source and effect; a completed value remains distinguishable from observation.
E200-034	Inspect aggregate populations, denominators, weights and changed composition; repeated or recoded items do not become independent observations.
E200-035	Compare confidence statements across targets or methods; unsupported commensuration and hidden unresolved dimensions are detected.
E200-036	Distinguish rejected, retained and unexamined alternatives; an unperformed sensitivity analysis is not described as completed.
E200-037	Reconstruct assessment criteria and evidence at the time; later rules do not silently change an earlier result.

Requirement	Required evidence and discriminating check
E200-038	Follow two revision branches. Latest entry order alone does not establish evidential precedence or erase disagreement.
E200-039	Separate pre-intervention evidence, intervention, later evidence and effect attribution; discovery differs from creation.
E200-040	Inspect generated links, imputed values and computational selection; structured output is not treated as independent observation.
E200-041	Test a stated reproduction or inspection claim against available inputs, method and configuration; unavailable detail limits the result.
E200-042	Compare custodian assurance, direct authorized examination and unavailable source; their scopes remain distinct.
E200-043	Inspect a formerly accessible source after loss or restriction; the historical assessment and current access limit remain distinguishable.
E200-044	Recover affected parties, evaluative comparisons and omitted effects; a recommendation is not reported as an adopted rule.
E200-045	Check every requirement's result and evidence against both normative annexes; absence of required information is not a missing trigger.
E200-046	Inspect coverage, sampling and automatic checks; partial examination does not acquire an exhaustive claim.
E200-047	Compare a revised package with its prior assessment; affected results are reassessed or explicitly pending.
E200-048	Inspect unknown-context declarations alongside mandatory references/content and reasoning; a missing structural component or unperformed examination does not acquire a fulfilled result.
E200-049	Inspect a grouped obligation with mixed component results; an unassessed or failed component remains visible and prevents overall fulfillment.

B.2 Assessment sequence and retained result

The assessor fixes the package edition, access arrangement and claim inventory before applying the schedule. The assessor identifies present conditional subjects, locates the Annex A information and examines the semantic checks in Table B.1. The result register records the requirement, trigger, evidence locator, observed result, assessor, date and limitation. A domain-equivalent case can test the same distinction when the package does not concern the illustrative delivery case.

One material item can support several checks, but every applicable requirement receives a separate result and materially distinct component results follow E200-049. A counterexample establishes a defect only within the tested scope; a passing case does not establish universal institutional performance. If assessor disagreement concerns the meaning of a claim, its material, criteria or scope, the report identifies that point rather than averaging incompatible conclusions into a numerical result.

Annex C

(informative)

Worked epistemic cases

C.1 A late-recorded delivery

This invented case tests recording distinctions. It supplies no claim about an actual institution or applicable law.

Target. Whether request Q arrived before the deadline specified in a synthetic institution's internal rule R1. The asserted rule and whether it applies are separate claims.

C1 version 1. Clerk A reports that Q arrived after the deadline, inferred from entry log L1. Target time is the claimed receipt time; recording time is the later creation of C1. The method assumes entry time matches receipt time.

Evidence use. L1 supports that an entry occurred at the recorded time. Reviewer B records that its support for receipt time depends on the untested assumption about queue delay. Three copies of L1 are not independent corroboration.

Alternative C2. A protected participant reports earlier delivery; a receipt image R2 is available to an authorized reviewer. The public view identifies restricted evidence and the scope of examination without naming the participant.

Action D1. The institution records exclusion of Q using C1 and R1. This is an attributed institutional act. Its occurrence, justification, and any claimed legal effect remain separate.

Challenge CH1. The participant challenges C1 and provides R2. The record includes the challenged version and receipt time of the challenge; a pending challenge is not displayed as a completed review.

C1 version 2. Review establishes that the entry occurred later than the claimed delivery. The assessed receipt time changes; the entry event does not. The revision links its grounds to R2 and records the continuing uncertainty. C1 version 1 and D1 remain identifiable historical records.

Dependency review. D1 is marked for review. Until a later action is evidenced, correction of C1 is not displayed as restoration of Q's participation. The record can identify consequences of the interval of exclusion separately.

Regime change. If the institution later defines arrival by a different channel, the change of rule/category has its own effective interval. It does not silently recode earlier evidence or establish that earlier actors used the new meaning.

C.2 Generated relationship and shared-source dependence

A fictional analysis receives three documents: an intake entry, its automated summary and a report that cites the summary. The summary adds a claim that two named organizations coordinated their decisions. The intake entry only records that messages were exchanged. The package keeps the communication occurrence, the inferred coordination and the later report as distinct claims.

The three documents share a derivation path. Their number does not supply independent corroboration. The generated relation has a source and method reference, but that provenance does not establish its content. A reviewer can reject the unsupported coordination inference while retaining evidence of the messages. A later independent account could change the assessment; its independence and target relevance would still need examination.

If a public graph displays only the generated edge, the reduced view needs its inferential qualification and relevant limitation. A caption that describes the edge as observed would lose the distinction. No universal

graph schema is needed to expose this failure; a reader can compare the graph's statement with the source material and assessment.

C.3 Reclassification, intervention and later evidence

A fictional institution broadens its participation category after reviewing evidence that earlier records omitted some forms of contribution. Existing archived material supports reclassification of some earlier cases, while others lack the necessary detail. The new category also changes later access to institutional resources.

The dossier retains three linked changes. The category changed; knowledge of some earlier contributions changed through re-examination; and later resource access changed through practical uptake. The unresolved earlier cases do not acquire a finer classification merely because the vocabulary now provides one. Nor does increased later participation prove that identical opportunities were available earlier.

An ethical assessment can favor the new arrangement while recording its additional reporting burden and effects on different groups. A policy proposal can recommend wider adoption without claiming institutional authority to impose it. The package records these positions and their criteria separately from evidence concerning participation and from the decision that implemented the change.

Annex D

(informative)

Source trace and drafting rationale

D.1 General

References are to the supplied local PDFs indexed in `foundation_manuscripts/MANIFEST.md`; page numbers are one-based PDF pages. Source passages provide conceptual grounds, not adopted requirements. No external compatibility or legal claim is made.

Table D.1 – Foundation passages and recording requirements

Source	Operational proposal and reason
FM-004, §4.2, pp. 11–14; §4.6, pp. 43–45	E200-003–008 distinguish target, manifestation, representation, and observation conditions. A single undifferentiated fact field cannot preserve these questions.
FM-005, §5.4, pp. 28–31	E200-010–013 assign evidence roles relative to claims and preserve trace paths, alternatives, and dependence. Material presence alone does not establish relevance or independent corroboration.
FM-005, §5.17, pp. 141–142	E200-014/015 preserve dimensional uncertainty and alternatives. A single mandatory confidence score was rejected for this draft because methods and uncertainty sources differ.
FM-007, §7, pp. 26–29	E200-009 separates record references, identity criteria, and lineage, permitting unresolved matches. Administrative identifier equality is insufficient as a universal criterion.
FM-005, §5.20, pp. 168–174	E200-017–020 distinguish evidential, intervention-related, historical, and category revisions, and the historical effects of an earlier representation. Silent overwrite loses those distinctions.
FM-005, §5.19, pp. 160–161, 168	E200-021–023 make machine mediation and contestability inspectable while allowing differentiated access. A declaration that “AI was used” omits material epistemic conditions.
FM-003, §3.10.9, p. 115; §3.13, pp. 141–142	E200-024 separates generative attribution from ethical evaluation and records affected parties and criteria. No universal beneficialness or commensuration is assumed.
Programme Brief, §3A; repository jurisprudential discipline	E200-025 preserves the asserted basis and status of legal claims. This is a recording boundary proposed by the programme, not a legal conclusion derived from a manuscript.

The selected direction is an inspectable claim package with attributed relationships and scoped evidence. Alternatives included a single verified-fact flag, a mandatory new ontology class for every assertion, and a fully specified adjudication process inside this document. The first loses distinctions; the second prematurely fixes implementation architecture; the third conflicts with the planned separation of epistemic representation from GR-210 procedures. The present choice leaves representation and procedural elaboration open while producing requirements that a small synthetic dossier can test.

D.2 Additional foundation analysis for edition 0.2

FM-005, sections 5.4.4–5.4.8, PDF pages 32–35, distinguishes observation, inference, latency, hiddenness and negative evidence. E200-030–032 require an inspectable observational and inferential path and do not infer concealment from silence. Sections 5.17.3–5.17.8, pages 145–150, distinguish generative linkage, boundary, scale, time, model and competing-explanation uncertainty. E200-034–036 preserve those dimensions without a compulsory scalar score.

FM-005, sections 5.18.1–5.18.5, PDF pages 152–156, explains why visibility and institutional legibility are uneven and why greater visibility can itself cause exposure. E200-042/043 separate accountable examination from unrestricted publication. These recording duties do not claim to complete the manuscript's broader account of epistemic justice.

FM-005, section 5.19, PDF pages 162–164, distinguishes computational observation, classification, inference and generated representation. E200-033/040/041 preserve transformations and limits on inspection. A generated description can aid inquiry without becoming an independent source of authority.

FM-007, section 10, PDF pages 45–50, distinguishes partial attributes, numerical scales and changing composition; section 17, pages 78–80, distinguishes regime alignment and recovery of omitted information. E200-034–038 adapt these distinctions to inspectable records without importing a formal model or declaring Property equivalent to Attribute.

D.3 External drafting models

The ISO model document and ITU-T author's guide inform the organization of scope, dated references, terms, clauses and normative or informative annexes. The United Nations National Quality Assurance Frameworks Manual provides a useful comparison for distinguishing institutional conditions, processes and outputs in a quality framework. Here, package recording, assessment performance and institutional effects remain separate subjects. No UN statistical quality indicator or external conformance rule is incorporated through this comparison.

Annex E

(informative)

Unresolved issues and specification needs

E.1 General

- **OPEN — Representation.** Whether claim identity is implemented through objects, qualified statements, wrappers, or hybrids requires disagreement, revision, protection, and exchange cases before a Specification decision.
- **OPEN — Burden.** Initial review needs to measure time and participant burden as well as field completeness. Shared context can reduce duplication; E200-027 addresses the preservation of claim-specific exceptions.
- **OPEN — Evidence assessment granularity.** The minimum useful rationale varies across testimony, measurement, historical interpretation, and routine record entries. Domain profiles need cases and relevant expertise.
- **OPEN — Challenge procedure.** The effective operation of submission routes, standing, accessible participation, impartial assessment, notification, timing, appeals and repair in GR-210 and institutional profiles needs evidence from actual practice. E200-021 records results without establishing that these practices exist or work.
- **OPEN — Retention and restriction conflicts.** Historical reconstruction, deletion, protection, and procedural examination can conflict. Named institutional and jurisdictional profiles need explicit review; this draft imposes no universal retention period or disclosure priority.
- **OPEN — Technical needs.** Independently addressable versions, evidence-role links, dependency notifications, missingness states, controlled locators, and loss-aware transformations are candidate inputs to GR-SPEC-120/130/200. No encoding or transport protocol is adopted here.
- **OPEN — Conformance practice.** The matrix is a review design, not a completed validator or certification programme. Independent reviewers need to test whether the same package yields reproducible assessments and whether affected participants can recover its meaning.

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GENERATIVITY STANDARDS PROGRAM

GR-210

Standards-track Working Draft

Version 0.2 2026-09-22

Evidence, Interpretation, and Contestation

WORKING DRAFT FOR REVIEW

This document contains proposed provisions for technical and institutional review. It is not an adopted Standard or an operative governance instrument. Its scope, application conditions and publication status are specified in the text.

Prepared by the Generativity Standards Program. Reference to external publications does not imply endorsement by ISO, IEC, IEEE or any United Nations body.

Foreword

Responsible editor: UNASSIGNED. Canonical source: standards/GR-210-evidence-interpretation/GR-210.tex. Intended readers are procedure operators, affected people, reviewers and assessors.

This is a **PROVISIONAL Standards-track Working Draft**. It is not adopted, and preparation does not formally initiate a standards project, authorize an institutional procedure, or establish a legal entitlement. Its requirements are proposals for review and experimental assessment. Draft 0.2 preserves the meaning of C210-001 through C210-032 and extends the procedure declaration, case handling, protection, and assessment schedules. Draft 0.1 remains historical material.

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Introduction

An account can be authentic, widely repeated, or institutionally accepted and still lack adequate grounds for its substantive conclusion. A person affected by that account also needs a usable route to question it. This document connects the examination of evidence with the practical organization of receipt, response, review, revision, and action. It keeps those functions distinct so that a successful correction of text is not mistaken for a completed remedy and an inclusive procedure is not mistaken for proof of truth.

The foundation manuscripts distinguish trace from evidence, evidential adequacy from epistemic justice, and current knowledge of the past from the past and its historical representations. They also identify unequal capacities to produce, preserve, interpret, and contest evidence. The procedures proposed here operationalize a bounded part of those concerns. They do not claim to exhaust the philosophical concepts or prescribe a single institutional model.

The procedure can be operated with documents and accountable people before a machine protocol is needed. Technical infrastructure becomes useful when case correlation, controlled exchange, version tracking, notification, or concurrent action requires interoperable behavior. Such infrastructure remains subordinate to declared authority and protection. A complete state log cannot establish that a reviewer actually considered the grounds or that an affected person could use the route.

1 Scope

1.1 General

This document proposes requirements for a bounded procedure through which people can question an attributed account, introduce evidence or an alternative interpretation, obtain a reasoned disposition and seek further review. Its subjects are the procedure operated by a named organization or recording practice and the associated case record.

An evidential assessment, a procedural disposition, an institutional action and an externally competent legal finding remain distinct. This draft provides no universal tribunal, evidentiary ranking or legal right to review. A conforming procedure can conclude that the available evidence does not resolve the dispute.

The scope includes a procedure declaration, accessible receipt, case scoping, reviewer assignment, evidential and interpretive examination, participation, reasoned disposition, notification, further review, correction propagation, practical response, closure, and protected retention. It excludes a universal evidentiary ranking, mandatory probability scale, cross-jurisdiction legal remedy, and a claim that procedural conformity proves the underlying facts. Institutional profiles determine the contextual service periods and authority within these boundaries.

2 Normative references

2.1 Dated draft dependencies

For experimental assessment against this edition, GR-100, *Foundations and Vocabulary*, Working Draft 0.2, supplies operational terms; GR-200, *Epistemic Recording Framework*, Working Draft 0.2, supplies the package and claim requirements invoked by C210-030. The source locations are `standards/GR-100-foundations-vocabulary/GR-100.tex` and `standards/GR-200-epistemic-recording/GR-200.tex`. Both are draft dependencies, not adopted Standards. Their relevant requirements remain applicable to the bounded claim package; a field-level check does not satisfy package-level obligations.

A dependency revision requires review of affected procedure declarations, claim packages, and assessment results. GR-110 concerns the broader generativity recording package and is a related informative publication here, not a blanket additional conformance dependency. Full GR-300/310/400 profiles remain in development. Directives Part 1 governs the programme's own development procedure after adoption; its periods are not universal periods for institutions using GR-210.

No external legal instrument or United Nations publication is a normative dependency of this edition. Comparative sources in the bibliography inform drafting and assessment architecture without importing institutional powers or policy commitments.

3 Terms and definitions

3.1 Operational procedure terms

The following terms narrow the procedural use in this document without redefining the broader GR concepts supplied by GR-100.

Operator The accountable organization, person, or arrangement that declares and provides the procedure within its stated authority.

Case A distinguishable collection of issues, submissions, review actions, dispositions, and follow-up concerning identified records or decisions.

Case record The retained representation of a case, including its boundaries, versions, access scope, and

known missing material. Its existence does not prove that every represented action occurred.

Issue A question capable of receiving a scoped response, such as whether a date is wrong, evidence supports a claim, a category is adequate, or the declared procedure was followed.

Reviewer The assigned person or accountable review function that examines specified issues within declared competence and authority.

Disposition The reasoned procedural outcome for an issue or case. It can maintain a judgment, support revision, record unresolved evidence, refer the matter, or close a procedure without settling the substantive question.

Practical response An authorized or proposed action following review, distinct from recording the disposition and from evidence that the action was completed.

Further review Reconsideration, a procedural appeal, or another declared examination of a previous handling or disposition, with the route's authority and independence stated.

Material grounds Evidence, assumptions, criteria, or reasons capable of changing a reasonable assessment of the issue, its disposition, or its consequential use within the declared scope.

Case state A procedural status indicating completed and pending handling. It is not a truth value, a probability, or an institutional judgment on the underlying claim.

4 Procedure declaration

4.1 General

C210-001 The operator shall publish or otherwise provide an accessible procedure declaration identifying its purpose, eligible users, covered records or decisions, responsible roles, asserted authority, submission routes and exclusions.

C210-002 The declaration shall distinguish technical correction, evidential disagreement, procedural complaint, ethical or conduct complaint and an asserted legal claim, identifying their available handling routes and limits of authority.

C210-003 The operator shall declare response and review periods, their start events, permitted extensions, notice arrangements and the route available when a period is exceeded. The chosen periods shall be justified for the institutional context and affected users.

C210-004 The operator shall declare the information needed to submit a case, the support or alternatives available to users and how restricted evidence or protected identities can be handled. A demand for unnecessary public disclosure shall not be a condition of receipt.

NOTE 1 No universal period is selected here. The programme's own standards-development comments and appeals are governed by Directives Part 1 if adopted; an institution using records has its own declared procedure and legal context.

4.2 Declared authority and service conditions

C210-033 The declaration shall have an identifier, version, effective interval, accountable owner, and accessible change history. It shall identify the normative dependencies and any institutional profile applied, the intended users and languages, and the procedure functions actually available. A named but unstaffed function shall be identified as unavailable rather than presented as an operative review route.

C210-034 For each kind of issue, the declaration shall identify who can receive it, examine evidence, determine a disposition, authorize action, and conduct further review. It shall distinguish an operator's

internal policy from a claimed external legal mandate and identify the source, scope, and uncertainty of the latter. Receipt by one function shall not transfer authority belonging to another.

C210-035 The operator shall maintain the service schedule in Annex A, including receipt, acknowledgement, clarification, review, reply, disposition, notification, further-review requests, action follow-up, and closure. The schedule shall identify clock starts, responsible roles, expected periods or deadlines, permitted pauses and extensions, and escalation when service cannot be provided.

C210-036 The operator shall make submission and further-review routes available without requiring a person to accept the challenged account, withdraw an unrelated complaint, or expose unnecessary protected information. Any eligibility limitation, fee, identity requirement, representative arrangement, or technological prerequisite shall have a declared purpose, authority, proportionality rationale, and available alternative or challenge route.

C210-037 Before changing the procedure, the operator shall assess effects on open cases, participation, protection, and remedies. The change notice shall state the new version, effective date, reasons, transition treatment, and how affected users can question the change. A later rule shall not be applied silently to make an earlier handling appear compliant.

C210-038 A profile shall identify its institutional setting, covered actions, authority limits, service periods, available resources, review competence, protection basis, and assessment scope. It shall identify any requirement not met rather than claim full GR-210 fulfillment through a profile that silently removes an applicable obligation.

C210-039 The operator shall assess whether its declared channels and staffing can support the expected cases and urgency. Material capacity gaps shall produce a documented mitigation, narrower service declaration, referral arrangement, or postponement with notice. A backlog shall not be concealed by classifying unexamined submissions as resolved.

NOTE 2 An institution can distinguish a clerical correction desk from a merits-review panel and an external legal forum. A single contact can assist routing, but that convenience does not make it competent to decide each type of question. A profile's named institution is part of the authority claim to verify, not evidence of authority by itself.

5 Receipt and scoping

5.1 General

C210-005 On receiving a submission, the operator shall create a distinguishable case reference and record receipt time, the target record or decision and version if available, the asserted issue and the submitter's attribution or protected-contact arrangement. Receipt shall not be reported as agreement with the submission.

C210-006 The operator shall acknowledge receipt through the declared route or record why acknowledgment is not possible. The response shall explain the next step, expected timing and any missing information needed for further action.

C210-007 Where a case is out of scope, incomplete, duplicated or directed to the wrong recipient, the operator shall record that procedural reason and any available correction or referral route. That outcome shall not be represented as factual refutation.

C210-008 Any restriction on repetitive or abusive submissions shall use declared criteria, record the reason and preserve a route to challenge the restriction. The operator shall not classify a submission as abusive solely because it criticizes an authoritative account or repeats an unresolved material concern.

5.2 Intake, triage, and issue separation

C210-040 The operator shall accept enough information to identify a concern without requiring the submitter to supply a complete evidentiary case or technically correct amendment at receipt. If the target or issue is unclear, the operator shall seek clarification and offer the declared assistance before closing for incompleteness, unless contact is unavailable or a stated protection constraint prevents it.

C210-041 Triage shall identify immediate protection or irreversible-consequence risks, the covered question, required routing, known deadlines, and whether temporary preservation or action review is available within the operator's authority. Triage shall not be presented as a concluded evidential finding. Any urgent measure shall have a responsible actor, scope, reason, review point, and notice appropriate to protection needs.

C210-042 A submission containing several kinds of issue shall be divided into distinguishable questions with linked handling routes and a coordinating contact. A referral shall identify what is sent, on what authority, to whom, and whether receipt or acceptance has been confirmed. The operator shall not describe sending a referral as evidence that the recipient has assumed the case.

C210-043 The intake record shall preserve the submitted meaning and relevant original formulation within protection limits. Translation, transcription, summarization, or assisted reformulation shall identify its responsible role, method, version relationship, and material uncertainty. The submitter shall have a practicable opportunity to correct a material misunderstanding through the permitted contact arrangement.

C210-044 A duplicate-case decision shall identify the related case and explain which issues are shared and which remain distinct. Consolidation shall retain separate attribution, protection preferences, and individual practical consequences where material. A previous disposition shall not automatically dispose of new evidence or a newly identified defect in the previous handling.

C210-045 A request for further information shall specify the missing information, why it matters, who is expected to supply it, available assistance or alternatives, the response period, and the effect of nonresponse. The operator shall not shift responsibility for evidence within its own declared control to a person who lacks access without explaining and addressing that access problem.

C210-046 A case placed on hold shall identify the reason, affected work, responsible owner, next review date, and clock treatment. A hold shall not remove the case from pending-work reporting or imply acceptance, rejection, or abandonment. The operator shall reassess the hold at the stated review point and notify permitted recipients of a material change.

C210-047 When a submitter withdraws a request, the operator shall record its scope, distinguish withdrawal of participation from withdrawal of an evidential assertion, and explain any continuing handling under a separate declared responsibility. Withdrawal shall not be described as proof that the original claim was false or that the person agreed with the challenged decision.

C210-048 Case transitions shall conform to the semantic controls in Annex B. The operator shall record the previous and new state, trigger, responsible actor, time, reason, and next action. Local status labels may differ if their mapping preserves the distinctions between receipt, review, disposition, action pending, and closure.

6 Review responsibilities and participation

6.1 General

C210-009 Before substantive review, the operator shall identify the reviewer or review function, relevant competence, relation to the contested account and conflicts of interest. Material conflicts shall be handled through recusal, reassignment or a disclosed limitation with an appropriate further-review route.

C210-010 The reviewer shall identify the questions within the case, the relevant claim versions, evidence available, known limitations and decision criteria. Factual, normative, procedural and legal questions shall remain distinguishable.

C210-011 Affected parties shall be given an opportunity to respond to material grounds used in the disposition through a procedure consistent with protection and applicable institutional constraints. Where direct disclosure is restricted, the operator shall explain the permitted alternative and its limits.

C210-012 The operator shall record participation barriers known to affect the case, assistance or adjustments offered and material perspectives that could not be obtained. Absence of a response shall not automatically be represented as consent or admission.

NOTE 1 A reviewer cannot promise that every perspective will be available. The proposed obligation is to expose the evidential and procedural consequence of a material gap.

6.2 Assignment, competence, and meaningful response

C210-049 The reviewer assignment shall state the questions delegated, relevant domain competence or situated knowledge, decision limits, availability, and accepted responsibility. Where several reviewers supply different expertise, the record shall identify who integrates findings and who is accountable for the disposition. Unavailable competence shall narrow the finding or trigger additional review, referral, or deferral.

C210-050 The operator shall provide a route to raise a conflict concern and assign its assessment to a person not deciding a complaint about their own interest. The conflict disposition shall identify the concern, relevant evidence, management action, and effect on the case. Disclosure alone shall not be represented as independent handling.

C210-051 An author of the challenged account may explain its sources or participate in a disclosed initial reconsideration, but shall not be described as an independent reviewer of that account. A material unresolved conflict shall not support an unqualified independent-review claim; the available further-review arrangement and its limits shall remain explicit.

C210-052 Before a consequential disposition, the operator shall give affected parties notice of the questions, material grounds proposed for reliance, applicable criteria, response route, and response period to the extent permitted by protection. A later-added material ground shall receive a further response opportunity unless a declared urgent measure requires temporary action with prompt subsequent review.

C210-053 An opportunity to respond shall be assessed in relation to actual access, language, disability, resources, time, and the form of the material. The operator shall record requested adjustments, its response, and unresolved barriers. Merely making a complex dossier available shall not establish that an affected person could meaningfully address the proposed grounds.

C210-054 Where direct participation is unsafe or impracticable, the operator shall assess the declared alternatives, including protected contact, assisted submission, representative participation, or controlled independent examination. The record shall identify the chosen arrangement, its authority and limitations, and any material perspective it cannot provide. Representation shall not be inferred without a basis.

C210-055 A reviewer shall assess testimony in relation to the source's access, claim scope, method, and material limitations rather than institutional status alone. Relevant experience and technical expertise shall remain distinguishable. Giving a person an opportunity to speak shall not be reported as showing that their grounds influenced the decision unless the disposition records how they were considered.

C210-056 If the reviewer and decision authority are different, the authority shall identify the review findings received, any departure from them, the grounds and competence for that departure, and the

additional response opportunity required by new material grounds. A managerial instruction shall not silently replace an evidential assessment while retaining the reviewer's attribution.

C210-057 The operator shall provide a protected route to report retaliation or interference linked to participation and shall record available protective responses within its authority. Such a report shall remain distinct from the factual merits of the original case. A person shall not have to publish the protected allegation to obtain triage or an explanation of the available route.

7 Evidence and interpretation

7.1 General

C210-013 An assessment shall identify the claim under examination, the evidence relied on, how that material bears on the claim, relevant method and assumptions, and known counterevidence or materially plausible alternatives.

C210-014 The reviewer shall distinguish the authenticity or integrity of a source from the warrant it provides for a particular claim. A signed assertion shall not receive an unqualified truth status merely because its signature validates.

C210-015 A conclusion based on missing evidence shall identify the expected trace-production, observation or preservation conditions supporting that inference. Where those conditions are not established, absence of the record shall remain distinguishable from non-occurrence.

C210-016 The assessment shall state uncertainty and its scope without inventing a common probability scale for heterogeneous judgments. Disagreement among assessors shall be attributed and retained where material and permitted.

C210-017 Where a category, method or institutional rule is challenged, the reviewer shall distinguish whether it was applied correctly from whether its adequacy or legitimacy is itself under review. A correct application shall not by itself dispose of a challenge to the rule.

C210-018 A material computational or AI-assisted contribution to the review shall be identified with the inputs or sources available for inspection, its role, relevant limitations and responsible human or institutional uptake. An inaccessible internal process shall not be replaced by an invented explanation.

7.2 Evidence plan and material examination

C210-058 The reviewer shall maintain an issue-to-evidence plan identifying the question, claim versions, relevant criteria, material available, material sought, expected access, alternatives to examine, and known gaps. A change in the plan that materially affects the scope or burden of review shall be recorded and communicated to permitted affected participants.

C210-059 An evidence item used in a disposition shall have a locator or controlled reference, source attribution, acquisition context, relevant version, and any known transformation or custody limitation material to the inference. An unavailable original shall be distinguished from an examined copy, excerpt, testimony about the item, or generated reconstruction.

C210-060 For each material item, the assessment shall state its role relative to the specified claim: support, challenge, qualification, non-discrimination, or another explained relationship. The reviewer shall not give the item a universal reliability status that silently transfers across different claims, times, or contexts. A role assigned by a party shall remain distinguishable from the reviewer's assessment.

C210-061 Where several items are treated as corroboration, the reviewer shall examine known derivation and dependence material to that claim. Copies, summaries, translations, model outputs, and repeated

citations of one source shall not count as independent observations solely because they are separately stored or differently worded. Any asserted independence shall have a stated basis and limits.

C210-062 The reviewer shall identify material alternatives that fit the accessible evidence and state why an alternative is retained, weakened, rejected, or outside the assessed scope. An alternative need not receive equal weight merely because a party proposes it. Failure to examine alternatives shall remain a limitation rather than be reported as evidence that none exists.

C210-063 When an identity, temporal order, measurement, classification, or causal link is contested, the review shall identify the relevant criterion or method and assumptions. Agreement on a record identifier, timestamp, endpoint, or category label shall not by itself resolve the corresponding underlying identity, chronology, trajectory, or causal question.

C210-064 An assessment of a generative contribution shall state the capacity, relation, distinction, constraint, or possibility at issue, the comparison condition, temporal horizon, proposed connection, and evidential limits. A change following an intervention shall be examined for whether it reveals an earlier condition, creates a new condition, or combines both; later observation shall not silently become direct evidence of the earlier configuration.

C210-065 If a rule or category is challenged, the operator shall separate the case-specific application question from the rule-review question and identify the competent recipient for each. A referral of the rule question shall leave its status visible. Rejection under the existing rule shall not be represented as a finding that the rule is adequate, fair, or legally valid.

C210-066 A change in evaluative criteria during review shall identify the earlier and revised criteria, authority, reasons, affected issues, and transition effects. The operator shall provide a response opportunity where the change materially affects a party's case. Historical acts shall retain the criteria actually relied on at the time, even when the present assessment uses a later framework.

C210-067 A numerical score, confidence estimate, or model recommendation used materially in review shall identify what it measures, relevant inputs, method and version where available, assumptions, uncertainty, and role in the decision. A threshold chosen for operational action shall remain distinguishable from an estimate of factual warrant. Unavailable technical details shall qualify the assessment rather than be fabricated.

C210-068 The reviewer shall document the planned examination actually performed, material steps not performed, reasons, and effects on the conclusion. An evidence request sent, an access permission obtained, or a tool available shall not be reported as an examination completed. A finding shall remain bounded by the material and methods actually used.

8 Disposition and practical response

8.1 General

C210-019 The disposition shall state the questions decided, findings and their scope, evidence and reasons, responsible decision function, decision time, remaining disagreement and matters outside its authority.

C210-020 The disposition shall distinguish correction of a record, changed evidential assessment, maintained judgment, changed institutional action, inability to decide and procedural closure. Procedural closure shall not imply epistemic agreement.

C210-021 Where the procedure supports a remedy or practical response, the disposition shall identify the proposed or authorized action, its responsible executor, scope, timing and evidence needed to establish completion. Recording a proposed action shall not establish that it occurred.

C210-022 The operator shall notify the submitter and other relevant recipients through the declared, permitted routes, explain any further-review route and record delivery or known failure. Public notices shall respect the case's disclosure limits.

C210-023 A material correction shall be linked to the earlier account and known dependent views or decisions. The operator shall record which corrections or notices were performed and which downstream effects remain unresolved.

NOTE 1 A corrected classification can leave lost opportunities, costs or harm unremedied. The procedure records the distinction rather than declaring repair complete because a field changed.

8.2 Reasons, notification, and action tracking

C210-069 Each disposition shall address every scoped material issue or state why it remains deferred, referred, withdrawn, or unresolved. The record shall distinguish the parties' positions, the reviewer's assessment, the authorized determination, and any minority or competing assessment retained within protection limits. A single closed-case label shall not conceal different outcomes for different issues.

C210-070 A maintained judgment shall explain why the challenge does not warrant the requested change, including treatment of material contrary grounds. An inability-to-decide disposition shall identify the limiting evidence, authority, or method and any conditions for further review. Neither outcome shall rely solely on institutional acceptance of the original account.

C210-071 An action plan shall distinguish proposed, authorized, assigned, initiated, completed, verified, failed, and no-longer-pursued actions where those differences are material. It shall identify the executor, authority, affected records or persons, due or review date, completion evidence, and route when execution fails. A reviewer lacking implementation authority shall identify the required decision recipient rather than promise completion.

C210-072 When immediate action is taken before full review, the operator shall record the urgency, authority, limited purpose, expected consequences, duration or review point, notice limits, and later examination required. The temporary action shall not be presented as a final evidential finding or remove the remaining opportunity to challenge material grounds.

C210-073 The notification record shall identify the permitted recipient, route, exact disposition or summary version, dispatch time, known delivery status, and any protected information withheld. The operator shall distinguish dispatch, delivery, receipt acknowledged, and substantive response. A delivery failure material to a review opportunity shall trigger the declared alternative or timing correction.

C210-074 A notice of disposition shall give an accessible account of the outcome, material reasons and limitations, action status, further-review route, relevant deadline and starting event, and assistance available. If the full record cannot be shared, the notice shall explain the permitted way to examine or challenge the grounds without overstating the completeness of the summary.

C210-075 Correction planning shall identify known dependent claims, assessments, records, presentations, and decisions within the operator's control or declared notification relationships. For each, the operator shall record correction performed, review pending, no change with reason, notification sent, unreachable recipient, or another explained status. It shall not assert universal propagation beyond the evidenced boundary.

C210-076 A correction shall preserve a distinguishable relationship between the prior and revised account, its reason and authority, and the time of each formulation, subject to protection and retention. The corrected view shall not present earlier decision makers as having used evidence or categories acquired later. A removed sensitive detail shall not be retained in the public history solely to illustrate the correction.

C210-077 A consequential action or remedy shall be evaluated separately from record correction. The follow-up shall identify the intended practical change, evidence of what occurred, unresolved costs or losses, affected perspectives obtained, and limits on causal attribution. An apology, amended field, or scheduled meeting shall not be recorded as restoration of an opportunity without supporting evidence.

C210-078 A case closure shall identify which issues are disposed, which actions remain pending, who owns continuing follow-up, and the conditions for reopening. Where the declared procedure requires action verification before closure, unavailable verification shall prevent that closure claim. Administrative closure shall not erase outstanding obligations, remaining disagreement, or unavailable evidence.

C210-079 If a disposition is itself corrected, the operator shall identify the earlier disposition and notice versions, the error, authority for correction, affected deadlines or actions, and renewed notifications or response opportunities. A substantive change shall receive the review warranted by its effect, rather than be hidden as a typographic correction.

9 Further review, reopening and continuity

9.1 General

C210-024 The procedure shall provide a declared route to request reconsideration of a material error, new evidence or procedural failure, with its scope, competent recipient and limitations. A reviewer of their own contested action shall not be described as independent.

C210-025 A reopened case shall identify the earlier disposition, trigger, changed evidence or criteria, reviewer and new outcome. Later interpretation shall not silently replace the record of what was known or decided earlier.

C210-026 If the operator lacks competence, authority or resources to complete a material step, it shall record the limitation and notify permitted recipients of the available alternative, postponement or closure basis. Passage of time alone shall not establish a finding on the substantive claim.

9.2 Reconsideration, procedural appeal, and reopening

C210-080 The declaration shall distinguish reconsideration of evidence or judgment, review of procedural failure, conduct handling, and an external legal route where one is asserted. It shall state who can request each route, the grounds and scope, responsible recipient, available remedies, timing, and independence arrangements. Routing assistance shall preserve the submitted concern rather than require technical knowledge of the operator's organization.

C210-081 A further-review request shall receive a linked reference, acknowledgement, admissibility decision with reasons, reviewer assignment, timetable, and notice of any effect on action or closure. A refusal to admit the request shall not be represented as substantive refutation and shall identify any remaining challenge route or explicit limit.

C210-082 A person who made the challenged decision shall not be described as independent when reviewing it. An independent-review claim shall identify the reviewer's separation from the disputed handling and relevant interests. If the declared independent function is unavailable, the operator shall disclose the limitation and refrain from claiming that an independent appeal occurred.

C210-083 The further-review authority shall assess whether disputed action needs a stay, temporary qualification, preservation measure, or other protection within its mandate. The decision shall identify urgency, consequences for affected parties, duration or review point, and reasons. Requesting review shall not be assumed either to stop every action or to leave every action unaffected.

C210-084 Further review shall identify the record and criteria reviewed, new material admitted, opportunities for response, questions determined, reasons, remedy, and implementation responsibility. A procedural reviewer acting outside authority to decide factual merits shall remit the appropriate question rather than relabel a procedural finding as a final factual conclusion.

C210-085 Where a remedy requires renewed notice, evidence examination, reassignment, reconsideration, or action, the operator shall record completion evidence before asserting the remedy fulfilled. The renewed disposition shall link the earlier decision and further-review grounds. Repeating the earlier conclusion without performing the required remedy shall not constitute compliance with the review outcome.

C210-086 A reopening assessment shall distinguish newly available evidence, a material error, changed target conditions, changed categories or criteria, procedural defect, and unimplemented remedy. It shall state whether these grounds affect the past assessment, current action, or both. A later event shall not automatically prove that an earlier claim was mistaken under the evidence then available.

C210-087 A reopened case shall preserve the earlier scope, evidence state, disposition, and consequential uses to the permitted extent and identify the new review boundary. New and prior issues may be linked or separated when the reason is recorded. Reopening shall not silently reset an overdue action or delete the history of a missed response.

C210-088 When a service period is exceeded, the operator shall record the missed event, cause, effect, notice, revised target or authorized extension, and available escalation. An extension shall identify who authorized it and why it is consistent with the declared procedure. Repeated extensions shall trigger capacity review and a reasoned alternative, rather than indefinite pending status without accountability.

C210-089 A handover, operator closure, or loss of a responsible function shall identify open cases, pending actions, permitted successor access, affected notices, and continuity limits. Transfer shall require a stated authority and custody record. Where no successor can accept responsibility, users shall receive the available permitted explanation and alternatives; an unavailable service shall not continue to be advertised as operational.

10 Protection and retention

10.1 General

C210-027 The operator shall specify access, retention, correction and disposal arrangements for submissions, evidence, reviewer notes, dispositions and notifications. Content and audit metadata shall be considered separately; history preservation shall not justify retaining prohibited sensitive material.

C210-028 Disclosure, redaction, access withdrawal or disposal affecting a case shall identify its authority, scope, executor and permitted evidence of the action. The operator shall state known limits concerning copies outside its control.

C210-029 A public summary shall distinguish the accessible grounds from material that cannot be disclosed, where that distinction is itself permitted. It shall not claim full independent inspectability when a material evidential restriction prevents it.

10.2 Differentiated access and protected case handling

C210-090 The operator shall distinguish submission content, identity and contact information, evidence, internal working material, disposition, public summary, and audit information in its access and retention schedule. Access shall correspond to an identified purpose and authority. Permission to examine one component shall not be presumed to authorize onward publication or unrestricted reuse of the case.

C210-091 Before relying on protected grounds for a consequential adverse disposition, the reviewer shall assess whether affected parties can receive a sufficient account or a credible authorized alternative examination. If protection prevents fair examination of a material issue, the operator shall narrow the finding, defer it, or state the unresolved limitation rather than claim fully contestable determination.

C210-092 A controlled view shall identify its source case and disposition version, intended audience, material selection or transformation, and permitted limitations. If acknowledging a particular item's existence is restricted, the view shall state its scope at a safe level without exposing that existence. The protected accountability record shall remain available only within its authorized boundary.

C210-093 A suspected unauthorized disclosure, misdirected notification, or compromise of protected evidence shall receive recorded triage, containment within authority, affected-case assessment, permitted notice, and review of whether the evidence or procedure remains usable. Correction of the public copy shall not be described as recall of copies beyond the operator's control.

C210-094 A retention or disposal decision shall assess ongoing review, action, and reconstruction needs against the applicable protection basis, authority, and schedule. The record shall state what is retained or disposed of, when, by whom, and the permitted verification method. It shall not retain prohibited content merely because a review might theoretically occur in the future.

C210-095 An assessor denied access to material required for an applicable finding shall state the resulting limitation. A protected assessment by another authorized competent person may be cited with its scope and independence limits, but shall not be represented as the first assessor's direct examination. Confidentiality shall not convert an unassessed obligation into fulfillment.

11 Conformance and assessment

11.1 General

C210-030 A conformance report shall identify the procedure or case record assessed, operator, institutional context, this draft and dependency versions, applicable requirements, reviewer relationship, evidence and results. It shall identify the case's material claims as a bounded GR-200 Working Draft 0.2 package and report its applicable requirement results, including package-level obligations. A case-record assessment alone shall not establish that unobserved procedural steps occurred.

C210-031 Each applicable requirement shall receive a supported result of fulfilled, not fulfilled or not assessed; a not-applicable result shall give its trigger-based reason. An unqualified claim of fulfillment shall not omit a failed or unassessed applicable requirement.

C210-032 A procedure assessment shall include an ordinary case and relevant failure cases concerning conflict, unavailable evidence, missed timing, restricted disclosure and correction propagation. A case-record-only assessment shall identify the supplied case and the procedural behavior it cannot establish. Reported success shall be limited to the cases and conditions actually exercised.

This edition defines no reduced case-record conformance profile. A case-only report is a partial documentary assessment. Performance obligations remain not assessed when only their records were examined; not applicable requires an absent stated trigger. A procedure claim covers all applicable requirements and the declared GR-200 package dependency. The multi-case rehearsal obligation in C210-032 is explicitly conditional on procedure assessment.

11.2 Assessment plan, results, and limitations

C210-096 Before assessment, the assessor shall define the procedure version, operator and institutional scope, period observed, cases selected, relevant failure conditions, methods, evidence access, and inde-

pendence or author involvement. A sample of cases shall have an explicit selection rationale and limit; a favorable sample shall not be generalized to unexamined settings without supporting grounds.

C210-097 The assessment register shall give each applicable requirement its own result, evidence locator, method, assessor, and unresolved action, distinguishing documentary adequacy from actual performance where both are required. A grouped test may support several results only when its evidence supports each obligation separately.

C210-098 A procedure assessment shall use the minimum coverage schedule in Annex C and justify any additional failure cases arising from the declared context. A synthetic exercise shall identify fictional actors and unperformed external actions. A demonstration of software behavior shall not establish competent human review, meaningful participation, legal authority, or practical remedy.

C210-099 Assessment shall include an intended user's attempt to locate the route, identify the issue, understand the notice and reasons, and determine the next available action under permitted conditions. The report shall record assistance, barriers, failures, and participant relationship to the design. Author familiarity shall not be reported as independent evidence of ordinary-user comprehension.

C210-100 An assessment finding that results in a corrected procedure, case record, or implementation shall identify the changed version, affected requirements, corrective action, and reassessment scope. Results for unchanged material may be reused only with a recorded reason that the change does not invalidate the evidence. A prior pass shall not automatically transfer across a material change.

C210-101 A public assessment summary shall identify the assessed scope, dependency versions, methods, failures and unassessed requirements, protected-evidence limitations, and whether actions were observed or merely documented. It shall not use a certificate, badge, or concise status to imply factual truth, institutional legitimacy, or full procedure fulfillment beyond the evidence.

Annex A

(normative)

Procedure declaration and service schedule

A.1 General

This schedule specifies the information needed to operate and assess the declared procedure. It does not set universal numerical deadlines. The operator supplies actual values, their justification, and the corresponding authority under C210-003/035. An unspecified period is an incomplete declaration, not an unlimited permission to delay.

C210-102 For every applicable service event in Table A.1, the schedule shall specify the responsible role, starting event, period or deadline, notification, allowed pause or extension, and escalation recipient. If institutional constraints impose a different controlling deadline, the declaration shall identify the asserted source and conflict treatment. A service extension shall not be represented as altering an external deadline beyond the operator's authority.

Table A.1 – Procedure declaration and service-event schedule

Event or arrangement	Required declared treatment
Receipt and acknowledgement	Submission routes; minimum intake content; time of receipt; distinction between receipt and agreement; acknowledgement channel and alternative when contact fails.
Clarification and scoping	Assistance; information requested and purpose; response period; inactivity treatment; routing of separate issues; decision on scope with reasons.
Urgent triage	Risks assessed; available temporary protection; authority; duration or review point; notice and later examination; limits on irreversible action.
Review assignment	Accepted reviewer role; competence; conflicts and challenge route; substitute or unavailable-capacity treatment; intended completion or status-update events.
Grounds and reply	Material grounds disclosed or authorized alternative; response period; adjustments; treatment of new material; consequence of failed notice.
Disposition and notice	Decision responsibility; required reasons; delivery arrangements; action plan; notice of further-review scope, deadline, and starting event.
Further review and reopening	Permitted grounds; recipient; independence; admissibility and response events; stay decision; remedy; new-evidence and closure rules.
Action and closure	Executor; due and review points; verification; dependent corrections; remaining action ownership; closure criteria and later contact.
Protection and continuity	Access categories; retention and disposal basis; incident handling; handover authority; limitations when evidence or operators become unavailable.

Annex B

(normative)

Case-state and transition controls

B.1 General

The states below define procedural meaning rather than mandatory serialized values. A procedure can use local terminology or several parallel issue tracks if the mapping remains explicit. State changes concern handling, while claim assessments and institutional actions have separate versions and statuses.

C210-103 A transition shall identify the prerequisite evidence, authorizing role, permitted notification, and continuing work in Table B.1. Skipping a named state shall be permitted only when its underlying obligations are either fulfilled together with another step or inapplicable for a recorded reason. A state label alone shall not serve as evidence that its prerequisite action occurred.

C210-104 Where a case contains multiple issue or action tracks, the overall state shall identify unresolved tracks and their owners. Disposition of one question shall not close another without an explicit reason. Reopening or remitting an issue shall preserve the earlier disposition and its procedural context while identifying the newly pending work.

Table B.1 – Semantic case states and transition conditions

State	Evidence and permitted transition	Meaning not established by the state
Received	Distinguishable submission and receipt time; move to clarification, scoping, or urgent triage with an accountable owner.	Agreement with the assertion or completeness of evidence.
Awaiting clarification	Specific missing information, support, response opportunity, and review point; proceed on receipt or give a reasoned scope or closure disposition.	Falsity, abuse, or abandonment inferred solely from delay.
Scoped / assigned	Questions, target versions, authority, reviewer and conflicts identified; proceed to material examination or a reasoned referral.	Jurisdiction outside the declared mandate or independent review by title alone.
Under review	Examination plan and performed work; material grounds and reply opportunity; pauses remain recorded with review dates.	That every source is authentic or every planned check has occurred.
Awaiting response	Specified grounds and usable response route; proceed after the declared opportunity, addressing barriers and newly raised issues.	Consent, admission, or waiver inferred from nonresponse.
Disposed	Reasoned issue outcomes, limitations, action and further-review notice; proceed to action, review, or permitted closure.	Action completion, truth certification, or agreement by the submitter.

State	Evidence and permitted transition	Meaning not established by the state
Action pending	Authorized executor, action and review point, dependency and verification record; close or escalate under declared criteria.	Remedy completed because it was ordered or scheduled.
Closed / withdrawn	Recorded basis, disposed and unresolved issues, continuing follow-up and reopening route; later reopen with a linked trigger.	Erasure of remaining disagreement, past consequences, or obligations owned elsewhere.
Reopened / remitted	Earlier outcome, trigger, scope, assigned reviewer, and required remedy identified; return to the affected review step.	Retrospective disappearance of the earlier decision or evidence state.

Annex C

(normative)

Minimum procedure-assessment coverage

C.1 General

This schedule applies to a procedure assessment under C210-032/098. For a case-record-only assessment it identifies behavior that the supplied record cannot establish; it does not turn unobserved performance into a not-applicable result. Cases can combine several conditions when each relevant obligation is separately examined.

C210-105 The procedure assessment shall cover each applicable condition in Table C.1, record the input and expected behavior, observe the action claimed, and retain permitted outcome evidence. It shall identify conditions not exercised and their effect on the assessment claim. A fulfilled result shall not be assigned merely because a specimen record contains the expected fields.

Table C.1 – Minimum assessment conditions and discriminating evidence

Condition	Required assessment focus
Ordinary material challenge	Exercise accessible receipt through reasons, notification and stated next action. Trace claim versions and GR-200 package results. Distinguish completed handling from a template showing intended steps.
Conflict or missing competence	Raise an assignment concern; inspect its independently handled assessment, reassignment or limitation, and effect on progression. A title alone does not prove independence.
Unavailable or dependent evidence	Supply a missing original and several derived copies. Observe scope qualification and treatment of dependence rather than invented verification or independent corroboration.
Missed timing or failed notice	Cross a declared target or introduce a delivery failure. Verify status, extension or escalation, renewed opportunity where needed, and absence of deemed substantive agreement.
Restricted material	Compare authorized and permitted reduced views. Check meaningful response alternatives, audit access, and the stated limit where examination cannot be provided.
Category or rule challenge	Separate application from adequacy or authority; trace referral and its acceptance status. Correct application does not alone dispose of a challenge to the rule.
Correction and practical action	Follow a revised assessment to known dependencies and an executor. Distinguish notification, correction, action completion, verification, and unresolved loss.
Further review and reopening	Exercise a procedural or evidential request, stay decision where relevant, reasoned outcome and remedy, and reopening on a distinct trigger. Preserve prior meanings and time boundaries.

Annex D

(informative)

Worked cases and interpretation

D.1 Missing attachment and changed classification

The following case elaborates the synthetic dossier in `examples/p1-contested-decision.md`. None of its actors, notices, decisions, or remedies represents a live institution. A fictional research fund rejects a water-monitoring application after a generated summary states that the equipment was never calibrated. Its intake extract shows only that a calibration attachment was absent. A technician later supplies testimony and a maintenance-log excerpt, while the protected original contains contact details.

Intake creates a case with three questions: whether calibration occurred, whether the application met the existing documentary rule, and whether that rule gives appropriate recognition to maintenance evidence. The first requires claim-relative assessment. The second requires application of the declared rule version. The third is referred to the function authorized to review the rule. None of these operations alone determines a legal claim or an award of funding.

The reviewer distinguishes the absent attachment from non-occurrence, the generated summary from source evidence, and the log excerpt from independent examination of its original. Testimony and a log can share a source; their number does not establish independence. The protected original receives controlled handling with a safe account of the grounds available for response. If the reviewer cannot examine calibration quality or instrument identity, the disposition preserves those limits even while revising the overbroad statement that no calibration occurred.

The record correction links the old and revised claims. A later rule change records its own effective interval rather than making the earlier decision appear to have used the new rule. Scheduling a renewed eligibility review creates an action-pending state, not an award or restoration of lost training opportunities. Practical follow-up investigates the reported interruption, the scope of attribution, and the actual effect of any later response.

D.2 Protected grounds and unavailable independent review

In a second synthetic case, a person disputes an adverse classification based partly on restricted testimony. The operator cannot safely disclose the witness's identity. It provides a redacted account of the material allegation and explores controlled examination by an independent reviewer. The distinction between protection and warrant matters: hiding an identity does not establish the allegation, while the need to test an allegation does not itself authorize publication of the identity.

Suppose the only available reviewer authored the classification. They can explain their original sources and conduct a disclosed reconsideration, but the operator cannot label that work independent. If a credible alternative examination cannot be arranged, the disposition identifies the unresolved procedural and evidential limits. A narrow temporary protective action can be separately considered within actual authority; it does not convert the disputed allegation into a final finding.

The relevant assessment results remain granular. A documented restriction basis can fulfill a documentary obligation. An unperformed independent review remains not assessed. A case record describing a desired notice does not establish delivery or a meaningful response opportunity. The case can close administratively under declared limits without claiming that the underlying factual disagreement has been resolved.

D.3 Outage, deadline, and later reopening

A third synthetic case concerns a challenge received during a service outage. The original timestamp and failed acknowledgement remain recorded. An extension notice identifies the operational cause, responsible

role, revised target and escalation route. If a separate institutional deadline applies, the operator states its asserted source and whether it has authority to alter it; a service notice is not treated as changing external law.

Later material reveals that the original classification depended on a mistaken identity link. Reopening identifies this evidential trigger and the affected past assessment, while preserving the decision and its consequences during the intervening period. The remedy includes checking known dependent views and actions. An unreachable external recipient is recorded as unreachable rather than silently treated as corrected.

Annex E

(informative)

Source rationale and unresolved profile decisions

E.1 Operational interpretation

The synthetic funding case accompanying GR-110 supplies a common example. The procedure's record requirements can be implemented manually before a network protocol is needed. A later Specification would define message correlation, delivery, authorization, concurrent revision and failure semantics in response to demonstrated requirements.

The initial operational direction is recorded in ADR-0004. This expanded procedure remains a programme proposal, not a claim that the foundation manuscripts prescribe these case states, deadlines, or institutional functions. Chapter 5 treats evidence as a role relative to an epistemic target and distinguishes just participation from evidential adequacy. Those distinctions motivate separate assessment of access, method, warrant, disposition, and consequences. The record preserves both a supported conclusion and the limits of the procedure that produced it. For the expansion decision and alternatives, see `decisions/ADR-0005-expanded-drafts-and-source-models.md`. The comparison record is `docs/references/drafting_models.md`.

The choice of explicit schedules follows the need to make a procedure exercisable by someone other than its author. Alternatives include a general right-to-comment statement, a fixed software workflow, or a single universal adjudication model. The first leaves response and remedy underspecified; the other two impose technical or institutional commitments beyond this draft's scope. The selected approach fixes inspectable obligations while profiles specify contextual authority and service arrangements.

The United Nations National Quality Assurance Frameworks Manual provides an informative comparison for separating institutional capacity, process quality, and output quality. Here, the operator and authority declaration, observed review behavior, and resulting case record receive distinct assessment evidence. This translation is a programme design choice; it does not assert that an official-statistics framework creates rights or governs the review procedure. ISO's model document and ITU-T drafting guidance inform publication structure rather than the evidential meaning of a finding.

OPEN ISSUE Service periods, independence arrangements, proof of authority, available remedies, costs and admissible disclosure depend on the institution and require a scoped profile. A synthetic procedure cannot establish their validity in a live jurisdiction.

OPEN ISSUE Abuse handling, protection of vulnerable participants, meaningful access under low resources and the burden of keeping case histories require review with affected users before live deployment.

OPEN ISSUE No reduced profile, universal evidential threshold, legal admissibility rule, or machine protocol is adopted. Domain-specific proof standards, representative arrangements, protected disclosure mechanisms, and independently feasible remedies require their own competent review and recorded authority.

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