

GENERATIVE RELATIONAL ECONOMICS

VOLUME II

Epistemology, Research Praxis, and Relational Inquiry

EPISTEMOLOGY • PRAXIS • INQUIRY

WANHONG HUANG

GENERATIVE RELATIONAL ECONOMICS

Seven-Volume Treatise

Volume II

**Epistemology, Research Praxis, and
Relational Inquiry**

Chapters 5–7

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Series Structure

Generative Relational Economics is organized as a seven-volume treatise. Chapter numbering remains continuous across the series.

Volume I. *Foundations, Constitution, and Ontology of Generative Relational Economics* (Chapters 1–4)

Volume II. *Epistemology, Research Praxis, and Relational Inquiry* (Chapters 5–7)

Volume III. *Generative Relational Inquiry and Integrated Research Design* (Chapters 8–9)

Volume IV. *Application-Dominant Praxis, Intervention, and Economic Architecture* (Chapters 10–12)

Volume V. *Allocation, Value, Spacetime, Power, and Epistemic Economy* (Chapters 13–17)

Volume VI. *Artificial Intelligence, Domains, and Economic Order* (Chapters 18–21)

Volume VII. *Research Programme, Disciplinary Interfaces, Limits, and Open Development* (Chapters 22–25)

The seven-volume division is a physical and editorial organization of the same continuous manuscript. Existing chapter identities, section numbering, notation, bibliography records, and conceptual architecture are preserved. The additional physical volume allows the edition to remain within the publisher's 1,050-page ceiling without compressing the typography or splitting chapters.

Preface

This book develops *Generative Relational Economics* (GRE) as an open research programme for studying economic life through relations, generative processes, historical transformation, heterogeneous forms of value, and the conditions under which present arrangements alter future possibilities. Its point of departure is economic, but the questions that must be answered before a relational-generative economics can be stated coherently are broader. A theory of economic relations requires a view of what kinds of realities may be treated as analytically real; claims about those realities require an epistemology; empirical work requires a research praxis and methodology; and economic intervention requires an account of decision and action under incomplete knowledge. The book therefore develops a limited set of broader Generative Relational (GR) foundations before returning to substantive economics.

The resulting architecture should not be read as a claim that economics contains ontology, epistemology, history, law, governance, aesthetics, or the other domains with which it interacts. The opposite discipline governs the project. A domain remains defined by its principal problem-space while retaining explicit interfaces with neighboring domains. GRE draws historical insight from generative relational approaches to history, governance insight from neighboring work on generative relational governance, and normative and aesthetic resources where economic questions require them. Those interfaces remain interfaces. They do not dissolve the boundaries among disciplines.

The central economic concern is the generation and transformation of relational possibilities. Conventional allocation questions remain important, but an allocation does more than change holdings. It may stabilize or weaken relations, generate capacities, alter access, reshape institutions, change the pathways through which heterogeneous values circulate, and modify what later actors are able to do. GRE therefore follows resources beyond the administrative recipient and asks how economic interventions enter relational structures and how those structures develop through time.

This orientation also changes the treatment of value. The book does not assume that all values can be placed in a single common metric. Material, capability, relational, epistemic, institutional, future, and other forms of value may interact without becoming fully commensurable. Their conversion is therefore an economic problem in its own right. GRE asks what happens at conversion interfaces, which actors can define or control those interfaces, what is lost or generated in conversion, how value circulates and returns, and how power and justice appear when heterogeneous values move through unequal relational systems.

Historical time is equally central. Economic processes operate across different temporal scales. Transactions, prices, attention, organizational routines, institutions, trust structures, infrastructures, and intergenerational capacities need not change at comparable rates. The book consequently treats trajectories, delayed generation, path dependence, multiple timescales, and

cross-scale coupling as economic objects rather than as secondary complications. Formal descriptions such as dynamical systems, networks, fields, geometry, category-theoretic structures, or spacetime-like representations are used where they clarify such problems. They remain analytical representations whose scope must be justified locally; they do not establish the ultimate ontology of social or economic reality.

The book also treats research itself as praxis. Historical, interpretive, qualitative, quantitative, empirical, formal, and computational methods provide partially irreducible modes of access to relational-generative systems. Their relation is therefore neither a hierarchy nor a simple synthesis. They can expose one another's blind spots, constrain one another's overreach, and generate revisions of concepts and theories. Research-dominant praxis and application-dominant praxis are likewise related configurations rather than separate worlds. Research contains decisions and interventions; application contains inquiry and learning. Their principal tensions differ, and either may transform into the other as the practical situation changes.

Artificial intelligence makes several of these questions more urgent. Large asymmetries in productive and epistemic capability may persist even where material output becomes abundant. Such asymmetries raise economic questions about ownership, dependence, participation, access, value capture, research orientation, and the relation between productive contribution and social membership. GRE approaches these questions without assuming that capability equality is either possible or desirable. The relevant issue is how heterogeneous capabilities enter relations and how those relations convert asymmetry into power, exclusion, participation, or new generative possibilities.

The programme offered here is deliberately revisable. Earlier GR formulations, including earlier historical and formal proposals, are treated as intellectual resources rather than canonical premises. A useful distinction may later fail in another domain; a formal analogy may lack empirical warrant; a theory may require a narrower scope; an apparently general GR structure may turn out to be economics-specific. Revision is therefore part of the framework's normal development rather than an exceptional repair.

For the same reason, GRE is presented in dialogue with existing economics rather than as a replacement for it. Neoclassical, Marxian, Keynesian, institutional, evolutionary, complexity, feminist and care, capability, ecological, commons, relational, and other traditions have developed objects, mechanisms, methods, and normative distinctions that GRE can learn from. A relational language may sometimes make translation among these traditions possible. Translation does not imply theoretical identity. Some disagreements should remain visible because they concern different ontologies, values, methods, scales, or historical commitments.

The book is consequently best read as an architecture for continuing inquiry. It makes substantive claims, proposes hypotheses, develops conceptual distinctions, and offers formal and methodological resources, while marking open problems and places where counterevidence would require revision. Its intended endpoint is not a closed economic system. It is a research programme capable of entering new relations, being altered by them, and preserving enough of its own history for later readers to understand how those alterations occurred.

Standing of the Work

This volume is a book-length statement of Generative Relational Economics as a developing research programme. Its standing is stronger than that of a preliminary note and weaker than that of a closed theoretical system. The distinction matters because the chapters contain several kinds of intellectual object whose evidential and argumentative status differs.

A *claim* is a proposition for which the book supplies an argument at the level required by its local purpose. A *proposal* identifies a conceptual or theoretical structure offered for further assessment. A *hypothesis* states a mechanism or relation whose standing ultimately depends on empirical, historical, or formal investigation beyond the argument that motivates it. A *heuristic* organizes inquiry without asserting that the represented structure literally constitutes the world. A *formal representation* specifies a mathematical or structural language under explicit assumptions. These categories should remain distinct throughout the manuscript.

The broader GR material in the book has a similarly limited standing. GRE is the principal domain. General ontological, epistemological, research-practical, and application-practical foundations are developed only to the degree required to construct GRE. The volume does not claim to provide a completed Generative Relational Theory across all disciplines. A more general theory would require sustained comparison across independently developed domains, including cases in which concepts useful in economics fail, change meaning, or become unnecessary elsewhere.

Ontological suspension provides the default discipline for that reason. Relational reality and manifestational reality are treated as analytically meaningful without requiring a final metaphysical settlement for every object under study. Formal language may sharpen a relational description, but formal usefulness does not by itself establish ontological identity. A field representation, a network, a dynamical system, a category-theoretic mapping, or a spacetime-like model earns its place through the question it helps answer and the evidence or interpretation to which it can be connected.

The historical standing of the programme is equally important. Earlier GR and GRH formulations are open to correction. The present book may retain an earlier distinction, weaken it, change its status from ontology to heuristic, or set it aside. Such changes should remain reconstructable rather than being hidden by retrospective rewriting. The research programme therefore values provenance, versioned concepts, preservation of negative results, and future re-epistemization.

GRE also declines several forms of premature closure. It assumes no single universal metric of value, no predetermined historical endpoint, no universal formalism, and no methodological monopoly. Generativity itself is not treated as automatically good. A process can generate capacities, relations, or options while also producing domination, extraction, exclusion, or

harm. Normative evaluation therefore remains an independent task informed by, rather than mechanically derived from, generative description.

The volume's relationship to existing economics is dialogical. Existing theories can correct GRE, delimit its scope, or supply better explanations for particular problems. GRE can also provide a comparative relational language through which theories that foreground different objects or scales may encounter one another. The success of such translation must be assessed case by case. Failed translation is itself informative because it identifies theoretical specificity that a common language should not erase.

The same discipline governs application. The book develops application-dominant praxis because economic actors often must decide before knowledge is complete. Decisions remain epistemically regulated, historically situated, normatively contestable, and revisable where reversal is possible. Practical closure is therefore distinguished from epistemic closure. Acting under uncertainty does not convert uncertainty into knowledge; it establishes a provisional commitment whose consequences become part of the next epistemic situation.

The work should therefore be evaluated at several levels: the coherence of its conceptual distinctions, the adequacy of its reconstructions, the quality of its dialogue with existing theories, the warrant of its formal representations, the empirical tractability of its hypotheses, and the practical usefulness of the questions it makes available. No single success at one level secures the others. The open research programme begins from that plurality of burdens.

Guide to the Book

The book is organized into eight Parts. The sequence is cumulative, although individual chapters can be read independently when a reader already accepts the foundations on which they rely.

Part I: Foundations and Constitution of Generative Relational Economics. The opening Part reconstructs the historical conditions under which GRE becomes necessary and possible, surveys the intellectual resources from which it can be constructed, and defines GRE as an emerging economic research programme. The emphasis is disciplinary: the Part explains the problem-space before introducing the broader GR foundations required later.

Part II: Ontology and Epistemology. The second Part develops the ontological view and epistemology used by the remainder of the book. Ontological suspension, relational reality, manifestational reality, representation, evidence, and the limits of inverse inference establish the conditions under which later economic claims can be made without converting analytical representations into final metaphysical commitments.

Part III: Research Praxis and Methodology. The third Part treats research as a historically situated form of praxis. It develops methodological pluralism across historical, interpretive, qualitative, quantitative, empirical, formal, and computational inquiry; then it develops methods for relational inquiry, generative relational inquiry, and integrated research design. Readers primarily interested in empirical or formal GRE can use this Part as the methodological gateway to the substantive economic chapters.

Part IV: Application-Dominant Praxis and Methodology. The fourth Part shifts the principal practical tension from understanding toward decision and intervention under incomplete knowledge. It develops action spaces, practical judgment, risk, reversibility, participation, responsibility, adaptive intervention, and the methodological instruments used for decision and institutional change. Research and application remain coupled throughout.

Part V: Foundations of Substantive Generative Relational Economics. The fifth Part returns fully to the economic domain. It develops the relational architecture of economic systems, allocation as relational intervention, generative and heterogeneous value, and generative spacetime. This Part contains the main conceptual machinery for following resources and values through relational structures across time and scale.

Part VI: Power, Knowledge, and Artificial Intelligence. The sixth Part develops several major consequences of substantive GRE. Power and justice are examined through asymmetry, conversion, capture, participation, and generative opportunity. The epistemic economy extends the analysis to knowledge abundance, attention, curiosity, aesthetic judgment, and research orientation. The final chapter of the Part examines artificial intelligence under radical capability and knowledge asymmetry.

Part VII: Domains and Economic Synthesis. The seventh Part examines selected domains in which GRE can be tested, translated, and limited. The purpose is not to absorb education, research institutions, humanitarian practice, communities, commons, ecology, or other domains into economics. Domain work identifies where GRE is useful, where neighboring theories are required, and where apparently general concepts become domain-specific. The Part concludes with a synthesis of the economic orders made thinkable by GRE.

Part VIII: Dialogue, Research Programme, and Disciplinary Return. The final Part turns the framework back toward economics as a discipline. Existing economic traditions are reconstructed in relational dialogue without ranking or forced unification. The book then states a GRE research programme, identifies interfaces with neighboring GR domains, records limits and open problems, and closes with GRE's standing as an open and historically revisable programme rather than a finished canon.

Readers can therefore enter the book at different points. A reader interested in foundations should begin with Parts I and II. A methodological reader can move from Chapter 6 through Chapter 11. A reader primarily interested in GRE's economic contribution can begin with Part V and return to the earlier foundations as needed. Readers concerned with AI, epistemic economy, power, or justice may begin in Part VI, while Part VIII provides the most direct account of GRE's relationship to existing economics and its future research agenda.

Cross-references are used to keep these entry points possible without pretending that the chapters are independent. Concepts are introduced where they first become structurally necessary, and later chapters should reuse rather than silently redefine them. Where a concept changes status or scope, the revision should be stated explicitly.

AI Assistance Statement

Artificial intelligence has been used as an assistive research and writing instrument in the development of this book. Its uses include structural planning, language revision, comparison of alternative organizations, code generation for manuscript tooling, compilation support, exploration of formal representations, and assistance in maintaining consistency across a long and evolving project.

AI assistance does not function as an evidential authority. External references are subject to a pre-verification rule: a source must be checked against an authoritative or reliable online record and against the claim it is intended to support before the citation is inserted into the manuscript. Bibliographic verification, claim selection, theoretical commitments, normative judgments, and responsibility for the final text remain with the author.

The use of AI is also treated as part of the book's substantive research problem. Abundant generation of prose, models, hypotheses, and technically difficult questions does not eliminate the need for research judgment. Problem selection, historical sensitivity, relational interpretation, aesthetic judgment, normative responsibility, and decisions about theoretical significance remain distinct tasks even when generative capacity is extensively automated.

Because the project is developed through iterative human–AI interaction, intermediate drafts may contain exploratory formulations that are later revised or abandoned. The standing of the published text is determined by the final human-reviewed manuscript rather than by any individual intermediate generation. Revision histories and project materials are preserved where useful so that the development of the programme remains reconstructable.

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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, behav-

iorally 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 develops 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 alterna-

tive 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 question 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 materially 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, selec-

tion 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 transformations 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 configura-

tion 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 non-entailment 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 Relational Knowledge and Manifestation

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.

$$\mathcal{K}(y \mid C, E, A) = \{x \in X \mid x \text{ remains compatible with } y \text{ under } C, E, A\}. \quad (5.1)$$

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 automat-

ically 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 altered 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 gener-

ate 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 co-variation* 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 recover 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 heterogeneous 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 configurations, 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 con-

tract 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, inconsistencies, 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 ac-

count 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 increase 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 in-

ferred 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, evaluating, 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 complete-

ness.

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 enabling 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 perfor-

mative 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 institutional 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 interaction 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 categories, 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 recon-

structions. 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 actions 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 economically 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 recoverable 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 observa-*

tion 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). Multi-scale 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, governance 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 re-constructed 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 some-

times 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 pro-

posed 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 formally 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 differs 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 observa-

tions 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 relation, 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 constituted.

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 concerns 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, nesting 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, multi-

layer 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 ex-

ceed 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 establishing 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, information, 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. Blockmodel-

ing, 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 observa-

tions 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 member-

ship. 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 arising 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 rou-

tines, 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 net-

work 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 ef-

fect 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 crite-

tion 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 re-

lation 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, disident 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 accessible, 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 lim-

itations 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 hori-

zons.

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 relational 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 interview, 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 be-

haviors (Einav and J. Levin 2014), while public data systems increasingly combine administrative, 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 con-

stitute 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 adjustment. 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 prema-

turely 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 transformed 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, images, 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 re-

coverable. 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 addi-

tional 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 ev-

idence 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. Normative 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 con-

tains 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. Longitu-

dinal 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 simultaneously 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 orga-

nization or resolution at which their relations are represented. The two interact, but they can vary independently. The same bounded population can be studied at individual, 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 prema-

ture 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 participa-

tion 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, rep-

utational 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, ecological 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 jus-

tice 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 evidential 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 re-

peated 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, missingness 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 subse-

quently 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 tem-

poral sequences, comparison of alternative classifications, detection of anomalous patterns, and generation of candidate hypotheses for human examination. These applications 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 consequential 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, his-

torical 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 be-

tween 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 evidence 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 evidence 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 mate-

rially 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 knowledge 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, un-

certainty, 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 in-

completely 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 appar-

ently 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 capacity 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 settle-

ment.

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 Methodological Implications of GRE Epistemology

This section closes the epistemic argument of this chapter by translating the chapter's commitments into requirements for subsequent research design. Its role is transi-

tional: 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 contrac-

tual 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 relation; 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 expose 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 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 answer-

able to the limits of its access and representation. Methodology therefore becomes the practical organization of disciplined inquiry under the epistemic conditions established here.

References

- Appadurai, Arjun (1986). “Introduction: Commodities and the Politics of Value”. In: *The Social Life of Things: Commodities in Cultural Perspective*. Ed. by Arjun Appadurai. Cambridge: Cambridge University Press, pp. 3–63. doi: [10.1017/CB09780511819582.003](https://doi.org/10.1017/CB09780511819582.003).
- Arthur, W. Brian (1989). “Competing Technologies, Increasing Returns, and Lock-In by Historical Events”. In: *The Economic Journal* 99.394, pp. 116–131. doi: [10.2307/2234208](https://doi.org/10.2307/2234208).
- (1999). “Complexity and the Economy”. In: *Science* 284.5411, pp. 107–109. doi: [10.1126/science.284.5411.107](https://doi.org/10.1126/science.284.5411.107).
- Austin, J. L. (1962). *How to Do Things with Words*. Ed. by J. O. Urmson. Oxford: Clarendon Press.
- Bar-Yam, Yaneer (2004). “Multiscale Variety in Complex Systems”. In: *Complexity* 9.4, pp. 37–45. doi: [10.1002/cplx.20014](https://doi.org/10.1002/cplx.20014).
- Battiston, Federico, Giulia Cencetti, Iacopo Iacopini, Vito Latora, Maxime Lucas, Alice Patania, Jean-Gabriel Young, and Giovanni Petri (2020). “Networks beyond Pairwise Interactions: Structure and Dynamics”. In: *Physics Reports* 874, pp. 1–92. doi: [10.1016/j.physrep.2020.05.004](https://doi.org/10.1016/j.physrep.2020.05.004).
- Bender, Emily M., Timnit Gebru, Angelina McMillan-Major, and Margaret Mitchell (2021). “On the Dangers of Stochastic Parrots: Can Language Models Be Too Big?” In: *Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency*, pp. 610–623. doi: [10.1145/3442188.3445922](https://doi.org/10.1145/3442188.3445922).
- Bourdieu, Pierre (1991). *Language and Symbolic Power*. Ed. by John B. Thompson. Cambridge, MA: Harvard University Press.
- Bourdieu, Pierre and Loïc J. D. Wacquant (1992). *An Invitation to Reflexive Sociology*. Chicago: University of Chicago Press.
- Breiger, Ronald L. (1974). “The Duality of Persons and Groups”. In: *Social Forces* 53.2, pp. 181–190. doi: [10.1093/sf/53.2.181](https://doi.org/10.1093/sf/53.2.181).
- Brubaker, Rogers and Frederick Cooper (2000). “Beyond “Identity””. In: *Theory and Society* 29.1, pp. 1–47. doi: [10.1023/A:1007068714468](https://doi.org/10.1023/A:1007068714468).
- Burrell, Jenna (2016). “How the Machine ‘Thinks’: Understanding Opacity in Machine Learning Algorithms”. In: *Big Data & Society* 3.1. doi: [10.1177/2053951715622512](https://doi.org/10.1177/2053951715622512).
- Cassirer, Ernst (1955). *The Philosophy of Symbolic Forms, Volume 1: Language*. Trans. by Ralph Manheim. New Haven, CT: Yale University Press.
- David, Paul A. (1985). “Clio and the Economics of QWERTY”. In: *American Economic Review* 75.2, pp. 332–337.
- Desrosières, Alain (1998). *The Politics of Large Numbers: A History of Statistical Reasoning*. Trans. by Camille Naish. Cambridge, MA: Harvard University Press.
- Duhem, Pierre (1954). *The Aim and Structure of Physical Theory*. Trans. by Philip P. Wiener. Princeton, NJ: Princeton University Press.

- Eglash, Ron (2016). "An Introduction to Generative Justice". In: *Teknokultura. Revista de Cultura Digital y Movimientos Sociales* 13.2, pp. 369–404. DOI: [10.5209/rev_TEKN.2016.v13.n2.52847](https://doi.org/10.5209/rev_TEKN.2016.v13.n2.52847).
- Eglash, Ron, Kwame P. Robinson, Audrey Bennett, Lionel Robert, and Mathew Garvin (2024). "Computational Reparations as Generative Justice: Decolonial Transitions to Unalienated Circular Value Flow". In: *Big Data & Society* 11.1. DOI: [10.1177/20539517231221732](https://doi.org/10.1177/20539517231221732).
- Einav, Liran and Jonathan Levin (2014). "Economics in the Age of Big Data". In: *Science* 346.6210, p. 1243089. DOI: [10.1126/science.1243089](https://doi.org/10.1126/science.1243089).
- Emirbayer, Mustafa (1997). "Manifesto for a Relational Sociology". In: *American Journal of Sociology* 103.2, pp. 281–317. DOI: [10.1086/231209](https://doi.org/10.1086/231209).
- Espeland, Wendy Nelson and Michael Sauder (2007). "Rankings and Reactivity: How Public Measures Recreate Social Worlds". In: *American Journal of Sociology* 113.1, pp. 1–40. DOI: [10.1086/517897](https://doi.org/10.1086/517897).
- Espeland, Wendy Nelson and Mitchell L. Stevens (1998). "Commensuration as a Social Process". In: *Annual Review of Sociology* 24, pp. 313–343. DOI: [10.1146/annurev_soc.24.1.313](https://doi.org/10.1146/annurev_soc.24.1.313).
- Fligstein, Neil and Doug McAdam (2012). *A Theory of Fields*. New York: Oxford University Press. DOI: [10.1093/acprof:oso/9780199859948.001.0001](https://doi.org/10.1093/acprof:oso/9780199859948.001.0001).
- Fraassen, Bas C. van (1980). *The Scientific Image*. Oxford: Oxford University Press. DOI: [10.1093/0198244274.001.0001](https://doi.org/10.1093/0198244274.001.0001).
- Fricker, Miranda (2007). *Epistemic Injustice: Power and the Ethics of Knowing*. Oxford: Oxford University Press. DOI: [10.1093/acprof:oso/9780198237907.001.0001](https://doi.org/10.1093/acprof:oso/9780198237907.001.0001).
- Gangl, Markus (2010). "Causal Inference in Sociological Research". In: *Annual Review of Sociology* 36, pp. 21–47. DOI: [10.1146/annurev_soc.012809.102702](https://doi.org/10.1146/annurev_soc.012809.102702).
- Gebru, Timnit, Jamie Morgenstern, Briana Vecchione, Jennifer Wortman Vaughan, Hanna Wallach, Hal Daumé III, and Kate Crawford (2021). "Datasheets for Datasets". In: *Communications of the ACM* 64.12, pp. 86–92. DOI: [10.1145/3458723](https://doi.org/10.1145/3458723).
- Giddens, Anthony (1984). *The Constitution of Society: Outline of the Theory of Structuration*. Cambridge: Polity Press.
- Giere, Ronald N. (2004). "How Models Are Used to Represent Reality". In: *Philosophy of Science* 71.5, pp. 742–752. DOI: [10.1086/425063](https://doi.org/10.1086/425063).
- (2006). *Scientific Perspectivism*. Chicago: University of Chicago Press. DOI: [10.7208/chicago/9780226292144.001.0001](https://doi.org/10.7208/chicago/9780226292144.001.0001).
- Granovetter, Mark (1985). "Economic Action and Social Structure: The Problem of Embeddedness". In: *American Journal of Sociology* 91.3, pp. 481–510. DOI: [10.1086/228311](https://doi.org/10.1086/228311).
- Gross, Thilo and Bernd Blasius (2008). "Adaptive Coevolutionary Networks: A Review". In: *Journal of the Royal Society Interface* 5.20, pp. 259–271. DOI: [10.1098/rsif.2007.1229](https://doi.org/10.1098/rsif.2007.1229).
- Hacking, Ian (2002). *Historical Ontology*. Cambridge, MA: Harvard University Press.
- Hansmann, Henry and Reinier Kraakman (2000). "The Essential Role of Organizational Law". In: *The Yale Law Journal* 110.3, pp. 387–440.
- Hart, H. L. A. (2012). *The Concept of Law*. Ed. by Joseph Raz, Penelope A. Bulloch, and Leslie Green. 3rd ed. Oxford: Oxford University Press.
- Hedström, Peter and Petri Ylikoski (2010). "Causal Mechanisms in the Social Sciences". In: *Annual Review of Sociology* 36, pp. 49–67. DOI: [10.1146/annurev_soc.012809.102632](https://doi.org/10.1146/annurev_soc.012809.102632).

- Holme, Petter and Jari Saramäki (2012). “Temporal Networks”. In: *Physics Reports* 519.3, pp. 97–125. DOI: [10.1016/j.physrep.2012.03.001](https://doi.org/10.1016/j.physrep.2012.03.001).
- Hutchins, Edwin (1995). *Cognition in the Wild*. Cambridge, MA: MIT Press. ISBN: 9780262082310.
- Kellogg, Katherine C., Melissa A. Valentine, and Angèle Christin (2020). “Algorithms at Work: The New Contested Terrain of Control”. In: *Academy of Management Annals* 14.1, pp. 366–410. DOI: [10.5465/annals.2018.0174](https://doi.org/10.5465/annals.2018.0174).
- Kivelä, Mikko, Alex Arenas, Marc Barthelemy, James P. Gleeson, Yamir Moreno, and Mason A. Porter (2014). “Multilayer Networks”. In: *Journal of Complex Networks* 2.3, pp. 203–271. DOI: [10.1093/comnet/cnu016](https://doi.org/10.1093/comnet/cnu016).
- Kopytoff, Igor (1986). “The Cultural Biography of Things: Commoditization as Process”. In: *The Social Life of Things: Commodities in Cultural Perspective*. Ed. by Arjun Appadurai. Cambridge: Cambridge University Press, pp. 64–92. DOI: [10.1017/CB09780511819582.004](https://doi.org/10.1017/CB09780511819582.004).
- Kroll, Joshua A., Joanna Huey, Solon Barocas, Edward W. Felten, Joel R. Reidenberg, David G. Robinson, and Harlan Yu (2017). “Accountable Algorithms”. In: *University of Pennsylvania Law Review* 165.3, pp. 633–705.
- Kuhn, Thomas S. (1962). *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press.
- Levin, Simon A. (1998). “Ecosystems and the Biosphere as Complex Adaptive Systems”. In: *Ecosystems* 1.5, pp. 431–436. DOI: [10.1007/s100219900037](https://doi.org/10.1007/s100219900037).
- Longino, Helen E. (1990). *Science as Social Knowledge: Values and Objectivity in Scientific Inquiry*. Princeton, NJ: Princeton University Press.
- MacKenzie, Donald (2006). *An Engine, Not a Camera: How Financial Models Shape Markets*. MIT Press. ISBN: 9780262134606.
- Manski, Charles F. (2008). *Identification for Prediction and Decision*. Cambridge, MA: Harvard University Press. ISBN: 9780674026537.
- Martin, John Levi (2003). “What Is Field Theory?” In: *American Journal of Sociology* 109.1, pp. 1–49. DOI: [10.1086/375201](https://doi.org/10.1086/375201).
- Newman, M. E. J. (2003). “The Structure and Function of Complex Networks”. In: *SIAM Review* 45.2, pp. 167–256. DOI: [10.1137/S003614450342480](https://doi.org/10.1137/S003614450342480).
- North, Douglass C. (1990). *Institutions, Institutional Change and Economic Performance*. Cambridge: Cambridge University Press.
- Ostrom, Elinor (1998). “A Behavioral Approach to the Rational Choice Theory of Collective Action: Presidential Address, American Political Science Association, 1997”. In: *American Political Science Review* 92.1, pp. 1–22. DOI: [10.2307/2585925](https://doi.org/10.2307/2585925).
- (2009). “A General Framework for Analyzing Sustainability of Social-Ecological Systems”. In: *Science* 325.5939, pp. 419–422. DOI: [10.1126/science.1172133](https://doi.org/10.1126/science.1172133).
- Pierson, Paul (2000). “Increasing Returns, Path Dependence, and the Study of Politics”. In: *American Political Science Review* 94.2, pp. 251–267. DOI: [10.2307/2586011](https://doi.org/10.2307/2586011).
- Popper, Karl R. (2002). *The Logic of Scientific Discovery*. 2nd ed. London: Routledge.
- Porter, Theodore M. (1995). *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life*. Princeton, NJ: Princeton University Press.
- Powell, Walter W., Kenneth W. Koput, and Laurel Smith-Doerr (1996). “Interorganizational Collaboration and the Locus of Innovation: Networks of Learning in Biotechnology”. In: *Administrative Science Quarterly* 41.1, pp. 116–145. DOI: [10.2307/2393988](https://doi.org/10.2307/2393988).
- Quine, W. V. (1948). “On What There Is”. In: *The Review of Metaphysics* 2.5, pp. 21–38.

- (1951). “Two Dogmas of Empiricism”. In: *The Philosophical Review* 60.1, pp. 20–43. DOI: [10.2307/2181906](https://doi.org/10.2307/2181906).
- Ricoeur, Paul (1991). *From Text to Action: Essays in Hermeneutics, II*. Trans. by Kathleen Blamey and John B. Thompson. Evanston, IL: Northwestern University Press.
- Searle, John R. (1995). *The Construction of Social Reality*. New York: Simon & Schuster.
- Sen, Amartya (1999). *Development as Freedom*. Oxford: Oxford University Press.
- Sewell William H., Jr. (1996). “Historical Events as Transformations of Structures: Inventing Revolution at the Bastille”. In: *Theory and Society* 25.6, pp. 841–881. DOI: [10.1007/BF00159818](https://doi.org/10.1007/BF00159818).
- Simmel, Georg (1906). “The Sociology of Secrecy and of Secret Societies”. In: *American Journal of Sociology* 11.4, pp. 441–498. DOI: [10.1086/211418](https://doi.org/10.1086/211418).
- Simon, Herbert A. (1962). “The Architecture of Complexity”. In: *Proceedings of the American Philosophical Society* 106.6, pp. 467–482.
- Stanford, Kyle (2023). *Underdetermination of Scientific Theory*. Stanford Encyclopedia of Philosophy, substantive revision 4 April 2023. URL: <https://plato.stanford.edu/entries/scientific-underdetermination/>.
- Throsby, David (2001). *Economics and Culture*. Cambridge: Cambridge University Press.
- Wellman, Barry (1983). “Network Analysis: Some Basic Principles”. In: *Sociological Theory* 1, pp. 155–200. DOI: [10.2307/202050](https://doi.org/10.2307/202050).
- White, Harrison C. (2008). *Identity and Control: How Social Formations Emerge*. 2nd ed. Princeton, NJ: Princeton University Press.
- White, Harrison C., Scott A. Boorman, and Ronald L. Breiger (1976). “Social Structure from Multiple Networks. I. Blockmodels of Roles and Positions”. In: *American Journal of Sociology* 81.4, pp. 730–780. DOI: [10.1086/226141](https://doi.org/10.1086/226141).
- Winsberg, Eric (2010). *Science in the Age of Computer Simulation*. Chicago: University of Chicago Press.
- Woodward, James (2003). *Making Things Happen: A Theory of Causal Explanation*. New York: Oxford University Press. ISBN: 9780195155273. DOI: [10.1093/0195155270.001.0001](https://doi.org/10.1093/0195155270.001.0001).
- World Bank (2021). *World Development Report 2021: Data for Better Lives*. Washington, DC: World Bank. ISBN: 9781464816000. DOI: [10.1596/978-1-4648-1600-0](https://doi.org/10.1596/978-1-4648-1600-0).
- Young, Iris Marion (1990). *Justice and the Politics of Difference*. Princeton, NJ: Princeton University Press.

Chapter 6

Research Praxis of Generative Relational Theory

Chapter 6 opens Part III by developing the praxis-level architecture within which the methodologies of Chapters 7–9 operate. Chapters 4 and 5 established the ontological and epistemological commitments of Generative Relational Theory (GR) and Generative Relational Economics (GRE): analytical objects remain compatible with ontological suspension; relational realities can exceed their manifestations; representations preserve some differences while compressing others; observation is partial and historically situated; and stronger claims require explicit bridges between evidence, interpretation, and inference. The present chapter asks what follows when these commitments are placed inside the activity of research itself. Its role is therefore neither to provide a catalogue of methods nor to add a separate philosophy of science alongside the earlier foundations. It develops research as a form of historically situated praxis whose questions, judgments, instruments, institutions, relations, revisions, and consequences condition what later methodology can responsibly do.

The chapter begins from a unified category of praxis. Knowing and acting are analytically distinguishable, yet concrete activity ordinarily contains both. Research involves choices about attention, categories, evidence, methods, models, publication, preservation, collaboration, and closure. Application involves observation, interpretation, learning, evaluation, and revision. The distinction between research-dominant and application-dominant praxis is therefore treated as a distinction in principal practical orientation and contradiction rather than as a division between two sealed domains. Research-dominant praxis is characteristically organized around the difficulty of constructing sufficiently warranted knowledge while the relevant reality remains partially known, relationally complex, historically changing, and generative of states that can exceed inherited descriptions. Application-dominant praxis is characteristically organized around the necessity of deciding or acting while relevant knowledge remains incomplete and consequences can be distributed, path-dependent, or partly irreversible. Both modes can contain the other, and a concrete project can move between them as its principal contradiction changes.

This distinction matters for methodology because methods do not enter inquiry in an empty space. A statistical estimator, archival procedure, interview protocol, formal model, ethnographic encounter, legal interpretation, simulation, or AI-assisted

workflow acquires epistemic meaning within a prior configuration of questions, boundaries, institutional conditions, evidential access, practical stakes, and judgments about relevance. A technique can therefore be rigorous in execution while remaining poorly aligned with the research object or claim. Conversely, a project can use comparatively simple techniques while maintaining strong epistemic discipline when the relation among question, evidence, representation, inference, uncertainty, and revision is explicit. Chapter 6 establishes this prior architecture so that Chapters 7–9 can develop methodology without treating techniques as self-sufficient sources of warrant.

Research is also relational in a stronger sense. Inquiry is constituted through relations among researchers, objects, participants, communities, institutions, archives, instruments, infrastructures, categories, computational systems, and audiences. These relations affect what can be encountered, who can gain access, which distinctions become legible, how evidence is produced, which interpretations receive circulation, and who bears the consequences of representation. The researcher therefore remains within the relational field rather than observing it from an analytically consequence-free exterior. Historical position, institutional location, language, material resources, power, access, and relational distance can condition evidential pathways without reducing warranted knowledge to standpoint alone. The chapter accordingly combines situatedness with answerability to evidence: position matters because it changes access and interpretation, while claims remain open to criticism, comparison, correction, and revision.

Ontological suspension provides a parallel discipline. Research requires sufficiently stable objects to proceed, yet methodological operation does not require final metaphysical settlement. A person, institution, market, legal category, relational field, network node, latent variable, event, or trajectory can be operationally specified for a research purpose while alternative ontological descriptions remain available. This permits inquiry to distinguish practical commitment from final ontology. The relevant question becomes which commitments are required by the present inference, what they make visible, what they exclude, and under what evidence they should be revised. Later methodological chapters inherit this discipline in their treatment of entities, boundaries, relations, scales, representations, and generative structures.

The chapter then moves to the pre-methodological formation of inquiry. Research can begin with an encounter before it begins with a finalized question: an anomaly, difference, recurrent pattern, unexpected relation, historical rupture, failed prediction, conceptual tension, or contingent observation can become salient before its significance is established. Encounter, salience, significance, and judgment are therefore kept analytically distinct. Aesthetic judgment can contribute to the recognition that an object or question is unusually fertile, coherent, surprising, or generative, while epistemic judgment concerns warrant and normative judgment concerns value, responsibility, fairness, or practical consequence. None of these forms of judgment automatically substitutes for the others. Their interaction helps orient inquiry by shaping which problems receive sustained attention, which uncertainties are tolerated, and which research trajectories are considered worth pursuing under finite time and resources.

Methodological pluralism follows from this architecture. Historical, interpretive, qualitative, quantitative, empirical, formal, computational, legal, institutional, comparative, and field-based inquiry provide partially irreducible forms of epistemic ac-

cess. Their differences concern more than technique. They can construct different objects, preserve different forms of evidence, operate at different scales, and support different inferential moves. A historical archive can reveal sequence and institutional transformation while inheriting the categories of record-producing institutions. Ethnographic inquiry can disclose tacit practice and meaning while remaining bounded by field access and relational position. Quantitative analysis can estimate patterned dependence or distribution while relying on operationalizations that compress meaning. Formal models can expose assumptions, dynamic possibilities, or logical consequences while remaining dependent on the adequacy of their mapping to empirical or historical objects. Methodological plurality therefore requires disciplined comparison, translation, and mutual correction rather than a universal hierarchy or an undifferentiated appeal to “mixed methods.”

Translation among methodological representations becomes a central practical problem. Narrative evidence can be transformed into variables; relations can be represented as edges; historical categories can be mapped onto state variables; field observations can become codes; legal classifications can become analytical objects; and formal results can be returned to interpretive language. Each transformation can preserve some distinctions while introducing remainders or losses. Research praxis must therefore retain provenance across such transformations and keep visible the difference between the evidential material encountered and the representation later used for analysis. This requirement anticipates the more detailed treatment of representation, relation identification, generative modeling, and cross-method adjudication in Chapters 7–9.

Inquiry is consequently iterative. Observation can alter interpretation; interpretation can reshape concepts; concepts can motivate formalization; formalization can expose missing distinctions; empirical examination can challenge a model; comparison can reveal hidden scope conditions; historical reconstruction can change the meaning of a category; and failed translation can motivate a new research object. The chapter treats this movement as iterative reconstruction rather than as a linear progression from question to answer. Reflexivity belongs within the same movement. Observation, classification, measurement, representation, publication, and institutional uptake can alter the relations being studied or the conditions under which later evidence becomes available. Reflexive analysis should therefore be proportional to plausible research-mediated effects rather than expanded into an unlimited requirement to analyze every conceivable influence of inquiry upon its object.

Historical change applies to the methods and evaluative standards of research as well as to its objects. Instruments emerge, archives become accessible or disappear, computational infrastructures change, evidential conventions shift, and criteria of rigor, relevance, novelty, significance, and value can themselves be revised. Earlier research can therefore become newly interpretable under changed concepts, data, methods, or historical consequences. The chapter develops preservation for future reepistemization as a practical response to this temporality. Primary materials, provenance, alternative interpretations, assumptions, negative results, methodological context, and version histories can preserve future epistemic options, subject to privacy, legal, security, stewardship, and resource constraints. Preservation is selective infrastructure for reconstructability, rather than maximal retention without governance.

Research also proceeds under incomplete evidence. Missing records, limited observation, conflicting testimony, inaccessible populations, uncertain measurement,

bounded resources, and historical loss can persist even in carefully designed inquiry. The practical problem is therefore to calibrate claims, decisions, and closure to the evidential conditions actually available. This requirement connects directly to epistemic justice and researcher power. Research actors can name, classify, measure, make visible, exclude, preserve, translate, and circulate representations. Such capacities can expand collective knowledge while also redistributing epistemic resources and authority. Methodological adequacy must therefore include the relations through which evidence is obtained, whose categories become operative, which absences remain visible, and what forms of contestation or correction remain possible.

Aesthetic and normative conditions extend beyond the selection of questions. Judgments about elegance, coherence, explanatory fertility, fairness, responsibility, urgency, harm, and public value can orient both research- and application-dominant praxis. The chapter preserves distinctions among these judgments while treating their interaction as unavoidable in many practical settings. This becomes particularly important when research outputs move toward decisions or interventions. A method can be epistemically adequate for one research purpose while remaining practically inadequate for allocation, treatment, prioritization, classification, or institutional action. Part IV will develop those application-dominant requirements directly; Chapter 6 prepares that later transition by establishing that practical consequence can already enter research and that application can generate new evidence for research.

AI-assisted research intensifies several of these themes. Computational systems can expand search, synthesis, coding, formalization, simulation, pattern discovery, critique, and theory generation. Increased generative capacity can relocate scarcity from production toward orientation, judgment, verification, provenance, and responsible closure. AI therefore enters the chapter as part of research praxis rather than as an external productivity layer. Its outputs require epistemic classification and verification, while its use can change dependency structures, research agency, and the distribution of labor within heterogeneous research collectives. The chapter extends this analysis from individual tool use to collective and distributed knowledge production involving people, institutions, archives, infrastructures, and computational systems with differentiated forms of expertise, memory, authority, and responsibility.

Theory becomes one of the central objects generated within these research relations. The chapter treats theory as historically produced, community-mediated, evidentially constrained, methodologically connected, revisable, and capable of conditioning later observation. The point is reflexive: GR itself is included within this account. Its concepts can be revised, narrowed, hybridized, differentiated across domains, or displaced where evidence and argument warrant change. Failure and negative results consequently become part of research knowledge when their conditions are sufficiently documented. Failed hypotheses, measurements, formalizations, interventions, methods, and theories can locate boundaries, reveal hidden assumptions, redirect inquiry, and preserve information that later projects would otherwise have to rediscover.

The resulting research praxis is open and cumulative without assuming that cumulation is purely additive. Reusable concepts, data, models, relational maps, assumptions, disagreements, replications, reinterpretations, and revision histories can support later inquiry when provenance and context remain legible. A research commons can preserve such objects across generations while allowing criticism and transforma-

tion. At the same time, cumulative practice remains bounded by partiality, interpretation, historical situatedness, institutional dependence, computational constraints, incomplete evidence, normative remainder, bounded reflexivity, incomplete methodological integration, and the provisional character of the research/application distinction itself. Recognizing these boundaries supplies methodological obligations: scope discipline, explicit assumptions, provenance, uncertainty, recoverable disagreement, proportional reflexivity, and revisable classification.

The internal structure of the chapter follows seven movements. Sections 6.1–6.6 establish the unified category of praxis, distinguish research-dominant and application-dominant configurations, develop principal and secondary contradictions, and examine recursive coupling between research and application. Sections 6.7–6.9 locate research within relational fields, specify researcher situatedness, and translate ontological suspension into practical research discipline. Sections 6.10–6.13 examine encounter, salience, judgment, and orientation before formal method selection. Sections 6.14–6.20 develop methodological plurality, differentiated modes of inquiry, epistemic functions of models, mutual correction, translation across representations, iterative reconstruction, and reflexivity. Sections 6.21–6.26 examine the historical evolution of methods and evaluation, preservation for future re-epistemization, incomplete evidence, researcher power, epistemic justice, and aesthetic and normative conditions. Sections 6.27–6.31 extend the analysis to AI-assisted inquiry, distributed knowledge production, theory development, failure, negative results, revision, and cumulative research practice. Sections 6.32–6.33 then delimit the scope and boundaries of research praxis and translate the chapter’s conclusions into requirements for methodology.

This progression establishes the logic of Part III. Chapter 6 specifies the praxis within which inquiry occurs. Chapter 7 develops methodologies for identifying, characterizing, comparing, observing, measuring, and validating relations. Chapter 8 extends that methodological architecture toward generative processes, trajectories, mechanisms, transformations, criticality, multiscale dynamics, and formal or computational representations of generation. Chapter 9 then integrates these elements at the level of complete research design, including method portfolios, cross-method adjudication, model–evidence dialogue, sensitivity, robustness, uncertainty, historical re-epistemization, AI workflow, governance, documentation, reproducibility, reusability, cumulative research, theory development, research decisions, model functions across praxis modes, and provisional closure. Part III therefore moves from the practical conditions of inquiry to relational methodology, from relational methodology to generative inquiry, and from individual methodological operations to an integrated and revisable architecture of research.

The objective of the chapter is correspondingly limited and constructive. It does not seek a final philosophy of research or a universal procedure applicable without modification across disciplines. It establishes a praxis-level discipline that later methodology can operationalize: research is historically situated and relational; questions emerge through encounter and judgment; methods provide differentiated access; representations transform evidence; inquiry revises itself; knowledge production has institutional and ethical conditions; AI changes the distribution of generative labor; failures and disagreements can remain informative; and closure should preserve the possibility of revision. Section 6.33 carries these commitments directly into Chapter 7. The rest of Part III develops what they require once inquiry begins specifying

relations, generative processes, and complete research designs.

6.1 Unified Category of Praxis

This section establishes the broad practical category within which Chapter 6 will locate research. Its role is foundational: before distinguishing research-dominant and application-dominant praxis, the chapter requires an account of what both modes share. The objective is to treat knowing, judgment, action, relation, feedback, revision, historical situatedness, and generativity as interdependent moments of praxis whose relative prominence changes across concrete situations. The discussion proceeds analytically through these moments and then returns to their historical and generative organization. The method is reconstructive rather than genealogically exhaustive. Several traditions have developed concepts of praxis, practice, experience, conduct, and situated action in different philosophical and social-theoretical vocabularies. Marx's early writings emphasize sensuous practical activity and historically constituted social relations; Dewey develops accounts of conduct and experience through organism–environment interaction, habit, inquiry, and consequence; Gramsci's philosophy of praxis situates thought and action within historically mediated social struggle; and Bourdieu develops a theory of practice through historically formed dispositions and structured fields (Marx 1994; Dewey 1922; Dewey 1925; Gramsci 2007; Bourdieu 1977). GRE draws a limited architectural lesson from these heterogeneous lineages: inquiry can be understood as activity conducted within a changing relational world, through which actors also participate in the production of later conditions of knowing and acting.

Definition 6.1 (Praxis). *Praxis* is historically situated relational activity in which knowing, judgment, action, feedback, and revision participate in the formation of subsequent capacities, relations, representations, conditions, or possibilities.

Definition 6.1 is intentionally broad. It does not identify praxis with purposeful intervention alone, nor does it require every practical episode to contain each listed moment with equal intensity. A concrete praxis can be predominantly investigative, administrative, political, productive, educational, technical, artistic, or otherwise organized. What makes these cases comparable for the present chapter is that activity occurs within relations, depends on inherited conditions, produces consequences, and can alter the conditions under which later activity proceeds. This broad category allows research to be analyzed as praxis without reducing research to application or application to research.

6.1.1 Praxis beyond the Opposition between Knowing and Acting

The initial analytical problem concerns the common tendency to separate knowing from acting into successive or independent domains. Research is then imagined as the production of knowledge, while application begins only after knowledge has been completed. Such a sequence can describe some institutional arrangements, yet it gives an incomplete account of concrete inquiry. Observation requires practical access; classification organizes what can be recorded; measurement changes the conditions under which phenomena become comparable; interpretation selects among possible descriptions; publication can alter expectations and behavior; and interven-

tions frequently generate evidence that did not previously exist. Knowing therefore occurs through practical relations with objects, participants, instruments, archives, institutions, and representations.

The converse relation also matters. Action rarely proceeds in the absence of knowing, however incomplete. Practical orientation depends on descriptions of the situation, expectations about consequences, distinctions among alternatives, judgments of significance, tacit knowledge, institutional memory, or inherited categories. Even urgent action under uncertainty involves an epistemic configuration, because uncertainty itself is apprehended through some representation of what is known, unknown, or contested. The relevant distinction is consequently one of organization and emphasis: some praxis is oriented primarily toward transforming an epistemic-theoretical system, while other praxis is oriented primarily toward transforming a practical-relational situation.

Dewey's accounts of conduct and experience offer one precedent for treating doing, undergoing, habit, consequence, and inquiry as connected within situated activity (Dewey 1922; Dewey 1925). Marx's emphasis on practical activity similarly provides a historical precedent for refusing an image of knowledge detached from material and social life (Marx 1994). GRE does not require identity with either philosophical system. Their relevance here lies in opening a space in which cognition and action can be analyzed as mutually implicated within praxis.

Definition 6.2 (Praxis configuration). A *praxis configuration* is a historically and relationally situated organization of epistemic, judgmental, practical, feedback, and revision processes whose relative prominence is determined by the activity, its conditions, and its current orientation.

The configuration concept allows the chapter to distinguish modes without converting them into separate substances. A research project can contain decisions with material consequences; an institutional intervention can contain substantial inquiry; a field experiment can simultaneously produce knowledge and alter the field; an archival project can reorganize public memory; and a computational classification can become operational in later decisions. The distinction between research and application will therefore be developed in the next section through dominant contradiction and practical orientation rather than through a strict border between thought and action.

Proposition 6.3 (Integrated moments of praxis). *Knowing and acting within praxis can be analytically distinguished while remaining practically interdependent, because the production of knowledge requires situated activity and practical action is ordinarily organized through some epistemic representation of its conditions and possibilities.*

Proposition 6.3 supplies the chapter's starting point. Later distinctions between research-dominant and application-dominant praxis concern which tensions organize the activity and where provisional closure is sought, while both modes remain configurations within the broader field defined here.

6.1.2 Knowing within Praxis

Knowing within praxis concerns the production, preservation, interpretation, testing, and revision of representations that orient activity. Chapter 5 developed the epistemic conditions under which relational and generative claims can receive bounded warrant. The present chapter adds a practical implication: knowledge is produced

through arrangements of access, attention, instruments, categories, institutions, archives, communities, and material resources. These arrangements are themselves parts of praxis and can change while inquiry proceeds.

This formulation gives knowledge an operational role without reducing it to instrumental usefulness. A claim may be epistemically valuable because it explains a historical trajectory, clarifies a relation, preserves an overlooked experience, or discriminates among competing descriptions even when no immediate intervention follows. At the same time, knowledge can alter later praxis by changing what actors can notice, formulate, compare, imagine, coordinate, or contest. A new concept can make a previously diffuse relation discussable; a measurement practice can make a pattern administratively legible; a historical reconstruction can reopen an apparently settled institutional narrative; a negative result can redirect a research programme. Knowing can therefore have generative consequences even where direct application is absent.

The epistemic commitments consolidated near the end of the preceding chapter remain relevant here. Partiality, explicit representation, boundary and scale, uncertainty, evidential pluralism, historical sensitivity, revisability, and epistemic humility are not only standards applied after research is complete. They shape the conduct of inquiry. A researcher who expects partial observation organizes documentation differently from one who assumes complete access. A project committed to revisability preserves provenance and alternative interpretations. A project attentive to boundary uncertainty records cross-boundary relations rather than treating them as accidental noise. Epistemology thus enters praxis through the organization of concrete research conduct.

Knowing also has a distributed dimension. Much research knowledge is generated across participants, technicians, archivists, informants, communities, software infrastructures, instruments, disciplinary traditions, datasets, reviewers, and institutions. The epistemic product attributed to an individual author can therefore depend on a wider relational configuration. Chapter 6 will later examine collective and distributed knowledge production in detail. At the present stage, the important point is that knowing within praxis is situated within relational conditions of possibility, access, maintenance, and correction.

Claim 6.4 (Practical conditions of knowing). *The warrant of knowledge can depend partly on practical conditions of inquiry because access, recording, classification, preservation, comparison, and revision affect which traces become available and how inferential alternatives can be evaluated.*

Claim 6.4 does not make truth equivalent to practice. It identifies a dependence of epistemic warrant on the practical organization through which evidence becomes accessible and contestable. This dependence becomes especially important when evidence is fragile, historically distributed, institutionally controlled, or mediated by computational systems.

6.1.3 Judgment within Praxis

Praxis requires judgment because actors encounter more possible observations, questions, interpretations, actions, and responses than can be pursued simultaneously. Judgment selects salience, significance, adequacy, priority, proportionality, and provisional closure under conditions of limited attention and incomplete knowledge. Re-

search judgment appears in the selection of problems, evidence, concepts, models, comparisons, stopping rules, and standards of sufficiency. Application-oriented judgment appears in the selection of actions, timing, acceptable risk, reversibility, and distributions of benefit or burden. These forms overlap while remaining analytically distinguishable.

The chapter will later separate aesthetic, epistemic, and normative judgment more carefully. For the present section, judgment is the mediating activity through which a praxis configuration assigns practical significance to possible interpretations and courses of action. This includes judgments whose criteria are explicit and formalized as well as judgments that rely on tacit expertise, disciplinary taste, historical sensibility, or experiential recognition. The existence of tacit elements does not place judgment beyond analysis. It creates a reason to examine how such criteria are formed, transmitted, contested, and revised.

Judgment links knowing to action without functioning as a mechanical rule that converts evidence into behavior. The same evidential state can support different practical responses when objectives, values, risks, temporal constraints, or acceptable error differ. Likewise, the same practical objective can lead to different judgments when the epistemic state changes. This is one reason the book distinguishes epistemic justification from normative evaluation. A well-supported description does not alone determine what should be done, while a normative commitment does not alone determine which empirical description is warranted.

Judgment is also historically situated. What counts as an elegant explanation, a serious anomaly, a meaningful effect size, an admissible source, a responsible intervention, or a research-worthy question can change with disciplines, technologies, institutions, political conditions, and accumulated experience. Such historical formation need not imply arbitrariness. Criteria can be criticized through evidence, consistency, consequences, comparative performance, justice considerations, and their capacity to generate productive inquiry. Judgment therefore belongs inside revisable praxis rather than outside it as an unexplained faculty.

Definition 6.5 (Praxis judgment). *Praxis judgment* is the situated evaluation through which an actor or collectivity assigns relevance, adequacy, priority, significance, or practical orientation to possible interpretations, questions, representations, or actions under specified epistemic and normative conditions.

Definition 6.5 prepares the later analysis of research judgment. It also clarifies why research praxis cannot be reduced to method execution. Methods generate and organize evidence; judgment remains necessary in deciding what object to construct, what evidence is sufficient, which anomaly deserves attention, what uncertainty matters, and when a claim should remain open.

6.1.4 Action within Praxis

Action within praxis includes deliberate intervention, but its scope is broader. Selecting a classification, opening an archive, designing a survey, training a model, conducting an interview, publishing a result, refusing an intervention, maintaining an infrastructure, or preserving a record can all alter the relational conditions under which later events occur. The practical effects vary greatly in magnitude and reversibility, yet each can participate in the production of subsequent evidence, capacities, expectations, or institutional responses.

This broader account is especially important for research. Scientific and scholarly activity sometimes presents itself as observation of a world whose relevant relations remain external to the act of inquiry. Chapter 5 showed why that image requires qualification. Representation can become performative; observation can alter behavior; machine classifications can enter administrative processes; public indicators can reorganize incentives; and categories can shape future records. Research action therefore includes the material and symbolic operations through which inquiry enters the relational field.

The presence of practical effects does not imply that every act of observation produces a substantively important transformation. The appropriate question is empirical and target-relative: which actions enter the relations under study, through what pathway, at what scale, and with what persistence? A laboratory measurement can have negligible effects on a distant institutional process, while publication of a ranking can materially alter organizational behavior. The category of praxis keeps this possibility visible without presuming its magnitude.

Action also introduces temporal consequences. Some effects are immediate; others accumulate through repeated routines, institutionalization, memory, learning, or delayed uptake. A methodological standard adopted today can shape what evidence is preserved for decades. An administrative category introduced for temporary coordination can become embedded in infrastructures and survive the problem that initially motivated it. Practical action therefore connects present judgment to future possibility structures, a connection that becomes central to the book's later treatment of generative relations.

Claim 6.6 (Action and epistemic consequence). *Actions undertaken within inquiry can become epistemically consequential when they alter access, trace production, participant behavior, classification, institutional memory, or the conditions through which subsequent evidence is generated.*

Claim 6.6 provides one reason for reflexivity in research praxis. The researcher may participate in the conditions that later appear as evidence. Recognizing this participation supports better attribution and documentation without requiring the researcher to treat every observed change as an artifact of inquiry.

6.1.5 Relations within Praxis

Praxis is relationally constituted because activity depends on relations among actors, objects, institutions, infrastructures, environments, concepts, representations, and historically inherited conditions. A researcher gains access through institutional permissions and participant relations; a practitioner acts through organizations, laws, material resources, and public expectations; a community sustains knowledge through memory, language, trust, and shared practices; a technical system depends on maintenance, standards, energy, data, and coordination. Activity therefore takes place within relational configurations that shape available capacities and constraints.

Bourdieu's theory of practice provides one influential precedent for relating durable dispositions to structured social conditions rather than locating practice exclusively in explicit calculation (Bourdieu 1977). Gramsci's philosophy of praxis likewise emphasizes historically mediated consciousness and action within social relations and institutions (Gramsci 2007). GRE draws from these traditions without adopting their concepts as interchangeable with its own. The narrower claim is that

practical activity is enabled and constrained through relations whose organization affects what participants can perceive, judge, and do.

Relations within praxis can be cooperative, competitive, hierarchical, fiduciary, contractual, affective, epistemic, administrative, ecological, technical, or otherwise heterogeneous. Their practical significance cannot be inferred from one general relational form. A relation of trust may enable evidence sharing in one context and suppress criticism in another. Institutional authority may make coordination possible while concentrating control over classifications. Technical infrastructure can expand observation while making inquiry dependent on opaque systems. Relational analysis therefore concerns the concrete organization and consequences of relations rather than a presumption that relationality is intrinsically desirable.

The relational constitution of praxis also distributes agency. Outcomes attributed to a named researcher, organization, or decision-maker can depend on many supporting relations whose contributions are weakly visible in conventional accounts. Maintenance work, translation, data stewardship, community access, technical support, legal authorization, caregiving, environmental stability, and accumulated public knowledge can all contribute to what an actor is able to accomplish. This point anticipates later discussions of distributed knowledge production and generative attribution.

Proposition 6.7 (Relational constitution of praxis). *A praxis configuration should be analyzed through the relations that enable, constrain, mediate, authorize, sustain, or transform its activity when those relations materially affect the capacities or consequences relevant to the inquiry.*

The proposition is deliberately selective. Relational analysis does not require exhaustive mapping of every conceivable connection. It requires attention to relations whose omission would materially weaken explanation of the praxis configuration under study.

6.1.6 Feedback within Praxis

Feedback occurs when consequences of activity re-enter the conditions of subsequent knowing, judgment, action, or relation. A research finding can redirect attention; participant responses can change an interview protocol; an intervention can expose an unanticipated mechanism; a failed model can reshape theory; a policy can generate new administrative categories; an institutional reform can alter the data through which its own effects are later evaluated. Feedback therefore links successive phases of praxis and makes practical activity recursively organized through time.

Feedback can carry heterogeneous information. Some feedback is intentionally designed, as in monitoring systems, replication, peer criticism, participant validation, or adaptive experiments. Other feedback appears through anomaly, resistance, breakdown, side effects, changed behavior, or the disappearance of expected traces. Its epistemic value depends on interpretation. A negative outcome can reflect a false theory, inadequate implementation, changed conditions, measurement failure, or interaction among several causes. Feedback becomes informative through analysis of the pathway that produced it.

Dewey's emphasis on consequences and the reconstruction of conduct through experience offers a useful precedent for this recursive view (Dewey 1922; Dewey 1925). GRE extends the architectural idea into relational inquiry: feedback may travel

through social, institutional, material, symbolic, ecological, or computational relations, and the pathway itself can change during the process. The same signal can therefore acquire different practical meanings across fields or historical moments.

Definition 6.8 (Praxis feedback). *Praxis feedback* is a pathway through which consequences, traces, responses, or transformations generated in one phase of activity become conditions or evidence for subsequent knowing, judgment, action, relation, or revision.

Feedback can reinforce an existing configuration, destabilize it, or redirect it. Repeated success can stabilize a method and make alternatives less visible; repeated failure can motivate conceptual revision; institutional rewards can amplify one research orientation; participant resistance can expose categories that fail to represent lived relations. Because feedback can reproduce error as well as correct it, recursive organization does not guarantee learning. Learning requires procedures capable of distinguishing informative feedback from self-reinforcing closure.

Proposition 6.9 (Recursive organization of praxis). *Praxis becomes recursively organized when consequences from earlier activity materially alter the epistemic, relational, or practical conditions under which later activity is conducted.*

Proposition 6.9 prepares the chapter's later analysis of iterative research, reflexivity, failure, and cumulative practice. It also makes revision a structural possibility of praxis rather than an external correction added after activity has concluded.

6.1.7 Revision within Praxis

Revision concerns changes to the organization of praxis in response to evidence, consequences, contradiction, reflection, historical transformation, or altered objectives. What is revised can include a factual claim, concept, model, category, research question, method, practical objective, institutional rule, allocation of authority, or relation among participants. Revision therefore extends beyond correcting propositions. It can transform the architecture through which later propositions and actions are produced.

Chapter 5 treated revisability as a condition of relational knowledge. Within praxis, revisability acquires an additional dimension: the procedures that generated the knowledge may themselves need revision. A category can become inadequate because the object changes; an observational instrument can produce effects that distort later evidence; a methodological convention can systematically exclude weakly institutionalized relations; a research question can become obsolete after an intervention changes the field. In each case, retaining the original procedure for the sake of consistency may weaken rather than strengthen continuity of inquiry.

Revision nevertheless requires provenance. If a project changes categories, methods, boundaries, or evaluative standards, later readers should be able to reconstruct what changed and why. Otherwise the appearance of cumulative knowledge can conceal shifts in the object or criteria of comparison. Versioned documentation, preserved alternative interpretations, explicit change rationales, and historical records therefore support revision as a disciplined form of praxis.

Revision can also concern goals. An application initially oriented toward efficiency can encounter evidence that distributional consequences are more significant than anticipated. A research programme organized around prediction can discover that

explanation, preservation, or participatory understanding is the more appropriate objective. Such changes should be made explicit because they alter the criteria by which success and failure are judged.

Definition 6.10 (Praxis revision). *Praxis revision* is a traceable modification of the epistemic, judgmental, relational, methodological, normative, or practical organization of activity in response to materially relevant evidence, consequences, contradictions, or historical change.

Definition 6.10 makes revision broader than error correction and narrower than arbitrary change. A revision is disciplined when the reason for change can be reconstructed and when the altered component is matched to the problem that motivates the change. This principle will later support the chapter's treatment of methods and evaluative criteria as historically revisable objects.

6.1.8 Historical Situatedness of Praxis

Praxis occurs within historical conditions that shape available concepts, institutions, technologies, resources, problems, and possibilities. The same nominal action can therefore occupy different relational positions across periods. Collecting population data with paper registers, centralized databases, or pervasive machine sensing involves different capacities, costs, access structures, privacy conditions, and possibilities of feedback. Conducting economic inquiry before national accounting, before large-scale digital transaction records, and under contemporary high-frequency data infrastructures similarly presents different objects of observation and different forms of blindness.

Historical situatedness also concerns categories and standards. Concepts such as household, employment, productivity, risk, intelligence, disability, development, or creditworthiness acquire operational meanings through institutions and measurement practices that change over time. Research conducted through these categories participates in their historical life. A category can stabilize coordination and comparison while also becoming inadequate as relations change. Historical analysis therefore concerns both the object studied and the practical apparatus through which the object becomes knowable.

Marx's historical materialist writings provide a major precedent for relating forms of consciousness and social organization to historically changing material and relational conditions (Marx 1859; Marx and Engels 1970). Gramsci further develops the historically mediated relation among ideas, institutions, social forces, and practical struggle (Gramsci 2007). GRE uses these lineages as critical resources while maintaining its broader ontological suspension and methodological pluralism. The practical implication is that research methods and evaluative standards should themselves be open to historical inquiry.

Historical situatedness does not confine inquiry to description of the present. It strengthens comparison by requiring explicit bridges across periods. A method transported historically should examine whether its categories, recording systems, participant positions, and institutional meanings remain sufficiently comparable. A normative or epistemic standard projected backward should state the basis on which the historical actors, relations, or records can be interpreted through it. The same discipline applies prospectively: future praxis will inherit present infrastructures and classifications in ways that present researchers cannot fully predict.

Claim 6.11 (Historical index of praxis). *A praxis configuration is historically indexed when its available capacities, relations, representations, evaluative criteria, and practical alternatives depend materially on conditions specific to its historical situation.*

Claim 6.11 prevents the chapter's general vocabulary from becoming a timeless template imposed identically on every case. Knowing, judgment, action, feedback, and revision are broad analytical moments; their concrete organization must be re-constructed historically.

6.1.9 Generativity of Praxis

Praxis is generative when activity contributes to the formation or transformation of conditions that affect later activity. These effects can include new knowledge, concepts, questions, skills, infrastructures, institutions, relations, habits, capacities, constraints, classifications, memories, or future possibilities. The generativity of praxis therefore extends beyond successful achievement of an immediate objective. An activity can fail at its stated aim while still generating evidence, coordination, institutional learning, distrust, dependence, or new possibilities that shape later trajectories.

This generative perspective is especially important for research. Inquiry can produce more than propositions. It can generate datasets, archives, measurement infrastructures, disciplinary vocabularies, participant expectations, research communities, computational tools, evaluative standards, institutional legitimacy, or public classifications. These products can support later inquiry, constrain alternative questions, redistribute representational authority, or become inputs into application-dominant praxis. Research praxis thus participates in the generative relational world it seeks to understand.

Generativity remains normatively open. A praxis can generate capability while simultaneously producing dependency; it can expand knowledge while narrowing privacy; it can stabilize cooperation while suppressing dissent; it can create a powerful research infrastructure while making future inquiry dependent on categories that later become inadequate. The descriptive claim that praxis is generative therefore remains separate from the normative judgment that its generated conditions are desirable. This distinction preserves the book's broader separation among generativity, value, justice, and governance.

Definition 6.12 (Generative praxis). *Generative praxis* is praxis whose activity contributes to the formation, reproduction, suppression, or transformation of capacities, relations, representations, institutions, constraints, or possibility structures that materially condition subsequent praxis.

The definition includes reproduction because maintaining a condition can require active work and can shape future possibilities as strongly as visible transformation. It includes suppression because practical activity can reduce the feasibility of later relations or actions. It also preserves target relativity: a praxis may be generative with respect to one capacity while merely reproductive, or even foreclosing, with respect to another.

Proposition 6.13 (Generative openness of praxis). *The generative effects of praxis should be evaluated separately from the immediate objectives of the acting participants, because practical activity can produce persistent relational and institutional consequences that exceed, redirect, or outlast those objectives.*

Proposition 6.13 closes the foundational argument of this section. Praxis is a useful unified category because knowing, judgment, action, relation, feedback, revision, historical conditions, and generative consequences can be analyzed within one practical architecture while retaining their differences. The next section narrows this broad category to research praxis and distinguishes research-dominant from application-dominant configurations according to their orientation, principal contradiction, and phase-dependent point of provisional closure.

6.2 Research Praxis within the Field of Praxis

Section 6.1 established praxis as a historically situated relational configuration in which knowing, judgment, action, feedback, and revision participate in the formation of subsequent conditions and possibilities. The present section narrows that broad category to research praxis. Its role is classificatory and architectural: the objective is to distinguish research-dominant and application-dominant praxis without treating research and application as separate domains of human activity. The discussion proceeds from research as a mode of praxis to dominant practical orientations, overlap, mutual transformation, hybrid configurations, and phase dependence. The method is analytical. It identifies differences in orientation, contradiction, and provisional closure while preserving the shared practical structure developed in the preceding section. This formulation also draws on traditions in which inquiry is embedded in experience and consequence, practical activity is historically situated, and practice is structured through relations and inherited conditions (Dewey 1922; Dewey 1925; Marx 1994; Gramsci 2007; Bourdieu 1977). The purpose is narrower than reconstructing those traditions: Chapter 6 requires a vocabulary capable of following inquiry as it moves between knowledge production and practical transformation.

Definition 6.14 (Research praxis). *Research praxis* is praxis whose organized activity includes the production, reconstruction, testing, preservation, comparison, or revision of epistemic representations concerning a specified object, relation, process, field, or generative trajectory.

Definition 6.14 describes research through an epistemic orientation while keeping its practical conditions visible. Research praxis can involve observation, conceptualization, archival work, measurement, formalization, interviewing, field engagement, experimentation, computation, interpretation, intervention, publication, preservation, or collective deliberation. The particular combination depends on the object and research design. Research praxis therefore belongs within the broader field of praxis because its epistemic activity is carried by practical relations, institutions, instruments, judgments, and consequences.

A second distinction organizes the section. Research-dominant and application-dominant praxis are treated as modes of practical organization rather than as fixed identities attached permanently to persons, institutions, or projects. A university laboratory can enter an application-dominant phase when urgent intervention becomes the immediate organizing problem. A public agency can enter a research-dominant phase when it suspends routine action to reconstruct why an intervention produced unexpected effects. The same collective activity can therefore move between orientations while preserving historical continuity.

6.2.1 Research as a Mode of Praxis

Research becomes intelligible as a mode of praxis when epistemic production is examined together with the relations and activities that make it possible. A researcher must gain access to sites, archives, instruments, participants, datasets, conceptual traditions, or computational infrastructures. Questions are formulated through inherited vocabularies. Evidence is produced or preserved through material and institutional arrangements. Results are judged, represented, circulated, criticized, and revised through scholarly and public relations. These activities can alter the conditions of later inquiry even where direct intervention in the substantive object is limited.

This account is compatible with the epistemic distinctions developed in Chapter 5. The fact that research is praxis does not make truth or warrant reducible to practical success. A claim can be well warranted and practically inconvenient; an intervention can succeed for reasons that remain poorly understood; a socially influential representation can possess considerable performative efficacy while remaining epistemically inadequate. The practical organization of research and the epistemic warrant of its claims therefore require connected but distinguishable analysis.

Dewey's treatment of inquiry within experience and conduct provides one historical resource for understanding knowledge production as activity within problematic situations rather than as detached contemplation (Dewey 1922; Dewey 1925). Marxian and Gramscian traditions likewise situate thought and knowledge within historically formed practical relations (Marx 1994; Gramsci 2007). GRE adopts a limited consequence from these lineages: research can be analyzed in terms of what relations organize inquiry, what contradictions motivate reconstruction, what actions generate evidence, what consequences feed back into representation, and how the resulting epistemic-practical configuration changes through time.

Research praxis can have objects that are themselves minimally affected by the research activity, as in some forms of historical reconstruction or remote observation. It can also have objects strongly affected by inquiry, as in participatory research, organizational study, experimentation, policy evaluation, or machine-mediated classification. The category therefore accommodates different degrees of reflexive coupling between observer and observed. The practical character of research lies in the situated organization of inquiry; the strength and direction of observer effects remain empirical questions.

Claim 6.15 (Research within praxis). *Research can be treated as a mode of praxis when epistemic production is analyzed together with the practical relations, judgments, infrastructures, consequences, and revision processes through which inquiry is conducted.*

Claim 6.15 does not erase disciplinary distinctions among laboratory science, historical inquiry, ethnography, formal analysis, economics, engineering, or political research. It establishes a common practical vocabulary through which their different research arrangements can later be compared.

6.2.2 Research-Dominant Praxis

A praxis configuration is research-dominant when its principal orientation concerns an epistemic-theoretical transformation. The immediate problem may involve inadequate observation, uncertain classification, conceptual inconsistency, unexplained

variation, conflicting evidence, insufficient formal representation, historical ambiguity, or a phenomenon that available theory cannot adequately reconstruct. Practical activity is organized primarily to transform the epistemic situation: to make a relation observable, distinguish alternatives, reconstruct a history, develop a concept, revise a model, formulate an explanation, preserve evidence, or establish the limits of what can presently be known.

The term *dominant* is important because research-dominant praxis still contains action. Researchers choose cases, allocate resources, design instruments, request access, intervene in measurement environments, create classifications, conduct experiments, maintain archives, write software, and publish representations. These actions can have material and institutional consequences. Research-dominant praxis is distinguished by the provisional point toward which these activities are organized. A phase can reach provisional closure when the epistemic contradiction that organized it has been sufficiently reconstructed for the current purpose, even though practical consequences and later revisions remain open.

Definition 6.16 (Research-dominant praxis). *Research-dominant praxis* is a praxis configuration in which the principal practical orientation is the transformation of an epistemic-theoretical situation through inquiry, representation, explanation, evaluation of evidence, or revision of knowledge.

This definition makes research dominance phase-relative. A long project may contain several research-dominant phases directed at different epistemic problems. Initial inquiry may clarify categories; later inquiry may reconstruct mechanisms; a subsequent phase may test whether the resulting explanation travels across scale or history. The practical orientation can change even while the project remains institutionally classified as research.

Research dominance also varies by the form of object under investigation. In highly mediated domains, the central epistemic transformation may concern the adequacy of representation. In historical inquiry, it may concern reconstruction from partial records. In formal work, it may concern whether a representation clarifies a structure and what assumptions support the mapping between model and target. In participatory inquiry, it may concern whether the research configuration makes previously excluded relations intelligible. The shared feature is organizational priority given to an epistemic-theoretical contradiction whose transformation structures the phase.

The detailed principal contradiction of research-dominant praxis is reserved for Section 137. At this stage, the important point is architectural: research dominance names the orientation of praxis, not a purified sphere in which action disappears.

6.2.3 Application-Dominant Praxis

Application-dominant praxis is organized primarily around transformation of a practical-relational situation. A decision must be made, a service delivered, a danger reduced, an institution reorganized, a technology deployed, a conflict managed, a resource allocated, or a collective capacity maintained. Knowledge remains important, often decisively so, yet the practical configuration cannot defer action until epistemic uncertainty disappears. Its provisional closure concerns a practical decision, intervention, maintenance activity, institutional arrangement, or other transformation in the relational world.

Definition 6.17 (Application-dominant praxis). *Application-dominant praxis* is a

praxis configuration in which the principal practical orientation is decision, intervention, maintenance, or transformation of a practical-relational situation under conditions that include incomplete and revisable knowledge.

Application dominance therefore does not imply the mechanical execution of prior knowledge. Action frequently requires situated judgment concerning whether available evidence is sufficiently relevant, whether circumstances match those under which knowledge was produced, which values and constraints should guide choice, what risks are reversible, and what information can be generated through action itself. The epistemic component remains internal to praxis even where action has temporal priority.

The category includes maintenance as well as visible intervention. Preserving an institution, infrastructure, ecological condition, archive, care relation, or technical system can require continuous practical activity. Maintenance may be application-dominant when its central problem concerns sustaining conditions in the face of deterioration, changing demands, or uncertainty. This matters for GRE because reproduction of a relational configuration can be generative: maintenance can preserve capacities and future possibilities, while neglect can alter them.

Application-dominant praxis can also generate knowledge. Implementation reveals friction that was absent from a model; users adapt a technology in unanticipated ways; an intervention exposes hidden dependencies; failure reveals a constraint; institutional resistance makes power relations visible; maintenance records create longitudinal evidence. Practical transformation can therefore become an epistemic event. The subsequent coupling of research and application will be developed in Section 139. Here, the key distinction is that generated knowledge remains embedded in a phase whose principal orientation concerns practical transformation.

The detailed principal contradiction of application-dominant praxis is reserved for Section 138. The present section establishes only the mode: action under incomplete knowledge belongs within praxis and remains capable of generating further inquiry.

6.2.4 Overlap between Research and Application

Research and application overlap whenever a praxis configuration simultaneously transforms an epistemic representation and the practical-relational situation to which that representation refers. This condition is common. Experiments alter conditions in order to learn from resulting differences. Participatory research can reorganize relations of voice and representation while producing knowledge about them. Policy pilots can test an intervention while delivering it. Clinical, educational, organizational, and engineering practice often requires observation and adaptation during implementation. Computational systems can generate predictions while simultaneously changing the decisions, incentives, or classifications that shape subsequent data.

Overlap should therefore be described by the functions performed within praxis rather than by institutional labels alone. A university project may contain application-dominant episodes; a public administration may conduct research-dominant reconstruction; an NGO may develop theory while delivering services; a firm may generate generalizable knowledge during product development; a community archive may simultaneously preserve history and transform representational authority. The location of an activity does not settle its mode.

Proposition 6.18 (Overlap of praxis modes). *Research-dominant and application-dominant praxis can overlap within the same activity when epistemic reconstruction and practical transformation are jointly produced, provided their respective orientations and points of provisional closure remain analytically distinguishable.*

Proposition 6.18 protects two useful insights. First, overlap is ordinary rather than exceptional. Second, overlap does not require abandoning distinctions. A project can ask whether a relation exists and simultaneously decide how to act upon it. The evidential standards governing the first question and the practical criteria governing the second can remain different even when both are pursued by the same participants.

Overlap also has ethical and epistemic implications. Research designed around practical goals may privilege evidence that is actionable while neglecting historically important or normatively significant relations that do not fit the immediate intervention. Conversely, inquiry designed around epistemic novelty may produce operational consequences for participants without treating those consequences as part of the research object. Recognizing overlap therefore expands the scope of reflexive analysis. Researchers and practitioners can ask which transformations are occurring simultaneously and whose capacities, risks, or representational positions are being altered in the process.

6.2.5 Mutual Transformation between Praxis Modes

Praxis modes can transform into one another when the contradiction organizing activity changes. An application-dominant intervention may encounter an unexpected failure, converting the immediate problem into one of explanation. A research-dominant inquiry may identify an urgent and sufficiently understood risk, shifting practical priority toward intervention. A new representation may make an actionable relation visible; an intervention may generate traces that make a previously inaccessible relation researchable. These transitions are transformations of orientation within continuing praxis rather than simple handoffs between isolated domains.

The transformation can be reversible or recursive. Inquiry generates an intervention; intervention produces evidence; evidence revises the theory; the revised theory changes the intervention. Dewey's account of inquiry within changing situations offers one historical resource for understanding such recursive movement between problematic conditions, inquiry, and consequence (Dewey 1922; Dewey 1925). In GRE, the emphasis falls on how each phase transforms the relational conditions inherited by the next. A research phase can change the available categories, datasets, expectations, or institutional legitimacy. An application phase can change the population, infrastructure, incentive structure, or institutional relations that later research observes.

Definition 6.19 (Praxis-mode transformation). *A praxis-mode transformation occurs when the principal orientation and provisional point of closure of an ongoing praxis configuration shift sufficiently for research-dominant or application-dominant organization to become the more appropriate description of the active phase.*

The definition avoids treating transition as a change in institutional identity. A hospital remains a hospital when clinical practice enters a research-dominant phase; a university remains a university when a research programme enters an application-dominant phase. What changes is the organization of the active contradiction and

the practical criteria by which the phase is provisionally advanced or closed.

Mode transformation can also generate path dependence. Decisions taken during an application-dominant phase can constrain what later inquiry can observe. Categories created for research can become embedded in administrative systems and shape later interventions. Infrastructure built for one epistemic purpose can become the default channel through which practical action occurs. The transition between modes therefore deserves historical reconstruction rather than being represented as a neutral switch.

6.2.6 Hybrid Praxis

Some activities sustain research and application orientations so closely that assigning a single dominant mode for the whole configuration would discard relevant structure. These cases can be described as hybrid praxis. Hybrid does not mean conceptually indeterminate. It indicates that multiple orientations remain materially consequential over the analytical interval and that the activity is deliberately organized to preserve their interaction.

Definition 6.20 (Hybrid praxis). *Hybrid praxis* is a praxis configuration in which research-dominant and application-dominant orientations remain jointly operative over the relevant analytical interval, with neither orientation adequately representing the configuration by itself.

Examples can include long-term participatory research, adaptive management, iterative engineering, action-oriented field laboratories, implementation research, community-based inquiry, or institutional experiments in which knowledge production and practical transformation are co-designed. The examples are illustrative categories rather than claims that every activity carrying those labels is necessarily hybrid. The analytical determination depends on how the actual praxis is organized.

Hybrid praxis creates special demands for evaluation. An epistemically productive intervention may be practically harmful; a practically successful intervention may generate little transferable knowledge; a method that increases comparability may undermine local participation; a participatory process may generate valuable situated knowledge while limiting standardization. A single success metric can therefore obscure the plurality of outputs and burdens. Evaluation should identify which orientation a criterion addresses and how tensions among criteria are managed.

Hybrid configurations also complicate authorship and responsibility. Knowledge may be produced through distributed contributions from researchers, participants, practitioners, technicians, institutions, and affected communities. Practical consequences may be generated by the same relational configuration that generates evidence. Later sections on researcher power, epistemic justice, AI-assisted research, and collective knowledge production will develop these problems in greater detail. The present concept provides a place within the architecture for praxis whose epistemic and practical orientations remain deliberately intertwined.

6.2.7 Phase-Dependent Practical Orientation

Praxis orientation often changes at a finer temporal resolution than project labels suggest. A multi-year research programme can move through exploratory observation, conceptual reconstruction, formalization, experimental intervention,

implementation, monitoring, and revision. Some phases are research-dominant, some application-dominant, and some hybrid. Treating the whole project as belonging permanently to one mode can hide the moments at which standards of warrant, urgency, responsibility, and acceptable uncertainty change.

Definition 6.21 (Phase-dependent practical orientation). *Phase-dependent practical orientation* is the dominant research, application, or hybrid organization of praxis relative to a specified temporal segment, practical problem, and point of provisional closure.

This definition makes the analytical interval explicit. A short interval may reveal a clear application-dominant decision episode inside a broadly research-oriented programme. A longer interval may reveal recursive alternation between inquiry and intervention. The appropriate scale therefore depends on the question. Analysis of responsibility for an urgent decision may require a fine-grained phase boundary; analysis of institutional learning may require a longer trajectory.

Phase dependence also alters acceptable epistemic posture. During exploratory research, broad uncertainty and competing explanations may be retained because the objective is to map a problem-space. During an urgent application phase, a decision may be necessary despite unresolved uncertainty, making reversibility, monitoring, and contingency planning more important. During post-intervention research, the system may already have changed, so evidence should be interpreted relative to the transformed configuration. The same claim can consequently play different practical roles across phases.

Claim 6.22 (Orientation is indexed to phase). *A classification of praxis as research-dominant, application-dominant, or hybrid should be indexed to a specified phase and problem, because practical orientation can change while institutional identity and overall project continuity remain stable.*

Claim 6.22 prevents the chapter's vocabulary from hardening into permanent classifications of people or organizations. It also prepares the analysis of contradictions in the next section, because a change in principal contradiction can mark a change in practical orientation.

6.2.8 Limits of Fixed Research–Application Boundaries

Fixed research–application boundaries remain useful for many institutional purposes. Ethics review, funding, professional responsibility, regulation, publication, and organizational accountability can require categorical distinctions. The analytical problem arises when these administrative distinctions are treated as complete descriptions of praxis. Institutional classifications can stabilize responsibilities while still failing to capture overlap, mode transformation, hybrid organization, or phase dependence.

A fixed boundary can obscure causal and generative relations across the divide. Research representations can alter later policy, investment, organizational design, public expectations, or technological development. Application can create new datasets, categories, infrastructures, and populations that later research treats as given. Research funding can shape what practical problems become visible; implementation requirements can shape what research questions are considered relevant. The boundary is therefore often permeable in both directions even where institutions assign different roles to each side.

The boundary can also distribute responsibility selectively. Researchers may treat downstream use as external to research even when a project is designed around foreseeable deployment. Practitioners may treat the categories or models they inherit as epistemically settled even when those representations were produced under narrow conditions. A relational account asks how responsibility, knowledge, authority, and consequences are actually connected across phases. This does not mean that every researcher is responsible for every later use, or that every practitioner must reconstruct the entire genealogy of a tool. It means that the structure of connection should be examined before institutional separation is taken as evidence of practical independence.

Proposition 6.23 (Analytical permeability of the research–application boundary). *Institutional distinctions between research and application can remain administratively necessary while their analytical boundary remains permeable whenever knowledge production and practical transformation condition one another across phases.*

Proposition 6.23 supplies the section’s closing architecture. Research praxis belongs within the field of praxis because epistemic and practical transformations remain historically and relationally connected. Research-dominant, application-dominant, and hybrid configurations can be distinguished by orientation and provisional closure, yet these modes can overlap and transform as the contradiction organizing activity changes. The next section develops contradiction as an analytical relation within praxis and prepares the more specific accounts of the principal contradictions of research-dominant and application-dominant activity.

6.3 Contradictions within Praxis

This section develops contradiction as an analytical category for examining how praxis becomes organized, strained, redirected, and transformed. Its role is intermediate between the general account of praxis developed in Sections 6.1–6.2 and the more specific analyses of research-dominant and application-dominant praxis that follow. The objective is to distinguish several forms of contradiction, specify the difference between principal and secondary contradictions, and explain how their relative significance can change across phases and historical conditions. The method is relational and generative: contradiction is treated as a structured relation among demands, capacities, representations, institutions, or practical conditions whose interaction can alter subsequent possibilities. The section therefore uses contradiction as an explanatory instrument for the dynamics of praxis while preserving room for non-contradictory mechanisms, contingency, and plurality.

The vocabulary has an identifiable historical lineage. Marx’s writings repeatedly analyze tensions among productive forces, social relations, forms of consciousness, and historically specific institutions (Marx 1994). Mao’s 1937 essay “On Contradiction” gives explicit form to the distinction between principal and secondary contradictions and emphasizes that their relative positions can change across stages of a process (Mao 1967). Althusser later develops an account of contradiction and overdetermination that resists reducing complex historical processes to a single expressive opposition (Althusser 2006). GRE draws selectively from these lineages. Its use of contradiction is narrower than a complete dialectical ontology: the concept functions here as a way to identify relational tensions that organize praxis and generate pressures for

transformation.

6.3.1 Contradiction as a Generative Relation

A contradiction within praxis arises when two or more practically significant demands, tendencies, capacities, commitments, representations, or conditions are mutually implicated yet cannot be simultaneously realized in their current form without producing strain, displacement, revision, or transformation. Examples include the demand for stable concepts under historically changing conditions, the need to decide while evidence remains incomplete, the pursuit of comparability alongside sensitivity to local difference, or the requirement to act quickly while preserving reversibility. The relevant relation is therefore practical and generative: its significance lies in how the tension reorganizes subsequent knowing, judgment, action, or institutional arrangement.

This use of contradiction differs from formal logical contradiction. A theory containing mutually inconsistent propositions presents a logical problem. A praxis contradiction can exist even when every proposition used by participants is logically consistent. A hospital may possess coherent protocols and still confront a contradiction between rapid standardized triage and the individualized attention required by heterogeneous cases. A research programme may possess internally coherent models and still confront a contradiction between stable formal categories and a changing object of inquiry. Logical analysis can become relevant within such situations, while the praxis contradiction concerns the relational organization of activity.

Contradictions can also be latent. Two requirements may coexist for long periods because institutional slack, abundant resources, weak interaction, or temporal separation prevents their tension from becoming consequential. The contradiction becomes practically salient when conditions force the requirements into tighter interaction. A budget constraint, technological change, legal reform, crisis, new evidence, or changed population can therefore disclose a contradiction that had previously remained weakly manifest. This temporal feature makes contradiction compatible with the chapter's broader emphasis on emergence and historical situatedness.

Definition 6.24 (Praxis contradiction). A *praxis contradiction* is a historically situated relation among practically significant demands, tendencies, capacities, commitments, representations, or conditions whose joint operation generates pressure for reorganization, prioritization, revision, or transformation within a specified praxis configuration.

Definition 6.24 makes the target and scope explicit. The relevant pressure may be epistemic, institutional, normative, material, temporal, or distributed across several dimensions. The presence of tension alone does not establish that the contradiction is decisive. Its explanatory significance depends on evidence that the relation materially organizes the praxis under study.

Claim 6.25 (Generative potential of contradiction). A *contradiction has generative significance when responses to the tension alter subsequent capacities, relations, representations, institutions, orientations, or possibility structures within the praxis configuration*.

Claim 6.25 also preserves normative openness. A contradiction can generate learning, institutional innovation, conceptual refinement, and new cooperation; it can also generate exclusion, coercive simplification, dependency, or foreclosure. Generativ-

ity describes transformation of subsequent conditions, while normative evaluation remains a separate task.

6.3.2 Principal and Secondary Contradictions

Complex praxis usually contains several contradictions at once. A research project may face uncertainty about its object, disagreement over categories, limited resources, institutional incentives, participant mistrust, technical failure, and pressure for practical relevance. Treating all tensions as equally organizing can make analysis diffuse. The distinction between principal and secondary contradictions provides a way to ask which tension most strongly structures the current phase and which tensions remain consequential through their relation to it.

The terminology has a direct historical precedent in Mao's analysis of complex processes, where one contradiction can become principal for a particular stage while others occupy secondary positions, and where those positions can change as the process develops (Mao 1967). GRE retains the stage-sensitive insight while giving the distinction a more explicitly analytical and revisable form. Principal status is attributed relative to a specified problem, temporal interval, boundary, and practical orientation. It is therefore a claim requiring evidence rather than a property assumed in advance.

Definition 6.26 (Principal contradiction of praxis). The *principal contradiction of praxis* is the contradiction that, relative to a specified phase, boundary, and practical problem, most strongly organizes the allocation of attention, judgment, resources, action, and revision within the praxis configuration.

Definition 6.27 (Secondary contradiction of praxis). A *secondary contradiction of praxis* is a materially relevant contradiction whose organizing significance is lower than that of the principal contradiction for the specified phase, while retaining the capacity to condition, amplify, redirect, or later displace it.

The distinction concerns organizing significance rather than moral importance. A contradiction can be ethically serious while remaining secondary to the process currently organizing action. Likewise, a principal contradiction can be analytically decisive while concerning a relatively narrow operational problem. This separation reduces the risk of turning analytical priority into normative ranking.

Several indicators can support identification of principal status. A contradiction may repeatedly redirect decisions, absorb disproportionate resources, constrain multiple other activities, structure institutional debate, trigger revision across methods or roles, or determine the point at which provisional closure becomes necessary. Evidence should also examine plausible alternatives. What appears principal from the viewpoint of a project leader may differ from what organizes participant experience, community response, or institutional behavior. Principal-contradiction analysis therefore inherits the observer-position and boundary problems developed in Chapter 5.

Althusser's account of overdetermination is useful as a caution against interpreting one contradiction as an isolated or self-sufficient cause (Althusser 2006). A principal contradiction can be constituted through many secondary relations, historical inheritances, institutional forms, and contingent conditions. GRE therefore treats principal status as relationally produced. Secondary contradictions can change the form through which the principal contradiction appears and can alter the pathways avail-

able for its transformation.

Proposition 6.28 (Relational identification of principal contradiction). *Attribution of principal status should be supported by evidence that a contradiction has greater organizing significance for the specified praxis phase than plausible competing contradictions, while the secondary relations that condition its operation remain analytically visible.*

6.3.3 Contradictions of Knowing

Knowing within praxis is organized by tensions between epistemic aspiration and limited access. Inquiry seeks sufficiently warranted understanding while observation remains partial, manifestations remain mediated, historical traces remain incomplete, and categories remain revisable. These conditions create contradictions whenever practical or theoretical demands exceed the knowledge presently available.

One recurring form concerns the relation between the openness of the object and the need for provisional epistemic closure. Research cannot retain every possible explanation indefinitely. Concepts, hypotheses, measurement rules, and evidential standards must eventually be selected sufficiently to permit inquiry to proceed. Yet closure can suppress alternatives too early and stabilize representations that later evidence challenges. The resulting contradiction concerns the need to make knowledge workable while preserving its revisability.

A second form concerns depth and tractability. Rich relational reconstruction can preserve historical, institutional, and qualitative complexity, while tractable inquiry often requires selective representation. Greater detail can improve local adequacy and simultaneously increase demands on evidence, computation, interpretation, and communication. Simplification can enable comparison while obscuring relations that matter for the target. The contradiction therefore lies in the organization of epistemic effort rather than in an abstract choice between complexity and simplicity.

A third form concerns breadth and situated access. Distributed inquiry can combine heterogeneous evidence across sites and scales, but each additional source introduces its own conditions of production, missingness, category structure, and observer position. Expanding the evidential field can therefore increase both epistemic reach and the work required to preserve provenance and comparability. The chapter's earlier account of profiled epistemic confidence provides one response: uncertainty can be localized instead of compressed into one global judgment.

Claim 6.29 (Contradiction of epistemic closure). *Research praxis often contains a contradiction between the provisional closure required for cumulative inquiry and the revisability required by partial, historically situated knowledge.*

Claim 6.29 prepares the more specific analysis of research-dominant praxis in the following section. The present point is broader: contradictions of knowing can appear in research, application, and hybrid praxis whenever action or interpretation requires commitments under incomplete epistemic conditions.

6.3.4 Contradictions of Representation

Praxis depends on representations because relations, institutions, populations, histories, and future possibilities cannot ordinarily be carried into deliberation in their

full complexity. Maps, categories, variables, narratives, legal classifications, indicators, models, visualizations, and computational embeddings make aspects of a relational system portable. Representation thereby expands the capacity to coordinate, compare, communicate, and act. The same operation selects, compresses, and transforms what becomes legible.

Contradictions of representation arise when the properties that make a representation practically usable also generate losses that matter for the task. Standardization can support comparison while reducing sensitivity to historically specific meanings. Aggregation can make a population visible while hiding internal relational differentiation. A network representation can expose connectivity while underrepresenting legal, affective, material, or temporal qualities of edges. A legal category can stabilize rights and obligations while failing to capture relations that exceed its criteria.

Representations can also become performative. Once used in funding, evaluation, eligibility, policing, credit, diagnosis, publication, or institutional planning, a representation can alter the relations it purports to describe. This creates a recursive contradiction: better operational integration can increase the representation's practical efficacy while simultaneously changing the object against which its adequacy is assessed. The epistemic and causal roles of representation then become intertwined.

Definition 6.30 (Representational contradiction in praxis). A *representational contradiction in praxis* is a tension in which features that increase the usability, portability, comparability, or operational force of a representation also generate losses, distortions, or performative effects that materially affect the object or purpose for which the representation is used.

The definition does not imply that representation can become complete. It directs attention to target-relative tradeoffs and to the possibility that the representation itself enters the relational system. The practical response may involve layered representations, provenance records, local supplements, multiple models, contestability mechanisms, or explicit uncertainty rather than pursuit of a universally exhaustive representation.

6.3.5 Contradictions of Theory

Theory organizes inquiry by stabilizing concepts, relations, explanatory structures, and expectations across cases. This stabilizing function creates continuity and cumulative development. Historical and generative reality, however, can alter the very relations that made an earlier theory adequate. Contradictions of theory emerge where theoretical stability encounters anomaly, counterevidence, new objects, transformed institutions, or relations that exceed the architecture through which the theory currently explains them.

The contradiction can concern scope. A theory developed in one historical setting may travel successfully across some contexts and fail in others. It can concern abstraction. A parsimonious mechanism may explain an important regularity while omitting relational conditions required for its reproduction. It can concern category formation. Terms that once differentiated relevant objects can lose discriminatory power as practices or institutions change. It can also concern theoretical productivity: a framework may continue to fit existing evidence while generating progressively fewer informative questions about newly emerging phenomena.

Theory revision therefore involves more than accumulating exceptions. The key

question is whether the encountered tension can be addressed through parameter adjustment, boundary revision, supplementary mechanisms, category differentiation, or deeper reconstruction of the theoretical architecture. These responses have different epistemic costs. A framework that can absorb every anomaly through ad hoc additions may preserve formal continuity while losing explanatory discrimination. A framework revised too readily may lose the stability required for cumulative comparison.

Claim 6.31 (Theory–counterevidence contradiction). *A contradiction becomes theoretically generative when counterevidence or newly observed relations create pressure to revise the scope, categories, mechanisms, or architecture through which the research programme organizes explanation.*

This formulation connects contradiction to generativity without assuming that every disagreement produces theoretical progress. Counterevidence can be mistaken, theory can remain adequate within a narrower scope, and apparent novelty can reflect measurement failure. The contradiction becomes productive through disciplined diagnosis of where the mismatch originates and what forms of revision it warrants.

6.3.6 Contradictions of Decision

Decision compresses an open field of possibilities into a provisional practical commitment. This operation is central to praxis because resources, time, attention, and institutional authority are finite. Decisions therefore create contradictions whenever several legitimate demands cannot be simultaneously satisfied under existing conditions. The tension may concern speed and deliberation, local benefit and distributed consequences, standardization and discretion, present needs and future options, or commitment and reversibility.

Decision contradictions differ from contradictions of knowing because additional knowledge may leave the practical tension intact. Two values can remain in conflict after the relevant facts are well established. Two groups can hold legitimate but incompatible claims over the same scarce resource. A decision may need to distribute risk among actors whose interests cannot be reduced to one metric. Epistemic improvement can clarify the structure of the problem while leaving a practical contradiction to be judged.

At the same time, uncertainty shapes the decision relation. A choice can alter future evidence, close options, create constituencies, change incentives, or transform the system whose consequences were initially estimated. Decision therefore has a generative dimension. The contradiction is partly about the present allocation and partly about which future conditions the decision helps create.

Definition 6.32 (Decision contradiction). *A decision contradiction is a relation among practically significant commitments, constraints, values, or consequences that cannot be jointly realized in their current form within the available decision space and therefore requires prioritization, redesign, sequencing, compensation, or transformation of that space.*

The definition leaves room for creative transformation. A contradiction need not be handled exclusively by choosing one side. Institutional redesign, new resources, temporal sequencing, modularity, reversible experimentation, or changed relational arrangements can alter the decision space itself. Contradiction analysis is therefore

useful when it reveals possibilities for transforming the conditions under which the choice is posed.

6.3.7 Contradictions of Action under Incomplete Knowledge

Action frequently becomes necessary before uncertainty can be substantially reduced. Emergencies, institutional deadlines, ecological thresholds, care obligations, infrastructure failure, financial constraints, or political decisions can impose temporal closure on deliberation. Application-dominant praxis therefore often contains a contradiction between the necessity of acting and the incompleteness of available knowledge.

The tension is intensified when action changes the evidential environment. An intervention can produce new data while also altering baseline conditions. It can reveal mechanisms that were previously hidden while creating path dependence that makes reversal costly. Early action can preserve options in one dimension and close them in another. Waiting for stronger evidence can reduce one form of uncertainty while allowing harms, lock-in, or lost opportunities to accumulate. The contradiction therefore concerns both epistemic quality and temporal structure.

Dewey's account of inquiry and conduct emphasizes learning through consequences and reconstruction of action in light of experience (Dewey 1922; Dewey 1925). Within GRE, this recursive structure motivates attention to reversible action, monitoring, feedback, adaptive revision, and preservation of alternatives where feasible. These practices do not eliminate the contradiction. They organize action so that the consequences of incomplete knowledge can remain partially observable and revisable.

Proposition 6.33 (Action under incomplete knowledge). *When action is required before epistemic uncertainty can be sufficiently reduced, praxis should treat monitoring, reversibility, feedback, and revision capacity as part of the action design whenever those capacities are materially available.*

Proposition 6.33 anticipates the dedicated analysis of application-dominant praxis later in this chapter. Its present function is to show why action contradictions can become principal even within projects that began with a research orientation.

6.3.8 Transformation of the Principal Contradiction

The principal contradiction of praxis can change as the configuration develops. A project may begin with uncertainty about whether a relation exists, later shift toward disagreement over how to represent it, and eventually confront a practical contradiction about intervention. A crisis can move the organizing problem from methodological adequacy to immediate decision. New evidence can resolve one tension while making a previously secondary contradiction visible. Institutional success can also create new contradictions by expanding scale, changing participants, or increasing dependence on infrastructures that were previously peripheral.

Transformation can occur through resolution, displacement, amplification, coupling, or reframing. Resolution reduces the organizing force of a contradiction sufficiently that another tension becomes more consequential. Displacement moves pressure elsewhere without removing the underlying relation. Amplification increases

the practical significance of a secondary contradiction. Coupling links several contradictions so that they begin to reorganize one another. Reframing changes how participants understand the problem and can alter which relations count as central.

Definition 6.34 (Principal-contradiction transition). A *principal-contradiction transition* occurs when the contradiction with the greatest organizing significance for a specified praxis phase changes because the relational configuration, available knowledge, institutional conditions, practical orientation, or field of feasible action has materially changed.

A transition should be reconstructed rather than inferred solely from labels. The same institutional project can retain its name while its organizing contradiction changes substantially. Conversely, a change in vocabulary can occur without a change in the practical relation that organizes activity. Evidence may include shifts in resource allocation, meeting agendas, methodological revision, intervention timing, authority structures, failure modes, or the kinds of uncertainty that participants attempt to reduce.

Claim 6.35 (Praxis-mode transformation through contradiction). A *transformation between research-dominant, application-dominant, and hybrid praxis* can occur when a change in principal contradiction reorganizes the project's orientation and point of provisional closure.

This claim connects the present section directly to Section 6.2. The relation is analytical rather than deterministic: a shift in contradiction can support a mode transformation, while institutional rules or deliberate design can preserve the previous orientation despite changed pressures.

6.3.9 Historical Transformation of Praxis

Contradictions are historically situated because the demands and conditions entering praxis are themselves historically produced. New instruments can alter what is observable; legal reforms can change which relations are recognized; institutional expansion can change scale; new infrastructures can redistribute access; changes in language can reorganize classification; crises can compress decision time; and new technologies can alter the relation between expertise and action. The contradiction organizing praxis therefore belongs to a historical configuration rather than to an invariant list of oppositions.

Historical transformation also affects the forms through which contradiction is managed. A tension once handled through professional discretion may later be handled through standardized protocols or computational systems. A contradiction between local knowledge and central coordination may be reorganized through new communication infrastructures. A conflict between research speed and evidential scrutiny can change when automated tools accelerate literature search, coding, simulation, or drafting. These transformations can reduce some burdens while generating new asymmetries, dependencies, and representational problems.

This historical sensitivity is consistent with the book's treatment of methods and evaluative practices as historically evolving. The criterion by which a contradiction appears salient can itself change. What counts as adequate evidence, acceptable delay, sufficient participation, or tolerable uncertainty is shaped by disciplinary, institutional, technological, and normative histories. Contradiction analysis therefore requires reconstruction of the practical standards operating in the period under study.

Proposition 6.36 (Historical index of praxis contradiction). *Claims about a principal or secondary contradiction should be indexed to the historical conditions that constitute the relevant demands, capacities, institutions, representations, and feasible responses.*

Proposition 6.36 prevents contradiction categories from becoming timeless templates. It also allows later inquiry to re-epistemize an earlier praxis configuration when new evidence or changed historical understanding reveals relations that contemporaneous actors could not easily observe.

6.3.10 Limits of Contradiction-Based Analysis

Contradiction-based analysis is useful when tensions materially organize praxis, yet it does not exhaust the causes of transformation. Change can arise through contingency, encounter, imitation, invention, demographic movement, ecological disturbance, institutional drift, random variation, aesthetic judgment, or the appearance of an opportunity whose significance is not well described as the resolution of an opposition. A generative relational analysis therefore treats contradiction as one family of transformative relations within a wider field of generative processes.

The vocabulary can also encourage premature binary reduction. Many praxis configurations involve several actors, values, temporalities, scales, and institutional logics whose relations cannot be adequately represented by two opposing sides. Higher-order and field relations developed in Chapter 5 remain relevant here. What appears to be one contradiction may be the manifest expression of a multilayer configuration, and different observers may identify different tensions because their positions expose different parts of the field.

A further limit concerns retrospective coherence. Once a transformation has occurred, researchers can reconstruct the preceding period around the tension that appears to explain the outcome. This can understate unrealized alternatives and overstate the inevitability of the path taken. Contradiction analysis should therefore preserve historical counterfactuals, failed responses, secondary tensions, and evidence of contingency where these are relevant to the trajectory.

The language of principal contradiction can also over-centralize analysis. A single contradiction may organize one phase while several partly independent tensions remain causally important. The strongest explanation can therefore combine principal-contradiction analysis with distributed generative attribution rather than forcing every effect through one dominant pathway. Althusser's emphasis on overdetermination provides one historical resource for maintaining this caution (Althusser 2006).

Proposition 6.37 (Scope condition for contradiction analysis). *Contradiction-based analysis is warranted when evidence shows that a relational tension materially organizes praxis, while alternative generative mechanisms, multiple interacting tensions, observer position, historical contingency, and unrealized possibilities remain available for examination.*

The proposition gives the section its closing discipline. Contradiction is neither a universal explanation nor a merely rhetorical label. It is an analytically bounded way to identify tensions that organize praxis and generate pressures for transformation. The distinction between principal and secondary contradictions then permits a phase-sensitive account of orientation without erasing relational complexity. The following sections apply this architecture to the characteristic principal contradictions of research-dominant and application-dominant praxis.

6.4 The Principal Contradiction of Research-Dominant Praxis

This section specifies the contradiction that most characteristically organizes research-dominant praxis. Its role is to refine the general account of contradiction developed in Section 6.3 into a claim about the practical organization of inquiry. The objective is to explain why research requires provisional stabilization of concepts, representations, explanations, and methods while its objects remain only partially known, historically changing, relationally complex, and capable of generating forms that exceed inherited descriptions. The section proceeds through nine dimensions of this contradiction: limited knowledge, representation, conceptual stability, counterevidence, formalization, emergence, methodological adequacy, theoretical closure, and transformation of the epistemic-theoretical system. The method is relational and generative. Each dimension is treated as a relation between epistemic requirements and properties of the object of inquiry whose interaction can reorganize subsequent research.

Research-dominant praxis cannot proceed through indefinite openness alone. Inquiry requires names, distinctions, records, models, inferential rules, standards of relevance, and points of provisional closure. These stabilizations make comparison, criticism, cumulative learning, and coordinated work possible. At the same time, Chapter 5 established that relational knowledge is partial, representation-sensitive, boundary- and scale-dependent, historically situated, and revisable. The principal contradiction of research-dominant praxis therefore concerns the need to stabilize an epistemic-theoretical system sufficiently for inquiry to proceed while preserving its capacity to be transformed by the reality it seeks to know.

Definition 6.38 (Principal contradiction of research-dominant praxis). The *principal contradiction of research-dominant praxis* is the historically situated tension between the practical need for sufficiently stable concepts, representations, explanations, methods, and standards of warrant and the continuing capacity of partially known relational reality to exceed, alter, or invalidate those epistemic-theoretical stabilizations.

Definition 6.38 identifies an organizing relation rather than a permanent law of research. Other contradictions can become principal in particular projects or phases. Institutional survival, ethical conflict, access, safety, or resource scarcity may temporarily organize research more strongly. The definition concerns the characteristic contradiction of research-dominant praxis when the activity is principally oriented toward the production and revision of warranted knowledge.

6.4.1 Limited Knowledge and Generative Reality

Research begins from an asymmetry between the reality under investigation and the knowledge presently available about it. The asymmetry is especially consequential when the target is generative. A generative relational system can alter its participants, capacities, classifications, institutions, and possibility structures through time. The object encountered later in an inquiry can therefore differ materially from the object represented at its beginning. Limited knowledge is then a condition of both incomplete access and continuing transformation.

This condition gives research its practical orientation. Inquiry is organized because what is already known is insufficient for the explanatory, descriptive, interpretive, or practical problem at hand. Dewey's account of reflective inquiry begins from problematic situations in which established habits and meanings cease to provide adequate guidance (Dewey 1910). GRE generalizes this insight cautiously. A research problem emerges when existing epistemic arrangements provide insufficient orientation toward a relational target whose relevant organization, history, or generative effects remain uncertain.

The relation between ignorance and inquiry is therefore structured. Researchers rarely confront an undifferentiated absence of knowledge. They inherit categories, prior findings, instruments, institutional archives, disciplinary expectations, and theoretical commitments. These resources make some questions observable and others difficult to formulate. Limited knowledge is consequently distributed across dimensions: the existence of a relation may be well supported while its historical formation remains uncertain; its current manifestation may be observable while its downstream generative effects remain weakly identified; its local organization may be clear while cross-scale consequences remain unresolved.

Definition 6.39 (Research-dominant epistemic tension). A *research-dominant epistemic tension* is the relation between a specified insufficiency in current knowledge and the requirement to construct sufficiently stable epistemic means for investigating a target that can remain partially accessible and generatively changing.

The definition prevents limited knowledge from becoming an abstract celebration of uncertainty. Research-dominant praxis seeks to reduce, reorganize, or more accurately locate uncertainty. It can produce stronger warrant concerning some dimensions while discovering additional uncertainty elsewhere. Progress can therefore consist in improved discrimination of what is known, how it is known, and where the current limits of warrant remain.

Generative reality intensifies the contradiction because successful inquiry can itself alter the conditions of later inquiry. New classifications can reorganize institutional practice; new instruments can reveal previously inaccessible traces; published findings can change participant behavior; theoretical innovations can redirect what later researchers regard as salient. The epistemic system develops in relation to an object that can also develop in relation to the epistemic system. Research-dominant praxis must therefore remain capable of distinguishing learning about an earlier configuration from observing a configuration transformed during the research process.

6.4.2 Representation and Relational Complexity

Research depends on representation. Relations are rendered through concepts, diagrams, narratives, datasets, classifications, equations, archival reconstructions, images, and computational objects. Representation enables portability and comparison, yet every representation selects. It foregrounds some dimensions, suppresses others, imposes boundaries, and translates heterogeneous phenomena into a tractable form. The contradiction becomes acute when relational complexity exceeds what a single representation can preserve without substantial loss.

Relational complexity can arise from multiplicity of participants, heterogeneous relation types, overlapping scales, changing boundaries, unequal visibility, temporally delayed effects, and recursive feedback. A compact representation can remain

analytically useful even when it omits many of these dimensions. The epistemic problem concerns the fit between the omission and the intended claim. A representation designed to estimate aggregate association may be poorly suited to reconstructing institutional meaning; an ethnographic account rich in situated interaction may provide limited support for population-level prevalence; a network representation can preserve topology while leaving the substantive meaning of edges underdetermined.

Definition 6.40 (Representational adequacy under relational complexity). *Representational adequacy under relational complexity* is the degree to which a representation preserves the dimensions of a relational target that are materially relevant to the claim for which the representation is used, while making consequential exclusions, transformations, and uncertainties explicit.

This definition makes adequacy claim-relative. Representational completeness is neither required nor generally available. What matters is whether the representation preserves the structure needed for the inference being made. Chapter 5 developed this requirement epistemologically; research praxis makes it operational. Researchers must decide which complexity can be bracketed, which must remain visible, and when a representation requires supplementation by another representational form.

Longino's contextual empiricism emphasizes that evidential relevance depends partly on background assumptions and that critical interaction among differently positioned inquirers can expose assumptions that remain invisible within a single perspective (Longino 1990). For GRE, this supports a plural representational discipline. Multiple representations can reveal different relational dimensions, and their divergence can itself become evidence about where the target resists compression into one schema.

Claim 6.41 (Representational remainder). *When a representation is used to support a relational claim, the dimensions of the target that are intentionally excluded, transformed, or left unresolved constitute a representational remainder whose relevance should be reconsidered when the claim, scale, boundary, or practical purpose changes.*

Claim 6.41 gives the principal contradiction a practical consequence. Research requires simplification, yet simplification should retain a pathway back to what was simplified whenever later evidence makes the remainder consequential.

6.4.3 Stable Concepts and Historical Change

Conceptual stability is necessary for cumulative inquiry. Researchers need sufficiently stable terms to compare cases, preserve records, construct datasets, communicate disagreement, and identify revision. Conceptual stability also carries risk when the target changes historically. A category can remain linguistically identical while its institutional conditions, practical meaning, membership rules, or generative consequences shift.

Historical change therefore creates a tension between comparability and semantic fidelity. If concepts are revised at every local difference, longitudinal comparison becomes difficult. If concepts are held fixed despite substantial transformation, apparent continuity can be produced by the classification system itself. Hacking's historical work on categories and styles of reasoning is relevant here because it shows how objects of knowledge and classificatory practices can emerge together historically (Hacking 2002). Kuhn's analysis of scientific development likewise emphasizes

that problem selection, standards, and conceptual organization are historically structured within research communities (Kuhn 1962).

GRE treats conceptual stability as a research achievement with explicit temporal scope. A concept can be stabilized for a phase of inquiry while remaining open to historically motivated revision. The relevant question concerns which dimensions must remain invariant for comparison and which dimensions can vary without destroying the analytical usefulness of the category.

Definition 6.42 (Conceptual stabilization). *Conceptual stabilization* is the provisional fixing of a concept's target, inclusion criteria, differentiating features, and inferential role for a specified research phase so that coordinated inquiry and comparison can proceed.

Proposition 6.43 (Historical revision of stabilized concepts). *A stabilized research concept should be reconsidered when evidence indicates that historical transformation has materially altered the relations, manifestations, mechanisms, or boundaries on which the concept's inferential role depends.*

The proposition does not require immediate replacement of every historically strained concept. Researchers can preserve older categories for archival continuity while introducing revised categories for current analysis. Versioned definitions, crosswalks, and explicit descriptions of semantic change allow historical comparability to coexist with conceptual revision. The principal contradiction is thereby managed through traceable transformation rather than a choice between permanent categories and continuous conceptual reinvention.

6.4.4 Theory and Counterevidence

Theory organizes research by specifying relevant objects, relations, mechanisms, expectations, and explanatory possibilities. Without theoretical stabilization, evidence can remain difficult to interpret because relevance itself is underdetermined. Yet the same theoretical organization can shield itself from counterevidence if every anomaly is reassigned to measurement error, auxiliary assumptions, exceptional cases, or future refinement.

The philosophy of science provides several important precedents for this tension. Popper makes continuing exposure to criticism central to scientific method (Popper 2002). Duhem and Quine, from different starting points, emphasize that empirical testing occurs within wider systems of assumptions, so discordant evidence does not mechanically identify which commitment requires revision (Duhem 1954; Quine 1951). These traditions jointly suggest that responsiveness to counterevidence requires judgment about where revision should occur.

GRE therefore treats counterevidence as relational. A finding counts as counterevidence relative to a specified theoretical expectation, measurement system, boundary, scale, and auxiliary structure. Its significance depends on how strongly the observation conflicts with the claim and on the credibility of the chain connecting evidence to target. Counterevidence can pressure a central proposition, expose a category failure, reveal a boundary problem, identify a missing mechanism, or indicate that the representation itself requires revision.

Definition 6.44 (Counterevidential pressure). *Counterevidential pressure* is the degree to which credible evidence strains the continued adequacy of a theoretical claim,

concept, mechanism, representation, boundary specification, or auxiliary assumption within a research configuration.

Proposition 6.45 (Distributed revision under counterevidence). *Responses to counterevidence should identify the specific component or relation under pressure and compare plausible revision pathways rather than treating empirical discordance as automatically decisive for either preservation or rejection of the whole theoretical system.*

This discipline resists two symmetrical failures: insulating theory from revision and abandoning theoretical structure whenever discordant evidence appears. Research-dominant praxis requires enough stability for cumulative explanation and enough permeability for credible counterevidence to reorganize the system.

6.4.5 Formalization and Lived Complexity

Formalization can clarify assumptions, relations, constraints, and inferential consequences with a precision difficult to achieve in ordinary prose. It can reveal hidden inconsistency, support simulation, identify invariants, and permit comparison across cases. Its epistemic strength depends on the relation between the formal object and the lived or historically situated complexity that the formalization is intended to represent.

The relevant contradiction concerns tractability and preservation. Formal systems require explicit variables, domains, operators, mappings, or probability structures. Lived social and economic processes can involve tacit knowledge, ambiguous boundaries, shifting meanings, institutional memory, unequal agency, embodied experience, and historically changing categories. Formalization can preserve some of these dimensions through richer models, yet additional complexity can reduce identifiability, interpretability, or empirical estimability. Research-dominant praxis therefore requires judgment about which dimensions must enter the formal object and which can remain outside it for the present analytical purpose.

Definition 6.46 (Formalization gap). *A formalization gap is the consequential difference between the structure represented by a formal model and the historically situated relational structure relevant to the claim for which the model is used.*

A formalization gap is not automatically a defect. Every model is selective. The epistemic issue is whether the omitted or transformed dimensions alter the intended inference. A simple model can be preferable when it isolates a mechanism transparently; a richer model can be preferable when interaction, heterogeneity, or temporal structure is constitutive of the phenomenon. The appropriate degree of formalization is therefore target-relative.

The principal contradiction appears when formal elegance begins to stabilize the research object more strongly than evidence warrants. Once a model becomes technically productive, institutionally established, or pedagogically convenient, later observations can be translated into the model's categories even when the underlying relational structure has changed. Research praxis should consequently preserve a distinction between mathematical coherence, empirical adequacy, interpretive adequacy, and ontological commitment.

Remark 6.47 (Formal precision and epistemic scope). Greater formal precision strengthens conclusions conditional on the formal specification; it does not by itself expand the empirical or ontological scope for which that specification is warranted.

Remark 6.47 preserves formalism as a powerful epistemic instrument while preventing symbolic precision from becoming a substitute for relational adequacy.

6.4.6 Explanation and Emergence

Explanation seeks regularity, mechanism, dependence, interpretation, or structure sufficient to render a phenomenon intelligible. Emergence creates difficulty because a later pattern can depend on relations among components whose collective organization was not adequately represented by the explanatory vocabulary available at an earlier stage. The research problem therefore concerns how explanation can remain cumulative while retaining sensitivity to novelty.

Emergence can be epistemic, relational, or generative. A phenomenon may appear emergent because earlier observations were incomplete; because interactions among already known components generate a higher-order organization; or because the system produces new capacities, relations, classifications, or institutional forms that alter subsequent dynamics. These cases require different explanatory responses. The first may require better access, the second a higher-order representation, and the third historical reconstruction of how new generative conditions formed.

Definition 6.48 (Emergence-sensitive explanation). An *emergence-sensitive explanation* is an explanation that specifies the level and historical conditions of its target, preserves the relations through which higher-order organization becomes possible, and remains open to revising its explanatory vocabulary when newly generated structures acquire consequential properties.

Emergence-sensitive explanation therefore avoids treating every unexpected event as evidence of a wholly new ontology. Novelty can arise from previously unobserved relations, nonlinear interaction, boundary change, institutional recombination, or path-dependent development. The explanatory task is to discriminate among these possibilities.

This task returns research to the principal contradiction. Explanation requires temporary closure around a mechanism or structure, while emergence can reopen what appeared settled. A research programme capable of learning from emergence preserves records of earlier explanatory commitments and makes visible the point at which a new phenomenon exceeds them. The transition itself becomes part of the object of inquiry.

6.4.7 Existing Methods and New Objects

Methods are historically developed instruments of inquiry. They carry assumptions about what can be observed, compared, measured, interpreted, sampled, modeled, and treated as evidence. New research objects can strain those assumptions. Machine-mediated social relations, novel institutional forms, rapidly changing classifications, cross-scale ecological-economic processes, and heterogeneous human–AI systems can generate targets that inherited methods capture only partially.

The tension is not resolved by novelty alone. A new object does not automatically require a new method. Existing methods can often be adapted, combined, or reinterpreted. Methodological innovation becomes warranted when the object's materially relevant properties systematically escape the observational, representational, inferential, temporal, or ethical capacities of the current methodological repertoire.

Definition 6.49 (Method–object adequacy). *Method–object adequacy* is the degree to which a method or coordinated set of methods can produce evidence and representations appropriate to the materially relevant properties of a specified research object and intended claim.

Claim 6.50 (Methodological pressure from new objects). *A new or transformed research object creates methodological pressure when its relevant relational properties repeatedly generate evidential or inferential failures that cannot be adequately addressed through ordinary adaptation of existing methods.*

The claim makes methodological innovation evidence-sensitive. Researchers should identify where existing methods fail: inaccessible temporal dynamics, category instability, distributed agency, cross-scale dependencies, reflexive feedback, provenance loss, or inability to represent heterogeneous relations. The next methodological response can then be proportionate to the failure rather than motivated by novelty for its own sake.

Research institutions also influence method–object adequacy. Funding schedules, disciplinary review, publication formats, data infrastructures, and training systems can stabilize methods long after their original objects have changed. Bourdieu and Wacquant’s emphasis on reflexive analysis of scientific fields is relevant because methodological choices are made within institutions structured by positions, resources, and inherited dispositions (Bourdieu and Wacquant 1992). The principal contradiction of research-dominant praxis therefore includes the relation between epistemic innovation and institutional reproduction.

6.4.8 Theoretical Closure and Revisability

Research requires closure at multiple levels. A dataset must eventually be frozen for analysis; a manuscript must be submitted; a model version must be specified; a conclusion must be stated strongly enough to be criticized and used. Closure is therefore part of research praxis rather than a failure of openness. The problem concerns the conditions under which provisional closure remains compatible with later revision.

Premature closure can suppress counterevidence, alternative explanations, category instability, or unresolved uncertainty. Perpetual deferral can make research unusable because no claim becomes stable enough for comparison, replication, critique, teaching, or application. The principal contradiction appears as a practical problem of timing and scope: when is the epistemic-theoretical system sufficiently stabilized for the current purpose, and what must remain recoverable for later revision?

Definition 6.51 (Theoretical closure threshold). *A theoretical closure threshold* is the project-relative level of evidential support, conceptual stability, explanatory adequacy, and uncertainty disclosure judged sufficient to stabilize a theoretical claim or model for a specified research purpose and phase.

Closure thresholds should be explicit enough to make disagreement possible. Exploratory research can tolerate greater uncertainty than a claim intended to guide high-stakes intervention. A conceptual proposal can be stabilized with different evidential expectations from an empirical estimate. The relevant threshold is therefore indexed to claim type, purpose, consequence, and available alternatives.

Popper’s emphasis on exposure to criticism remains useful as a discipline against self-sealing theory (Popper 2002). GRE extends revisability beyond falsification nar-

rowly conceived. Revision can arise from counterevidence, historical transformation, category failure, representational inadequacy, observer effects, ethical challenge, or emergence of new objects. A theoretically mature research practice therefore preserves the provenance of closure: why a conclusion was stabilized, which alternatives were considered, which uncertainties remained, and what kinds of future evidence would warrant reopening the claim.

Proposition 6.52 (Revisable closure). *Theoretical closure supports cumulative research when the stabilized claim is sufficiently explicit for use and criticism while the evidential, conceptual, methodological, and historical conditions of its stabilization remain recoverable for subsequent revision.*

6.4.9 Research as Transformation of the Epistemic-Theoretical System

The preceding contradictions converge on a broader conception of research. Research-dominant praxis does more than add propositions to an existing stock of knowledge. It can transform the system through which future knowledge becomes possible. New concepts alter what can be distinguished; new instruments alter what can be observed; new methods alter what can count as evidence; new theories alter what can be explained; new archives alter what can be reconstructed; and new standards of criticism alter what can remain stabilized.

This transformation can be cumulative, corrective, or reorganizing. Some research extends an existing representation without revising its architecture. Other work changes category boundaries, introduces new relations, displaces an explanatory mechanism, links previously separate scales, or reconstructs the historical object itself. Kuhn's account of scientific revolutions provides one influential model of large-scale reorganization in scientific practice (Kuhn 1962). GRE does not require research change to follow a single revolutionary pattern. Epistemic-theoretical transformation can also occur incrementally through repeated local revisions whose cumulative consequences alter the research field.

Definition 6.53 (Epistemic-theoretical system). *An epistemic-theoretical system is the historically situated configuration of concepts, representations, evidential standards, methods, inferential practices, theoretical commitments, infrastructures, and institutional routines through which a research community renders objects knowable and claims assessable.*

Definition 6.54 (Epistemic-theoretical transformation). *Epistemic-theoretical transformation is a change in one or more components or relations of an epistemic-theoretical system that materially alters the conditions under which later research objects can be represented, investigated, explained, criticized, or revised.*

This conception clarifies why the principal contradiction is generative. The tension between stabilization and exceedance does not merely obstruct research. Responses to it can generate new research capacities. Counterevidence can produce revised concepts; representational failure can produce new instruments; emergent phenomena can produce new explanatory levels; historically transformed objects can produce new comparison strategies; and method-object mismatch can produce methodological innovation.

Proposition 6.55 (Generative research transformation). *Research-dominant praxis*

becomes generatively transformative when responses to epistemic contradiction alter the capacities, relations, representations, methods, or standards through which subsequent inquiry is organized.

Proposition 6.55 also marks the transition toward the next section. Research-dominant praxis is principally organized around transforming the epistemic-theoretical conditions of knowing, whereas application-dominant praxis is more directly organized around transforming a practical-relational situation under incomplete knowledge. Both remain forms of praxis, and both contain knowing and action. Their characteristic contradictions differ in the point at which provisional closure is demanded and in the object that the praxis is principally oriented toward transforming.

6.5 The Principal Contradiction of Application-Dominant Praxis

This section specifies the contradiction that most characteristically organizes application-dominant praxis. Its role is to complement the research-dominant contradiction developed in Section 6.4 by examining situations in which practical orientation requires a decision, intervention, institutional response, or deliberate restraint before relevant knowledge can be completed. The objective is to explain how application proceeds when uncertainty, plural values, systemic interdependence, temporal pressure, and potentially irreversible consequences remain active. The section develops nine dimensions of this contradiction: necessity of action, decision under uncertainty, unintended consequences, plural values, urgency, systemic effects, reversibility, learning through action, and transformation of the practical-relational world. The method is relational and generative. Application is treated as an intervention into a field whose relations can respond to the intervention and thereby alter both later possibilities and the conditions of subsequent knowledge.

Application-dominant praxis differs from research-dominant praxis principally in its provisional point of closure. Research can often continue gathering evidence, revising representation, and refining explanation before a claim is stabilized for a particular purpose. Application frequently encounters a time at which a choice must acquire practical form even though evidence remains incomplete. The relevant choice may concern implementation, allocation, treatment, regulation, organizational design, public communication, infrastructure, protection, or the decision to preserve current arrangements. Each option enters a relational system whose responses cannot be known exhaustively in advance.

Definition 6.56 (Principal contradiction of application-dominant praxis). The *principal contradiction of application-dominant praxis* is the historically situated tension between the practical requirement to orient action within finite time and institutional conditions and the persistence of incomplete knowledge, uncertain consequences, plural values, and generative system responses at the point of decision and intervention.

Definition 6.56 identifies a characteristic organizing tension rather than a universal description of every applied activity. Some practical situations are highly standardized and well understood; others are dominated by legal authority, emergency survival, resource scarcity, or conflict among institutional mandates. The definition

applies most strongly when action is consequential, knowledge remains materially incomplete, and the intervention can reorganize later relations or possibility structures.

6.5.1 Necessity of Action and Incomplete Knowledge

Application-dominant praxis begins from a practical asymmetry. The actor may know that available knowledge is incomplete while also knowing that delay, omission, continuation of the status quo, or refusal to choose can have consequences. The practical field therefore contains more than the contrast between action and inaction. Delay and non-intervention can themselves preserve, redistribute, or intensify existing relational processes.

Chapter 5 developed incomplete knowledge as an epistemic condition. Application converts that condition into a problem of orientation. The operative question concerns what level and kind of warrant are sufficient for a specified intervention under the consequences of both action and delay. Manski's work on identification and decision emphasizes the importance of separating what evidence identifies from what follows only after stronger assumptions are introduced (Manski 2008). Application-dominant praxis extends this discipline into the decision environment: assumptions can be practically necessary, yet their epistemic status should remain visible when they support consequential action.

Definition 6.57 (Practical closure under incomplete knowledge). *Practical closure under incomplete knowledge* is the provisional stabilization of a course of action, restraint, or decision rule at a point where relevant uncertainty remains, because the practical field imposes a finite horizon for orientation.

Practical closure is therefore different from epistemic completion. A decision can be justified for a specified horizon while important uncertainties remain unresolved. The quality of praxis depends partly on whether these residual uncertainties are retained as conditions for monitoring and revision. A decision that suppresses its own uncertainty can harden provisional assumptions into institutional facts, while a decision that records uncertainty can preserve pathways for later correction.

The necessity of action also has a distributional structure. Some actors bear the consequences of delay more strongly than others, and some possess greater capacity to wait for additional evidence. A demand for more knowledge can therefore function differently across positions. Epistemic restraint remains important, yet prolonged inquiry can itself redistribute risk when the costs of waiting are unequal. Application-dominant praxis must consequently relate evidential incompleteness to the temporal and relational distribution of consequences.

6.5.2 Decision and Uncertainty

Decision transforms uncertainty from a descriptive feature of knowledge into a practical condition of selection. An actor must compare possible courses whose consequences are only partially specified, whose probabilities may be uncertain, and whose relevant outcomes can be heterogeneous. The decision problem is therefore rarely reducible to choosing the numerically largest expected quantity. Some consequences resist commensuration, some probabilities are poorly identified, and some possibilities remain outside the current representation.

The epistemic confidence profiles developed in Chapter 5 provide a useful basis for application. Confidence concerning the existence of a relation can differ from confidence concerning its causal contribution, future persistence, cross-scale portability, or response to intervention. A practical decision should therefore inherit the multi-dimensional structure of epistemic uncertainty rather than compress it prematurely into a single certainty score.

Definition 6.58 (Decision-relevant uncertainty profile). A *decision-relevant uncertainty profile* records the dimensions of uncertainty that materially affect the comparison, implementation, monitoring, or revision of candidate courses of action within a specified practical horizon.

The profile is selective. It does not require representation of every conceivable unknown. Its purpose is to preserve uncertainties capable of changing the practical ranking, safety, reversibility, distributional consequence, or monitoring requirement of an intervention. This discipline also prevents false precision. Quantification can be useful when probabilities and outcomes are supportable, while qualitative or scenario-based representation may be more adequate when the structure of uncertainty remains only partially identified.

Decision also involves judgment. Aristotle's treatment of practical wisdom and Dewey's pragmatist account of inquiry both place practical reasoning within situations whose particulars matter and whose consequences become known through experience (Aristotle 2014; Dewey 1910). GRE draws a narrower methodological implication: application requires context-sensitive judgment concerning which uncertainties are decision-relevant, how they should constrain action, and which conditions should trigger reassessment.

Proposition 6.59 (Uncertainty-preserving practical judgment). *When materially decision-relevant uncertainty persists at the point of practical closure, application-dominant praxis should preserve that uncertainty in the design of implementation, monitoring, and revision rather than treating closure as evidence that uncertainty has disappeared.*

Proposition 6.59 links decision to later learning. It converts uncertainty from a residual weakness into a design condition for practical adaptation.

6.5.3 Intervention and Unintended Consequences

Intervention changes the relational field in which its consequences unfold. The intervention can alter incentives, expectations, classifications, resource distributions, institutional routines, visibility, strategic behavior, and the capacities of affected actors. Some effects therefore arise through pathways that were absent or negligible before implementation. Application cannot infer all consequences by extrapolating from the pre-intervention state.

The causal problem is especially important in generative systems. An intervention can initiate chains whose later effects depend on responses, adaptations, feedback, and interactions among multiple relations. Woodward's interventionist framework emphasizes the value of asking how outcomes would change under specified interventions (Woodward 2003). GRE retains that logic while adding a practical caution: real interventions can transform the mechanism structure itself, so the post-intervention system may no longer satisfy all relations inferred from prior observations.

Definition 6.60 (Intervention-generated consequence). An *intervention-generated consequence* is a change whose occurrence depends materially on relational responses, adaptations, or feedback activated or reorganized by an intervention, including consequences that were weakly represented or absent from the initial intervention model.

Unintended consequences vary in epistemic status. Some are genuinely difficult to anticipate because they emerge through novel combinations or long feedback chains. Others were foreseeable but excluded by a narrow boundary, weak representation, institutional incentives, or unequal authority over what counted as relevant evidence. The practical response should therefore distinguish surprise generated by system complexity from surprise generated by avoidable epistemic omission.

Monitoring is one response, although monitoring alone cannot guarantee correction. Indicators can lag behind harm, categories can miss affected relations, and institutions can resist revision after resources and reputations become committed. Application-dominant praxis therefore benefits from pre-specified channels for detecting weak signals, receiving situated evidence, and revising the intervention before consequences become deeply stabilized.

6.5.4 Normative Commitment and Plural Values

Application is oriented toward some conception of what should be protected, changed, expanded, reduced, or preserved. Even technically framed interventions embed value judgments through target selection, outcome definition, weighting, eligibility rules, acceptable risk, time horizon, and the distribution of burdens. Application-dominant praxis therefore contains a normative dimension that cannot be delegated entirely to empirical evidence.

Plural values complicate practical orientation because relevant goods can be heterogeneous and only partially commensurable. Welfare, autonomy, capability, security, ecological integrity, procedural fairness, recognition, care, cultural continuity, and future possibility can conflict within the same intervention. Sen's work emphasizes the informational limitations of narrow evaluative spaces and the importance of capabilities and substantive freedoms in assessing social arrangements (Sen 1987; Sen 1999). Rawls similarly locates justice in the basic structure and institutional terms of cooperation rather than reducing evaluation to aggregate outcome alone (Rawls 1999). GRE does not treat either framework as exhaustive. Their relevance here is to demonstrate that practical evaluation can require multiple normative dimensions and institutional considerations.

Definition 6.61 (Normative configuration of application). The *normative configuration of application* is the explicit or implicit arrangement of values, priorities, rights, duties, acceptable risks, and distributional concerns through which a practical intervention is oriented and evaluated.

Making the normative configuration visible serves two functions. First, it separates empirical disagreement from disagreement about values or priorities. Second, it makes revision more disciplined: new evidence can alter beliefs about likely consequences without automatically settling how heterogeneous consequences should be valued.

Plurality also concerns whose values acquire practical authority. Institutional decision procedures can privilege professional, administrative, market, legal, or polit-

ical valuations while marginalizing situated forms of knowledge and concern. The epistemic-justice analysis developed in Chapter 5 therefore has a practical extension. Inclusion in decision processes does not determine the correct outcome, but it can alter which effects become visible, which trade-offs are recognized, and which forms of loss receive representational standing.

6.5.5 Urgency and Epistemic Restraint

Urgency changes the feasible relation between inquiry and action. Time for evidence gathering, consultation, modelling, deliberation, and institutional coordination can contract while the consequences of error remain substantial. Application-dominant praxis must then establish forms of practical closure that preserve proportionate epistemic restraint within a compressed horizon.

Urgency has several sources. Physical hazards, rapidly compounding social harm, financial instability, ecological thresholds, legal deadlines, humanitarian need, or organizational breakdown can narrow the period available for decision. Institutional actors can also produce urgency rhetorically, using claims of emergency to reduce scrutiny or participation. Praxis therefore requires both temporal sensitivity and examination of how the time constraint itself was constituted.

Definition 6.62 (Urgency-adjusted epistemic restraint). *Urgency-adjusted epistemic restraint* is the calibration of claim strength, intervention scope, reversibility, monitoring, and review to the evidential limitations that remain under a constrained decision horizon.

This calibration allows urgent action without requiring rhetorical certainty. A provisional intervention can be strong in implementation while modest in epistemic claim, provided its mandate, duration, uncertainty, and review conditions remain explicit. Conversely, urgency can justify rapid action in one dimension while leaving broader structural transformation for a later phase in which evidence and participation can expand.

A useful practical principle is proportionality between epistemic uncertainty and commitment structure. When uncertainty is substantial, modular, staged, geographically limited, time-bounded, or otherwise revisable interventions can preserve learning capacity where circumstances permit. High-certainty language should not be manufactured merely to support institutional decisiveness.

6.5.6 Local Action and Systemic Effects

Application usually occurs through bounded sites: an organization changes a rule, a municipality redesigns a service, a regulator changes a requirement, a community reorganizes access, or a project reallocates resources. The effects of these local actions can propagate across scales through markets, institutions, infrastructures, ecological relations, symbolic classifications, imitation, displacement, or strategic response.

The boundary and scale analysis of Chapter 5 therefore becomes a practical requirement. An intervention can succeed according to a local metric while shifting costs or constraints beyond the boundary of evaluation. It can also produce benefits at one scale while weakening conditions at another. Polycentric and institutional analyses associated with Ostrom demonstrate the importance of considering multiple centers of decision and nested institutional arrangements in complex governance

problems (Ostrom 2005; Ostrom 2010). GRE extends this insight to application more generally: local interventions should be assessed for cross-boundary and cross-scale relations that materially affect the target.

Definition 6.63 (Systemic spillover of application). A *systemic spillover of application* is a materially relevant effect that propagates beyond the primary intervention boundary or scale through relational pathways connecting the intervention site to other actors, institutions, environments, or temporal horizons.

Systemic analysis does not require total system knowledge. Such a requirement would reproduce the contradiction by making action impossible whenever the field is complex. The practical task is to identify plausible pathways through which local success can coexist with displaced harm, delayed cost, institutional substitution, or cross-scale amplification.

This also changes evaluation. Outcome assessment should ask whether a favorable local result depended on externalizing constraints elsewhere. A program that improves measured performance by transferring difficult cases, a regulation that reduces one visible risk while shifting production into weakly observed jurisdictions, or an infrastructure project that improves present access while degrading future ecological capacity can appear successful under a narrow boundary. Systemic effects therefore reconnect application to the boundary discipline developed in Chapter 5.

6.5.7 Reversibility and Irreversibility

The consequences of application differ in reversibility. Some interventions can be withdrawn with limited residual effect; others reshape infrastructures, legal statuses, ecological stocks, institutional expectations, skills, dependencies, or technological pathways in ways that persist after formal reversal. The degree of reversibility therefore affects the burden of justification and the design of experimentation.

Economic history provides familiar cases in which early technical or institutional choices can become difficult to reverse because later investments and complementarities accumulate around them (David 1985). Ecological-economic reasoning likewise emphasizes material processes whose consequences can be thermodynamically or ecologically irreversible over relevant human horizons (Georgescu-Roegen 1971). GRE uses these examples as distinct mechanisms rather than a general claim that all application is path dependent or physically irreversible.

Definition 6.64 (Practical reversibility profile). A *practical reversibility profile* specifies which components and consequences of an intervention can plausibly be withdrawn, repaired, compensated, or redirected within relevant temporal and institutional horizons, and which can persist through residual relations or path-forming effects.

Reversibility should be evaluated relationally. A formally reversible rule may create investments, dependencies, expectations, or classifications that remain after repeal. A pilot project may be administratively temporary while producing irreversible disclosure of personal information. A physical intervention may be technically removable while its ecological or distributive effects persist. The practical profile therefore includes residual effects, exit costs, lock-in mechanisms, and the distribution of capacity to recover.

Proposition 6.65 (Irreversibility-sensitive burden). *As plausible consequences be-*

come more difficult to reverse within the relevant horizon, the practical burden on prior justification, monitoring design, affected-party representation, and contingency planning generally increases.

Proposition 6.65 is a design principle rather than a mechanical decision rule. Severe urgency can still require action with limited reversibility. The proposition indicates which aspects of practical scrutiny become more consequential when correction after implementation is structurally difficult.

6.5.8 Learning through Action

Action can generate knowledge unavailable before intervention. Implementation reveals operational constraints, behavioral responses, institutional frictions, unanticipated relations, and forms of situated knowledge that remain latent in planning documents. Dewey's pragmatism treats inquiry as an iterative transformation of problematic situations in which consequences inform subsequent judgment (Dewey 1910; Dewey 1939). Application-dominant praxis therefore contains an epistemic potential: intervention can become a source of evidence for later revision.

Learning through action requires more than observing outcomes. The intervention, context, assumptions, implementation variation, and changes in surrounding relations must be documented sufficiently to distinguish learning from retrospective storytelling. Unexpected success is as epistemically important as unexpected failure when the operative mechanism differs from the one originally assumed.

Definition 6.66 (Application-generated learning). *Application-generated learning* is the revision of practical or epistemic understanding through evidence produced by the implementation, reception, consequences, and relational adaptation associated with an intervention.

This learning can concern several objects: the target relation, implementation capacity, institutional constraints, stakeholder interpretation, mechanism viability, side effects, boundary conditions, or the adequacy of the original normative configuration. The knowledge generated by action can therefore transform both later application and research-dominant praxis.

Application-generated learning also depends on institutional memory. When failures are concealed, negative results disappear, implementation records are destroyed, or evaluation criteria are changed without provenance, action can generate experience without generating cumulative knowledge. Preservation and revision infrastructures are therefore part of practical design rather than administrative afterthoughts.

The possibility of learning should not be used to excuse avoidable harm. Experimentation acquires stronger ethical and epistemic obligations as potential consequences become severe or irreversible. Learning through action is most defensible when uncertainty is explicit, exposure is proportionate, monitoring is capable of detecting relevant effects, and revision or exit remains feasible where the context permits.

6.5.9 Application as Transformation of the Practical-Relational World

Application-dominant praxis ultimately differs from a purely representational activity because it intentionally participates in the transformation of the practical-relational world. Decisions allocate resources, authorize actions, establish categories, alter rights, configure infrastructures, change incentives, produce expectations, and reshape the capacities through which later action becomes possible. Application therefore modifies the field within which its own future evaluation will occur.

Definition 6.67 (Practical-relational transformation). A *practical-relational transformation* is a change in relations, capacities, institutions, constraints, distributions, representations, or possibility structures generated in part through application-dominant praxis and materially relevant to subsequent practical activity.

The definition captures both intended and unintended transformation. A policy can alter institutional expectations even when its target outcome is not achieved. A technology can reorganize work relations independently of its measured productivity effect. A legal intervention can change the categories through which later claims become recognizable. A failed program can generate organizations, data infrastructures, or political commitments that continue after the program ends. Evaluation therefore extends beyond whether the immediate objective was reached.

This generative perspective clarifies the principal contradiction of application-dominant praxis. Action cannot wait for complete knowledge because complete knowledge is unavailable and the practical field continues to evolve. At the same time, action can alter the very relations whose incompleteness made the decision difficult. Application consequently operates through provisional closure in a field that is partly transformed by the closure itself.

Proposition 6.68 (Generative recursion of application). *When an intervention changes the relations, capacities, institutions, or possibility structures that condition later decisions, application-dominant praxis becomes recursively generative: the consequences of one practical closure partly constitute the field of subsequent practical closure.*

Proposition 6.68 gives the section its connection to the wider architecture of GRE. Application is simultaneously oriented by inherited relations and capable of reorganizing those relations. The central practical task is therefore neither the elimination of uncertainty nor the achievement of perfect control. It is the construction of forms of action whose scope, commitments, monitoring, reversibility, and revision remain adequate to the incompleteness and generativity of the field in which they operate.

The research-dominant contradiction in Section 6.4 and the application-dominant contradiction developed here are analytically distinct, yet practical activity frequently moves between them. Research produces representations that orient action; action generates evidence that reorganizes research; institutional interventions transform the objects later studied; and revised knowledge redirects subsequent application. Section 139 develops this coupling explicitly.

6.6 Coupling between Research and Application

Sections 6.4 and 6.5 distinguished the characteristic contradictions of research-dominant and application-dominant praxis. The present section examines the relations through which these modes become coupled. Its role is to prevent their analytical distinction from becoming an image of practical separation. The objective is to specify how research can orient action, how action can generate evidence, how intervention can become a site of inquiry, and how knowledge, theory, institutions, and practical possibilities can transform one another through repeated movement between praxis modes. The section develops nine dimensions of this coupling: research-informed action, action-generated evidence, intervention as inquiry, practice-induced theory revision, research-generated action possibilities, institutional change as an epistemic event, co-evolution of knowledge and practice, co-evolution of theory and institution, and recursive movement between praxis modes. The method is relational and generative. Research and application are treated as distinguishable practical orientations whose outputs can become conditions, inputs, constraints, and objects of one another.

The coupling is therefore stronger than a linear model in which research first discovers truth and application subsequently implements it. Research may alter the categories through which a practical problem is recognized; intervention may produce evidence unavailable before action; institutions may change in response to research and thereby alter the phenomena later investigated; and practical failure may expose theoretical assumptions that were difficult to identify within research alone. The relation is also weaker than an identification of research with application. Distinctive epistemic, ethical, institutional, and practical responsibilities remain. Coupling concerns structured interaction across praxis modes rather than their collapse into one activity.

Definition 6.69 (Research–application coupling). *Research–application coupling* is the historically situated set of relations through which research-dominant and application-dominant praxis condition, inform, generate evidence for, transform, or redirect one another while retaining analytically distinguishable orientations and standards of provisional closure.

Definition 6.69 makes the degree and form of coupling an empirical and institutional question. Some domains maintain long intervals between research and intervention; others place inquiry and action in continuing contact. Coupling can be productive, weak, asymmetric, coercive, or distorted. A strong practical link does not by itself establish epistemic quality, and high-quality research does not by itself determine what should be done. The relevant question is how movement across the two modes is organized and what each movement generates.

6.6.1 Research-Informed Action

Research can orient application by changing what actors know, which relations they regard as salient, which consequences they anticipate, and which alternatives they consider feasible. This influence is broader than the direct transfer of a finding into a decision rule. Historical reconstruction can alter the interpretation of an institutional problem; qualitative inquiry can reveal meanings or dependencies omitted from administrative categories; formal models can clarify conditional consequences;

and quantitative evidence can narrow uncertainty concerning prevalence, association, or causal contribution. Research-informed action therefore begins with translation from an epistemic object into a practical configuration.

The translation is selective. A research claim is ordinarily produced under a specified boundary, scale, population, historical period, representation, and uncertainty profile. Application introduces additional conditions: legal authority, time, resources, organizational capability, affected interests, plural values, reversibility, and systemic spillovers. The practical relevance of a finding consequently depends on how these conditions relate to those under which the finding was warranted. A result can be epistemically strong within its research domain while remaining weakly portable to a different practical field.

Definition 6.70 (Research-informed action). *Research-informed action* is application-dominant praxis whose orientation, design, monitoring, or revision is materially conditioned by warranted research claims together with an explicit practical translation across relevant boundaries, scales, values, and institutional conditions.

The phrase *research-informed* is deliberately narrower than research-determined. Research can constrain a practical claim, rule out some explanations, expose uncertainty, or identify plausible mechanisms without selecting a unique action. Practical orientation also contains normative and institutional judgments that cannot be derived from empirical evidence alone. Dewey's account of inquiry is useful here because it treats judgment as situated within problematic conditions rather than as mechanical deduction from antecedent propositions (Dewey 1910). GRE retains the distinction between evidence and practical judgment while emphasizing their relational dependence.

Proposition 6.71 (Practical translation requirement). *When a research claim is used to orient application beyond the conditions under which it was warranted, the practical use of that claim should specify the material differences in boundary, scale, population, historical setting, institutional capacity, and decision horizon that can alter its relevance.*

Proposition 6.71 makes translation part of responsible coupling. It also limits a common failure mode in which an evidential conclusion is rhetorically converted into a practical imperative without showing how the relation between research context and application context has been established.

6.6.2 Action-Generated Evidence

Application can generate evidence because intervention reveals responses, constraints, adaptations, and dependencies that remain latent under observation of the pre-intervention configuration. A policy can expose administrative bottlenecks; a new organizational rule can reveal previously hidden coordination relations; an infrastructure change can alter patterns of access; and a pilot intervention can reveal how actors adapt when an assumed condition is changed. Action therefore can produce traces whose evidential significance did not exist before the practical change.

This does not mean that consequences of action are automatically interpretable. The action changes the field from which evidence is drawn. Observed outcomes can reflect implementation differences, anticipation, strategic response, concurrent events, selection into participation, or changes in measurement. Woodward's in-

terventionist account of causal explanation illustrates why interventions can be evidentially powerful while also requiring careful specification of what has been changed and what remains stable (Woodward 2003). In GRE, the same discipline extends to relational and generative claims: an intervention can reveal a dependency while simultaneously reorganizing other parts of the relational system.

Definition 6.72 (Action-generated evidence). *Action-generated evidence* is evidence whose availability, form, or discriminating power arises materially from a practical intervention, implementation process, institutional response, or deliberately maintained restraint within the relational field under investigation.

Action-generated evidence is therefore historically indexed to the intervention that produced it. Its interpretation should preserve what the system was before action, what was altered, how implementation occurred, which actors were affected, and what subsequent adaptations followed. The evidence can support learning about an earlier configuration, a transformed configuration, or the transition between them; these targets should remain distinct.

Claim 6.73 (Intervention-indexed evidence). *Evidence generated through application should be indexed to the intervention and implementation conditions that made it observable, because the same trace can support different inferences about the pre-intervention system, the transformed system, and the process connecting them.*

Claim 6.73 connects application-generated learning in Section 6.5 to research praxis. The practical field can become a source of new knowledge without being reduced to an experiment and without assuming that every intervention was designed for epistemic purposes.

6.6.3 Intervention as Inquiry

Some interventions are organized partly to learn. A pilot programme, staged institutional change, adaptive implementation, field experiment, prototype, or reversible organizational modification can be designed so that action both addresses a practical problem and produces evidence about the relations that organize it. In such cases, intervention occupies a hybrid position between praxis modes. Its immediate orientation includes practical transformation, while its design also preserves an epistemic question.

Dewey's broader pragmatist conception of inquiry emphasizes the transformation of problematic situations through operations whose consequences contribute to later judgment (Dewey 1910; Dewey 1925). GRE draws a limited methodological implication from this lineage. Intervention can function as inquiry when it is structured to discriminate among relational or generative explanations, when relevant changes and observations are documented, and when the practical consequences of the intervention remain ethically and institutionally accountable.

Definition 6.74 (Intervention as inquiry). An *intervention as inquiry* is a practical transformation whose design includes an explicit epistemic target, a specified relation between intervention and expected evidence, procedures for observing relevant responses, and conditions for revising the interpretation or the intervention itself.

The definition excludes the retrospective relabeling of any action as research merely because something was learned from it. Learning is common after action; inquiry requires a more explicit architecture of question, intervention, observa-

tion, interpretation, and revision. Ethical constraints also remain. An intervention cannot acquire legitimacy merely by promising knowledge. Exposure to risk, consent, authority, distribution of consequences, and reversibility remain practical and normative considerations independent of epistemic value.

Intervention as inquiry is particularly useful when relevant relations are activated only under changed conditions. Institutional resilience, strategic adaptation, coordination capacity, and latent dependencies may become visible when the field is perturbed. Yet the inference remains local to the intervention and its context. A response to one perturbation need not reveal how the system would respond to another. The epistemic advantage lies in disciplined access to otherwise difficult relations, not in unrestricted generalization.

6.6.4 Practice-Induced Theory Revision

Practical activity can expose theoretical insufficiency. A theory may describe observed regularities adequately while failing when actors respond strategically to implementation, when institutional rules change, when neglected values become practically consequential, or when an intervention reveals a relation absent from the original representation. Practical failure can therefore function as counterevidence, but practical success can also create pressure for revision when success occurs through mechanisms different from those anticipated by the theory.

The relevant object of revision may be a substantive claim, an auxiliary assumption, a boundary condition, a classification, a mechanism, or the theory's account of how its concepts map onto institutional practice. Longino's analysis of the role of background assumptions in evidential reasoning is relevant because disagreement between expectation and observation can reveal assumptions that remained tacit within an accepted explanatory framework (Longino 1990). Application adds a distinctive source of pressure: background assumptions can become operationalized and encounter consequences in a transformed field.

Definition 6.75 (Practical counterevidence). *Practical counterevidence* is evidence generated in or through application that materially weakens a theoretical claim, mechanism, boundary condition, classification, or transfer assumption relative to the practical configuration in which it was used.

Practical counterevidence should not be interpreted mechanically. A failed intervention can result from implementation failure rather than theoretical failure; a successful intervention can result from compensating mechanisms; and practical outcomes can be judged differently under different value configurations. Revision therefore requires reconstruction of the pathway linking theory, intervention design, implementation, and outcome.

Proposition 6.76 (Practice-sensitive theoretical revision). *When practical outcomes diverge materially from theoretically informed expectations, revision should identify whether the divergence concerns the theory, its boundary conditions, the translation into application, the implementation process, or a transformation of the relational field itself.*

This proposition protects both theory and practice from premature attribution. The practical field can correct theory, while theory can also reveal that an apparent implementation failure arose because the intervention did not instantiate the conditions it was intended to test or realize.

6.6.5 Research-Generated Action Possibilities

Research does more than evaluate an existing menu of actions. It can generate new possibilities for action by making relations visible, creating classifications, inventing instruments, reconstructing histories, formalizing previously diffuse constraints, or identifying mechanisms through which intervention becomes conceivable. A practical possibility can therefore be generated epistemically before it becomes institutionally available.

The process is visible when a newly identified category makes a population administratively recognizable, when a measurement infrastructure allows a condition to be monitored, when a causal mechanism suggests a different intervention point, or when historical research reveals that an apparently fixed institution has changed before and can therefore be imagined otherwise. Hacking's analysis of historically constituted categories and objects provides one precedent for treating classification as active within the worlds it describes (Hacking 2002). MacKenzie's study of financial models similarly shows that representations can become incorporated into practice and contribute to reshaping the domain represented (MacKenzie 2006). GRE generalizes this possibility cautiously without assuming that every research representation is performative.

Definition 6.77 (Research-generated action possibility). A *research-generated action possibility* is a practically relevant course of action, intervention point, institutional arrangement, monitoring capacity, or form of coordination that becomes materially conceivable or feasible through knowledge, representations, instruments, classifications, or infrastructures produced in research praxis.

This generativity has epistemic and political consequences. Research can expand possibility structures by revealing alternatives, but it can also narrow them by stabilizing a problem representation around a limited set of measurable variables or institutionally familiar interventions. The design of research can thus condition the practical imagination of later actors even before a specific recommendation is made.

Remark 6.78 (Possibility generation and recommendation). Generating an action possibility is distinct from recommending it. Research can make an intervention intelligible or feasible while leaving its normative desirability, distributional effects, institutional legitimacy, and comparative practical value unresolved.

The distinction in Remark 6.78 preserves the separation between epistemic generativity and normative judgment established throughout the book.

6.6.6 Institutional Change as Epistemic Event

Institutions organize action, but they also organize what can be known. Rules determine which transactions are recorded, which identities receive official recognition, which decisions require documentation, who can access archives, what counts as a reportable event, and which categories acquire administrative continuity. Institutional change can therefore be an epistemic event because it changes both the practical relations under study and the infrastructures through which those relations become observable.

North treats institutions as humanly devised constraints that structure interaction and change through time (North 1990). Ostrom's institutional analysis similarly emphasizes rules, action arenas, participants, and the diverse institutional arrange-

ments through which interaction is organized (Ostrom 2005). GRE adds an epistemic emphasis: when these arrangements change, the relation between reality, manifestation, trace, and representation can also change. A newly required record may create evidence where earlier practice left few traces; a changed eligibility rule can alter the population represented by an administrative category; a decentralized institution can redistribute both decision authority and observational access.

Definition 6.79 (Institutional epistemic event). An *institutional epistemic event* is an institutional change that materially alters the production, accessibility, classification, preservation, interpretation, or practical relevance of evidence concerning the relational field.

The definition does not imply that institutional change is reducible to epistemic change. Institutions also distribute resources, authority, rights, obligations, risks, and capacities. The epistemic event is one dimension of a broader transformation. It matters because comparisons across an institutional transition can otherwise confuse changes in the underlying relation with changes in how the relation becomes legible.

Institutional change can therefore require re-epistemization. A time series may contain a break because a category changed; testimony may acquire new strategic incentives after a rule change; previously hidden relations may become formally recognized; or old records may become newly interpretable because later institutional developments reveal their significance. Coupling between research and application is especially dense at such moments because the practical transformation changes both the object of inquiry and the conditions of future inquiry.

6.6.7 Co-Evolution of Knowledge and Practice

Repeated coupling can produce co-evolution rather than a sequence of isolated feedback events. Knowledge changes practice; practice generates evidence; evidence reorganizes knowledge; and revised knowledge conditions the next practical intervention. Over longer periods, neither side can be adequately reconstructed as an independent trajectory. Their histories become partially interdependent.

The term *co-evolution* is used here in a restrained sense. Nelson's analysis of technology, industrial structure, and supporting institutions provides an economic precedent for studying reciprocal development among distinct but interacting domains rather than attributing change to a single direction of causation (Nelson 1994). GRE applies a similar relational discipline to knowledge and practice. The claim is not that all knowledge develops through application or that all practice is research-driven. It is that, where repeated reciprocal conditioning is evidenced, the trajectories should be reconstructed together.

Definition 6.80 (Knowledge–practice co-evolution). *Knowledge–practice co-evolution* is a historically extended process in which changes in warranted knowledge materially condition practical organization while changes in practice materially alter the evidence, objects, questions, or inferential conditions of subsequent knowledge production.

Co-evolution implies more than mutual influence. The interaction becomes developmentally consequential when each trajectory changes the conditions under which the other subsequently changes. A new measurement system may make a regulatory strategy feasible; regulation may generate a new dataset; that dataset may enable a revised theory; and the revised theory may support a different institutional design.

The relevant unit of analysis is then a recursively connected history rather than a series of independent transfers.

Proposition 6.81 (Reciprocal generative conditioning). *When knowledge and practice repeatedly alter the conditions of one another's subsequent development, the coupling should be analyzed as reciprocal generative conditioning rather than as one-directional transfer from research to application or from experience to theory.*

This proposition preserves asymmetry where it exists. Some phases may be strongly research-led, others practice-led, and others weakly coupled. Co-evolution concerns the historical pattern of reciprocal conditioning, not equal causal weight at every moment.

6.6.8 Co-Evolution of Theory and Institution

A more specific form of coupling occurs between theory and institution. Theories can supply categories, models, performance criteria, causal narratives, and expectations that enter institutional design. Institutions can in turn stabilize concepts, generate data, fund particular questions, define legal or administrative categories, and shape which theoretical problems become practically salient. The relation can therefore become recursive even when no actor intends a comprehensive co-evolutionary process.

Historical work on economic development offers precedents for this kind of reciprocal analysis. Murmann's study of firms, technological knowledge, and national institutions reconstructs development through interactions among knowledge, organizations, and institutional arrangements rather than through a single independent causal stream (Murmann 2003). The performativity literature provides another, more specific possibility: models can become embedded in institutional practice and thereby influence the domain from which later observations are drawn (MacKenzie 2006). GRE treats these as examples of mechanisms through which theory–institution coupling can occur, not as a claim that institutional reality is generally produced by theory.

Definition 6.82 (Theory–institution co-evolution). *Theory–institution co-evolution is a historically extended relation in which theoretical representations materially condition institutional categories, rules, instruments, or evaluation practices while institutional development materially conditions the evidence, problems, concepts, and selection pressures through which theory is subsequently revised.*

The epistemic danger is circular confirmation. If a theory shapes the institution that produces the data later used to evaluate the theory, empirical fit can partly reflect institutional incorporation of the theory rather than independent confirmation. The opposite danger also exists: institutional categories can become so entrenched that theoretical inquiry inherits them as if they were natural divisions of the object. Reflexive research should therefore reconstruct how categories and evidence were institutionally produced before using their apparent stability as support for theory.

Caution 6.83 (Institutionally generated confirmation). Observed conformity between a theory and an institutionally organized domain should be interpreted cautiously when the theory, its classifications, or its instruments have materially contributed to the organization of that domain or to the production of the evidence used for evaluation.

Caution 6.83 links the praxis account back to the recursive representation problem developed in Chapter 5. A theory can be epistemically informative and practically generative at the same time; these properties require separate assessment.

6.6.9 Recursive Coupling of Praxis Modes

The preceding subsections make research–application coupling recursive. Research-informed action can generate evidence; that evidence can revise theory; revised theory can generate new possibilities for action; institutional implementation can change future evidence; and the transformed field can redirect subsequent research. The distinction between research-dominant and application-dominant praxis therefore remains necessary, but the active mode can change repeatedly within a single programme, institution, or historical trajectory.

A movement between modes occurs when the principal orientation and point of provisional closure change. A research phase may stabilize a claim sufficiently to support a practical decision. Application may then become dominant because implementation, responsibility, timing, and consequences organize the activity. Unexpected outcomes can reopen an epistemic problem and return the activity toward research-dominant praxis. A later intervention can again shift the centre of gravity toward application. Hybrid phases arise when these orientations are simultaneously consequential and cannot be institutionally separated without substantial loss.

Definition 6.84 (Recursive praxis-mode movement). *Recursive praxis-mode movement* is the repeated phase-dependent reorganization of a praxis configuration between research-dominant, application-dominant, and hybrid orientations as knowledge, practical demands, interventions, consequences, and institutional conditions alter one another.

The definition avoids treating recursion as automatic cycling. A programme can remain application-dominant for long periods, research can become institutionally isolated from practice, and organizations can suppress evidence that would otherwise reopen inquiry. Recursive movement therefore depends on infrastructures of monitoring, preservation, contestation, communication, authority, and revision. Coupling can be blocked as well as enabled.

Proposition 6.85 (Praxis-mode recursion). *When outputs of one praxis mode materially alter the conditions that organize the next phase of knowing, judgment, or action, the subsequent mode should be identified from its current orientation and closure conditions rather than inherited from the institutional label of the preceding phase.*

Proposition 6.85 completes the initial architecture of Chapter 6. Praxis is unified without being homogeneous; research and application are distinguishable without being isolated; their characteristic contradictions differ; and their repeated coupling can transform knowledge, institutions, practical possibilities, and the relational field itself. The remaining sections turn more closely toward research praxis. The next section begins by treating research itself as a relational practice constituted through relations among researchers, objects, participants, communities, institutions, instruments, and infrastructures.

6.7 Relational Constitution of Research Practice

The preceding sections established research-dominant praxis as a mode within a wider field of praxis and examined its characteristic contradictions and its recursive coupling with application. This section develops the relational constitution of research itself. Its role is to specify the principal relations through which inquiry is organized before the chapter turns in the next section to the more specific problem of the researcher's position within a relational field. The objective is therefore neither to reduce research to interpersonal interaction nor to treat relations as a background context surrounding an otherwise self-sufficient investigator. Research is approached as a historically situated configuration involving researchers, objects of inquiry, participants, communities, institutions, instruments, infrastructures, categories, and channels through which observations and representations are produced. The discussion proceeds from inquiry within relational systems to researcher–object, researcher–participant, and researcher–community relations; it then examines research institutions, instruments and infrastructures, generative effects, and reflexive consequences. The method is analytical and reconstructive: the section identifies distinct relational interfaces and asks how each can condition access, evidence, interpretation, practical possibility, and later inquiry.

6.7.1 Inquiry within Relational Systems

Research rarely enters a domain that is relationally empty before observation begins. Economic transactions are embedded in legal, organizational, technical, familial, ecological, and symbolic relations. Administrative categories are sustained by institutional routines. Scientific objects are approached through existing languages, instruments, archives, and disciplinary conventions. Even apparently isolated measurements depend on material and social arrangements that make the measured event detectable, recordable, and comparable. Inquiry therefore takes place within relational systems whose organization partly conditions what can become an epistemic object.

Bourdieu and Wacquant's methodological relationalism provides one important precedent for treating positions, practices, and observable properties through relations rather than isolated substances (Bourdieu and Wacquant 1992). GRE adopts a more general and deliberately open formulation. The relevant relational system may include social positions, material infrastructures, legal statuses, ecological dependencies, technical interfaces, historical inheritances, or combinations among them. The point is methodological: a research object can be partially constituted by relations that are external to the immediate unit of observation yet materially relevant to its persistence, manifestation, or transformation.

Definition 6.86 (Relational research configuration). A *relational research configuration* is the historically situated set of relations among researchers, objects, participants, communities, institutions, instruments, infrastructures, representations, and wider field conditions that materially condition how an inquiry can be conducted and what can become observable, interpretable, or revisable within it.

The definition does not imply that every relation in the surrounding world must be reconstructed before research can proceed. Such a requirement would make inquiry impossible. It instead places a burden on researchers to identify relations that are

plausibly relevant to the target claim and to state the boundary within which those relations are treated. The boundary remains revisable when anomalies, missingness, intervention effects, historical evidence, or cross-scale dependencies indicate that apparently external relations have become explanatorily important.

Relational inquiry also changes the status of methodological independence. A sample, archive, model, or measurement procedure may be analytically isolated for practical reasons while remaining relationally dependent on the processes that generated it. Independence is therefore an achieved property of a design or argument, not an automatic property of separated data points. Chapter 5 developed this problem epistemically through boundary, scale, and partial observation. Research praxis adds a practical question: which relations must be preserved, monitored, or made explicit so that the inquiry remains capable of recognizing its own dependencies?

Proposition 6.87 (Relational adequacy of inquiry). *The adequacy of a research design depends partly on whether the relations material to the target claim are represented, controlled, traced, or explicitly left uncertain rather than silently excluded by the operational boundary of the study.*

Proposition 6.87 does not privilege larger studies over smaller ones. A narrowly bounded inquiry can be highly informative when its limits are explicit and when the target relation is appropriately localized. The problem arises when a local design is interpreted as if its operational boundary coincided with the boundary of the phenomenon.

6.7.2 Researcher–Object Relations

The relation between researcher and object varies across domains. A historical archive does not respond strategically to an investigator in the same way that an organization, market participant, or research participant may respond. A distant astronomical object is differently accessible from a legal institution whose categories are partly constituted through interpretation and practice. Yet in each case the object is encountered through a relation of access, measurement, representation, or interpretation. The epistemic object is therefore never identical to an unmediated totality of whatever exists independently of inquiry.

Longino’s contextual empiricism is relevant because evidential relevance depends on background assumptions and because critical interaction can expose assumptions that remain invisible from a single standpoint (Longino 1990). GRE extends this concern to the researcher–object relation itself. Choice of scale, variable, archive, instrument, category, temporal window, and model can make some dimensions of the object available while rendering others peripheral or invisible. These choices can be justified; the relational point is that they participate in the conditions under which the object appears epistemically.

Definition 6.88 (Researcher–object relation). *A researcher–object relation is the structured relation through which an object of inquiry becomes accessible to observation, measurement, interpretation, reconstruction, or formal representation under specified material, conceptual, institutional, and historical conditions.*

This definition separates object dependence from object construction. Some objects may exist independently of the research relation, while the specific object represented in a study can still depend on classificatory and instrumental choices. Ontological suspension allows the inquiry to preserve this distinction without requiring a

universal answer to whether every research object is socially or conceptually constituted.

The relation can also be dynamic. A theoretical model can redirect measurement; measurement can reveal an anomaly; the anomaly can alter the model; the revised model can change what is considered relevant evidence. The researcher–object relation is then historically extended rather than confined to a single act of observation. This extension matters particularly in generative inquiry because the object may itself change while the means of knowing it also change.

A further complication arises when the object can respond to research. Publication of a market model, a risk category, a legal interpretation, or an organizational ranking can become part of subsequent practice. Hacking’s historical work on classification and MacKenzie’s account of financial models provide different precedents for understanding how representations can enter the domains they describe (Hacking 2002; MacKenzie 2006). GRE treats such responsiveness as a contingent possibility rather than a universal property of objects. When it occurs, the researcher–object relation acquires a reflexive dimension developed further in Subsection 6.7.8.

6.7.3 Researcher–Participant Relations

Research involving human participants introduces relations of communication, interpretation, access, trust, vulnerability, authority, and representation. Participants can provide testimony, contest categories, strategically manage disclosure, reinterpret questions, or withdraw cooperation. Researchers can control interview structure, sampling, recording, coding, publication, and the institutional channels through which findings gain authority. The research relation therefore influences both evidence production and the distribution of epistemic power.

Fricker’s account of testimonial and hermeneutical injustice provides a specific vocabulary for examining credibility deficits and unequal participation in shared interpretive resources (Fricker 2007). GRE does not treat these concepts as a complete theory of research relations, but they clarify why participant testimony cannot be analyzed solely as a neutral data channel. Credibility is allocated within social and institutional relations, and some experiences can be difficult to articulate within the categories available to a research programme.

Definition 6.89 (Participant relation in inquiry). *A participant relation in inquiry is the historically and institutionally situated relation through which a person or group becomes involved in producing, communicating, contesting, withholding, interpreting, or being represented by evidence within a research process.*

The participant relation therefore includes more than informed consent at entry. It can continue through interpretation, representation, publication, archival preservation, secondary analysis, and downstream application. A participant may have little control over these later stages even when initial participation was voluntary. The relational architecture of research should consequently distinguish consent to participate from authority over interpretation, access to findings, contestability of representation, and control over later uses.

Power asymmetry does not imply that participant accounts automatically override other evidence. Epistemic justice requires neither unrestricted deference nor the abandonment of evidential comparison. It requires that testimonial position, access, incentives, vulnerability, interpretive resources, and opportunities for contestation

are made relevant to the assessment of evidence rather than treated as external ethical considerations.

Proposition 6.90 (Participant-sensitive evidential interpretation). *Evidence produced through participant relations should be interpreted together with the conditions of communication, authority, vulnerability, credibility allocation, and representational control that materially shape what can be expressed, recorded, and retained.*

This proposition also applies when participants possess epistemic advantages. Practitioners, local communities, workers, patients, administrators, or other situated actors may observe relations unavailable to external researchers. Their proximity does not guarantee comprehensive knowledge, but it changes the distribution of access and therefore the design of inquiry.

6.7.4 Researcher–Community Relations

A research project can also enter relations with communities that exceed the set of formally enrolled participants. Communities may host fieldwork, maintain archives, provide language and interpretive context, sustain ecological or cultural knowledge, experience downstream consequences, or become objects of public representation. The unit called a “community” is itself heterogeneous and can contain internal disagreement, unequal authority, contested membership, and multiple relations to the research problem.

Researcher–community relations therefore cannot be reduced to a single representative voice. A local organization, public official, elder, advocacy group, online forum, or institutional gatekeeper may provide access without possessing authority to speak for everyone affected. Conversely, treating a community as infinitely fragmented can erase collective histories and institutions that materially organize relations. The methodological task is to reconstruct the relevant forms of collective organization while preserving internal differentiation.

Definition 6.91 (Researcher–community relation). *A researcher–community relation is the set of relations through which inquiry gains access to, represents, learns from, affects, or becomes accountable to a historically situated collectivity whose members or shared conditions are materially connected to the research process or its consequences.*

Ostrom’s work on institutional diversity and collective-action arrangements is useful here because collectivities can organize rules, monitoring, participation, and resource governance through varied institutional forms rather than through a single centralized representative structure (Ostrom 2005; Ostrom 1990). GRE draws a narrower research implication: community relations should be approached through the actual institutions, practices, conflicts, and channels of participation through which collective action and knowledge are organized.

Community relations also have temporal depth. A research group can leave data infrastructures, classifications, expectations, disappointments, or relationships of trust that shape later projects. Repeated extraction of information without reciprocal access, preservation, or accountability can alter willingness to participate and change the evidential field encountered by subsequent researchers. Research praxis is therefore cumulative not only through publications but also through the histories of relations that research institutions leave behind.

Remark 6.92 (Community continuity and project closure). The administrative closure of a project does not necessarily end its researcher–community relations. Data retention, publication, reputational effects, institutional memory, later reuse, and downstream application can extend the relation beyond the funded or observed research period.

Remark 6.92 anticipates the later discussion of preservation and cumulative research. It also shows why project-based ethics can be insufficient when consequences persist across longer relational trajectories.

6.7.5 Research Institutions as Relational Systems

Researchers usually operate within institutions that allocate resources, define roles, authorize access, evaluate outputs, preserve records, and regulate acceptable methods. Universities, laboratories, archives, funding agencies, journals, professional associations, public agencies, firms, and community organizations can therefore be treated as relational systems that participate in knowledge production rather than as neutral containers around it.

Institutional relations influence which questions receive resources, which forms of evidence are inexpensive or accessible, which risks are permissible, which outputs count toward evaluation, and which collaborations can be sustained. Bourdieu and Wacquant’s analysis of fields and positions provides one framework for examining how institutional position and accumulated forms of capital shape practice (Bourdieu and Wacquant 1992). GRE retains the general insight while avoiding the claim that every research institution should be represented through one sociological vocabulary.

Definition 6.93 (Research institution as relational system). *A research institution as a relational system* is an organized configuration of roles, rules, resources, evaluative practices, infrastructures, authority relations, and external dependencies that conditions the production, circulation, preservation, and revision of knowledge.

Institutional organization can generate epistemic advantages. Stable archives, peer criticism, specialized equipment, long-term funding, interdisciplinary teams, and replication infrastructures can make knowledge possible that isolated individuals could not produce. The same organization can also generate blind spots through metric incentives, disciplinary boundaries, access restrictions, short funding cycles, reputational pressures, or concentration of infrastructural control.

The relation between institution and inquiry is therefore bidirectional. Institutions shape research, while successful methods, classifications, technologies, and research programmes can reshape institutions. Section 6.6 described this more broadly as theory–institution and knowledge–practice co-evolution. Here the emphasis is internal to research praxis: changes in evaluation, funding, publication, or technical infrastructure can reorganize the relations through which future inquiry is carried out.

Proposition 6.94 (Institutional conditioning of epistemic possibility). *The set of practically available research questions and methods is partly conditioned by institutional relations that allocate time, access, authority, infrastructure, recognition, and preservation capacity.*

This proposition does not imply institutional determinism. Researchers can work against prevailing incentives, create alternative infrastructures, form new collabo-

rations, or pursue questions outside dominant evaluation systems. Such resistance itself requires relational conditions, including time, resources, networks, or alternative institutions capable of sustaining it.

6.7.6 Instruments and Infrastructures

Research relations are mediated materially. Instruments extend perception, transform phenomena into traces, standardize observations, and sometimes create new objects of comparison. Infrastructures coordinate storage, computation, communication, access, and reuse. Their epistemic role is therefore deeper than convenience: they condition what can be detected, at what resolution, by whom, over what temporal horizon, and with what possibility of verification.

Frischmann's analysis of infrastructure as a shared input enabling heterogeneous downstream activities provides a useful economic precedent for treating infrastructural access as generative rather than merely consumptive (Frischmann 2012). Applied to research, a telescope, database, archive, computing cluster, survey platform, laboratory protocol, identifier system, or open repository can support many downstream inquiries whose specific forms were not predetermined when the infrastructure was created.

Definition 6.95 (Research infrastructure). A *research infrastructure* is a relatively durable material, technical, organizational, or informational arrangement that supports multiple acts of observation, representation, coordination, analysis, preservation, or verification across one or more research programmes.

Instruments and infrastructures are analytically distinct. An instrument can mediate a specific act of observation, while infrastructure coordinates repeated or distributed research activity. In practice they overlap: a sensor network is both a set of instruments and an infrastructure; a computational model may depend on shared software, data standards, and hardware. The distinction remains useful because infrastructure creates dependency relations extending beyond the immediate study.

Dependence raises questions of access and epistemic autonomy. When only a small set of institutions can operate a costly instrument, obtain proprietary data, or access frontier computation, the resulting asymmetry concerns more than efficiency. It can shape which questions are feasible, who can reproduce findings, and which research communities can contest dominant representations. Conversely, open infrastructures can broaden participation while introducing other dependencies, including maintenance burdens, standardization pressures, and vulnerability to common technical failures.

Caution 6.96 (Infrastructure and evidential authority). The scale, precision, or computational sophistication of a research infrastructure should not be treated as independent evidence for the validity of the representations it produces. Infrastructure expands or reorganizes epistemic capacity while leaving questions of calibration, category choice, model fit, missingness, and interpretation open.

Caution 6.96 is especially important in AI-assisted and large-scale computational research. Greater productive capacity can generate more candidate patterns, models, and analyses while increasing the importance of judgment concerning which outputs deserve epistemic attention.

6.7.7 Research as Generative Process

Research does not merely retrieve information from an unchanged world. It can generate concepts, measurements, datasets, classifications, instruments, methods, infrastructures, theoretical objects, questions, communities, skills, institutional capacities, and practical possibilities. Some of these products remain internal to research; others circulate into administration, markets, law, education, technology, or public discourse. Research is therefore a generative process even when its dominant orientation remains epistemic.

Hacking's account of historically changing classifications and MacKenzie's study of models incorporated into financial practice illustrate two mechanisms through which research representations can participate in later reality (Hacking 2002; MacKenzie 2006). The general GRE claim is broader but weaker: research outputs can become inputs into subsequent relational processes. Whether they do so, how strongly, and with what consequences requires separate empirical reconstruction.

Definition 6.97 (Generative research process). *A generative research process is an inquiry whose activities or outputs materially contribute to the formation, stabilization, transformation, or suppression of later capacities, relations, representations, institutions, methods, infrastructures, questions, or practical possibilities.*

The definition includes generativity within the research system itself. A reusable dataset can enable later inquiry; a failed model can generate a new conceptual distinction; a methodological criticism can change evaluation standards; an archive can preserve materials that allow future re-epistemization. These effects need not involve direct practical intervention outside research.

Generativity also creates responsibility for preservation and provenance. When later work depends on earlier classifications, datasets, code, instruments, or interpretive decisions, hidden assumptions can propagate across generations of inquiry. A generative research system should therefore preserve sufficient context for downstream users to identify how an epistemic resource was produced and under what limits it can be reused.

Proposition 6.98 (Recursive generativity of research). *Research becomes recursively generative when the concepts, evidence, methods, infrastructures, or institutions produced in one phase materially alter the conditions under which later research questions can be posed, observed, evaluated, or revised.*

Proposition 6.98 links research praxis to the wider GRE concern with transformation of generative conditions. A research programme can therefore be evaluated partly by what kinds of future inquiry it enables or forecloses, while such evaluation remains distinct from the truth of any particular claim it produces.

6.7.8 Reflexive Consequences of Inquiry

Once research is treated as relational and generative, reflexivity becomes a practical requirement rather than an optional philosophical supplement. Inquiry can change participant expectations, community relations, institutional categories, incentives, public narratives, market behavior, administrative visibility, and the researcher's own conceptual repertoire. These effects can alter the field from which subsequent evidence is drawn.

Bourdieu and Wacquant develop reflexivity as a way of objectifying the social and

intellectual conditions of scholarly practice (Bourdieu and Wacquant 1992). Longino emphasizes organized criticism and plural perspectives as conditions supporting objectivity in the presence of background assumptions (Longino 1990). GRE connects these insights to the chapter's praxis framework: reflexivity concerns the capacity to reconstruct how inquiry participates in the relations through which its own evidence, categories, and consequences are produced.

Definition 6.99 (Reflexive consequence of inquiry). *A reflexive consequence of inquiry is a change in the relational field, epistemic system, participants, institutions, representations, or researcher that is materially produced by the conduct, communication, or institutionalization of the inquiry and that can condition subsequent observation, interpretation, judgment, or action.*

Reflexivity therefore differs from self-description. A positional statement can be informative while remaining insufficient if it does not identify how position, access, classification, communication, or publication could affect the inquiry. The relevant question is causal and relational: through which pathways can research activity alter what is later observed or how it is interpreted?

These pathways vary. An interview can change how a participant articulates an experience; publication of a classification can influence institutional uptake; a ranking can redirect organizational behavior; an experimental intervention can modify the process later measured; a long-term field relation can create trust that changes disclosure. Some effects improve epistemic access, while others generate reactivity or dependence. Reflexivity therefore does not presume that influence is contamination. It requires that influence become an explicit object of inquiry when it matters to the target claim.

Proposition 6.100 (Reflexive monitoring requirement). *When the conduct or communication of research plausibly alters relations material to the target claim, the inquiry should document the relevant pathway, distinguish pre-existing from research-induced conditions where possible, and revise its interpretation or design when those effects materially change the evidential field.*

The proposition completes the section's movement. Research is relational because its objects, participants, communities, institutions, and instruments are connected through conditions of access, authority, mediation, and consequence. It is generative because these relations can produce new capacities, representations, infrastructures, and practical possibilities. It is reflexive because research can become part of the field it studies and thereby alter the conditions of subsequent knowledge. The next section turns from this relational architecture to the researcher's more specific situatedness within it: historical position, institutional position, language, material conditions, power, access, distance, movement across fields, and transformation through inquiry.

6.8 The Researcher within the Relational Field

Section 6.7 treated research as a relational practice constituted through objects, participants, communities, institutions, infrastructures, and reflexive consequences. The present section narrows the analysis to the researcher as a situated participant within that field. Its role is to specify how historical location, institutional position, language, material conditions, power, access, relational distance, and movement across

fields condition observation and interpretation without reducing knowledge to the researcher's standpoint. The section therefore develops a positional account of inquiry in which evidence remains answerable to relational reality while the pathways through which evidence becomes available are historically and materially differentiated. The discussion proceeds from situated observation to dimensions of researcher position, then to mobility across fields and transformation of the researcher through inquiry.

Definition 6.101 (Researcher position). A *researcher position* is the historically situated configuration of institutional, linguistic, material, epistemic, and power relations through which a researcher gains access to a field, encounters evidence, interprets representations, communicates claims, and participates in the consequences of inquiry.

Definition 6.101 treats position as relational rather than as a fixed personal attribute. A researcher can occupy several positions simultaneously, and relevant aspects of position can change across phases of a project. The same researcher may be institutionally central and locally unfamiliar, linguistically competent and materially constrained, technically privileged and dependent on community gatekeepers, or historically distant from the events being reconstructed while possessing archival access unavailable to contemporaries. Positional analysis therefore requires specification of which relation matters for the claim under investigation.

6.8.1 Situated Observation

Observation occurs from within conditions of access, instrumentation, categorization, attention, and prior understanding. This situatedness affects which manifestations become available, how they are recorded, and which contrasts become salient. It does not follow that observation is exhausted by the observer's position. The epistemic architecture developed in Chapter 5 remains in force: evidence is mediated and partial, while relational reality can constrain observation independently of what the researcher expects or prefers.

Definition 6.102 (Situated observation). A *situated observation* is an evidential encounter whose accessibility, resolution, salience, and interpretation are materially conditioned by the researcher's position within the relevant relational field.

The definition contains two distinct claims. First, the route to evidence is position-dependent. A researcher who can observe an administrative process from inside an institution may encounter documents, informal routines, and decision sequences that remain unavailable to an external observer. Second, position-dependence does not establish that every interpretation supported from that position has equal warrant. Claims remain constrained by provenance, competing evidence, inferential discipline, and the properties of the object under investigation.

Longino's contextual empiricism provides a useful precedent for treating evidential relevance as dependent partly on background assumptions while retaining organized criticism as a resource for objectivity (Longino 1990). Bourdieu and Wacquant similarly insist that scholarly practice itself can be made an object of reflexive analysis (Bourdieu and Wacquant 1992). GRE uses these insights to formulate situated observation as a reconstructable component of research design rather than as a general declaration that all perspectives are equivalent.

Proposition 6.103 (Positional disclosure and evidential interpretation). *When a re-*

searcher's position materially affects access, salience, interaction, or interpretation, the relevant positional relation should be documented to the degree needed for readers or collaborators to evaluate its likely effect on the evidential claim.

The relevant degree varies by study. A positional relation can be central in ethnography, participant observation, archival access, interviewing, or research conducted inside an organization, while it may have a narrower role in the interpretation of a public dataset. Positional disclosure is therefore claim-relative rather than a uniform autobiographical requirement.

6.8.2 Historical Position

Researchers occupy historical positions from which earlier and contemporary relations become differently visible. Concepts available to describe a phenomenon, archives preserved from earlier periods, prevailing standards of evidence, and knowledge of downstream consequences all depend partly on temporal location. Historical position therefore changes both epistemic opportunity and epistemic risk.

Gadamer's account of historically effected understanding emphasizes that interpretation occurs through historically formed horizons rather than from a timeless standpoint (Gadamer 2004). Hacking's historical ontology likewise demonstrates how objects of inquiry and classificatory possibilities can emerge through changing conceptual and institutional practices (Hacking 2002). For GRE, the methodological implication is that the researcher should distinguish the historical constitution of an interpretive vocabulary from the historical reality of the relations being reconstructed.

Definition 6.104 (Historical research position). *A historical research position is the temporal location of an inquiry together with the concepts, records, institutions, consequences, and standards of interpretation that are available from that location.*

Later researchers can possess epistemic advantages because longer trajectories have become observable. They may see consequences, institutional transformations, or previously inaccessible archives. The same distance can create loss. Tacit practices disappear, documents are destroyed, categories change, witnesses die, and later concepts can be projected backward onto periods in which they did not organize experience in the same way.

Historical position therefore requires a double discipline. Researchers should use later knowledge where it genuinely expands evidential access while resisting retrospective determinism. Knowledge of what eventually happened does not show that the later outcome was already inevitable, nor does the availability of a contemporary category establish that historical actors inhabited the same classificatory world.

Caution 6.105 (Retrospective positional privilege). Historical distance can enlarge the evidential field while also introducing retrospective categories, selective survival of records, and outcome knowledge. Later observation should therefore be treated as differently situated rather than automatically superior.

6.8.3 Institutional Position

Institutional position concerns the researcher's location within organizations and organized fields of knowledge production. Affiliation, disciplinary membership, rank, contractual status, funding relations, professional networks, publication venues, and

formal authority can affect access to data, credibility, time, equipment, collaborators, and audiences. They can also affect what kinds of questions carry professional reward or institutional risk.

Bourdieu and Wacquant analyze scholarly and social fields through positions, resources, and relations rather than through isolated actors (Bourdieu and Wacquant 1992). GRE adopts a limited version of this orientation: institutional position is one set of relations conditioning inquiry, and its relevance must be shown rather than presumed.

Definition 6.106 (Institutional research position). An *institutional research position* is the researcher's location within organizational and disciplinary relations that allocate authority, resources, recognition, access, obligations, and exposure to evaluation.

Institutional position can generate epistemic capacity. A laboratory appointment may provide equipment and technical expertise; an archival affiliation may open collections; a public-agency role may provide access to administrative records; a long-term university position may allow research that requires many years. These capacities can coexist with institutional blind spots. Evaluation metrics can narrow acceptable outputs, funding conditions can privilege specified problem frames, disciplinary conventions can stabilize inherited categories, and confidentiality obligations can limit what can be shared.

Institutional reflexivity should therefore examine both enablement and constraint. The fact that research is institutionally supported does not invalidate it, just as institutional independence does not guarantee superior judgment. The relevant question is how institutional relations alter the production, circulation, contestability, and preservation of the evidence and claims at issue.

Proposition 6.107 (Institutional-position audit). *When institutional position materially affects access, incentives, disclosure, or evaluative authority, research design should record the relevant dependency and consider how the claim could be checked from positions with different institutional relations.*

This proposition gives plural criticism a practical role. Independent replication, cross-institutional collaboration, community review, open documentation, and adversarial evaluation can each reduce particular positional dependencies, though none removes situatedness altogether.

6.8.4 Linguistic Position

Language is simultaneously a medium of access, interpretation, categorization, and relation. Researchers encounter testimony, archives, legal categories, technical vocabularies, metaphors, and ordinary practices through linguistic repertoires that are unevenly distributed. Linguistic position therefore concerns more than translation accuracy. It shapes which distinctions can be recognized, which communities can be addressed directly, and which concepts become available for theoretical reconstruction.

Wittgenstein's account of meaning through use and language-games is relevant because a term's practical significance depends on its role within forms of linguistic activity rather than on an isolated lexical correspondence (Wittgenstein 2009). Gadamer similarly treats language as a medium through which understanding is his-

torically articulated (Gadamer 2004). Bourdieu adds a power-sensitive dimension by emphasizing linguistic markets and symbolic authority (Bourdieu 1991).

Definition 6.108 (Linguistic research position). A *linguistic research position* is the researcher's situated repertoire of languages, disciplinary vocabularies, classificatory conventions, translation practices, and communicative relations through which evidence and interpretation become expressible.

Translation can expand relational access while also introducing transformation. A legal or administrative term may lack a stable equivalent in another language; an apparently ordinary word may carry institutional histories that disappear in literal translation; a technical concept imported from another discipline can reorganize the object by foregrounding some relations and suppressing others. These effects become especially important in interdisciplinary and cross-cultural inquiry.

GRE therefore treats translation as an epistemic operation whose remainder should remain visible where it affects the argument. Preserving source-language terms, documenting competing translations, consulting situated speakers, and distinguishing researcher-created analytical categories from participant categories are among the available practices. Their necessity depends on the target claim rather than on a universal rule that every term must remain untranslated.

Remark 6.109 (Linguistic plurality and conceptual revision). Encounter with another linguistic repertoire can reveal distinctions that the researcher's prior vocabulary did not make salient. Linguistic difference can therefore generate conceptual revision in addition to creating translation difficulty.

6.8.5 Material Position

Research also depends on material conditions. Time, income, mobility, housing stability, equipment, computing resources, physical access, documentation capacity, legal status, and organizational support can change which questions are practicable and how long an inquiry can remain open. Material position is therefore part of the generative conditions of knowledge production.

This point complements the infrastructural analysis in Section 6.7. Infrastructure concerns durable arrangements supporting many inquiries, whereas material position concerns the researcher's concrete relation to those arrangements and to the resources required for a particular research trajectory. Two researchers may inhabit the same disciplinary field while having very different ability to travel, acquire data, maintain long-term field relations, purchase access, hire assistance, or absorb the opportunity cost of slow research.

Definition 6.110 (Material research position). A *material research position* is the configuration of resources, temporal capacity, mobility, equipment, security, and infrastructural access that conditions the researcher's practical ability to observe, preserve, analyze, communicate, and revise inquiry.

Material position affects method choice in ways that can be mistaken for purely intellectual preference. Short funding cycles can favor readily measurable outcomes; expensive instruments can concentrate inquiry in well-resourced institutions; unstable employment can reduce the feasibility of long historical or ethnographic projects; limited computing access can constrain model exploration. These constraints do not mechanically determine conclusions, yet they shape the feasible set of research prac-

tices from which conclusions can emerge.

Material asymmetry also affects cumulative knowledge. A project capable of maintaining archives, code, data documentation, and long-term personnel may preserve conditions for later re-epistemization that a resource-constrained project cannot sustain. Evaluation of research systems should therefore distinguish scientific merit from the material capacities required to render work visible, reproducible, and durable.

Proposition 6.111 (Material feasibility and methodological choice). *Observed method choice can reflect both epistemic judgment and material feasibility. Methodological evaluation should therefore examine whether relevant alternatives were rejected on epistemic grounds, rendered impracticable by material conditions, or excluded through a combination of both.*

6.8.6 Power and Access

Access to relational fields is organized through power. Gatekeepers authorize entry, institutions classify records, participants decide what to disclose, organizations can impose confidentiality, and researchers themselves can control publication, coding, interpretation, and public visibility. Power therefore affects both who can observe and who can determine how observations circulate.

Foucault's analysis of power relations emphasizes structured action upon action rather than a simple possession held by one actor (Foucault 1982). Fricker's account of epistemic injustice identifies credibility and interpretive inequalities that can shape participation in knowledge practices (Fricker 2007). These literatures support a GRE distinction between access capacity and epistemic warrant. Powerful access can reveal otherwise hidden evidence, while also creating dependence, selective visibility, strategic disclosure, or constraints on contestation.

Definition 6.112 (Power-mediated research access). *Power-mediated research access* is access to evidence, participants, sites, infrastructures, or representational channels whose availability and conditions are materially structured by relations of authority, dependence, vulnerability, gatekeeping, or control.

The same researcher can be powerful in one relation and dependent in another. A university affiliation may confer authority when requesting an interview while leaving the researcher dependent on an organization for site access. A technical specialist may control analytical tools while depending on local actors for interpretation. An external researcher may possess publication power while lacking the situated knowledge held by participants.

For this reason, power analysis should avoid reducing the research field to a single hierarchy. A more useful approach reconstructs who can grant or withdraw access, who can refuse participation, who controls categories and records, whose testimony receives credibility, who bears disclosure risk, who can challenge a representation, and who retains the capacity to circulate a competing account.

Proposition 6.113 (Access-warrant separation). *Expanded access increases the potential evidential field but does not by itself establish stronger warrant. Claims remain dependent on provenance, selection processes, representational adequacy, competing evidence, and the power relations through which access was produced.*

This separation is particularly important when privileged access is treated rhetor-

ically as proof of superior knowledge. Insider status, elite interviews, proprietary datasets, or confidential archives can each expand evidence while simultaneously narrowing independent contestability.

6.8.7 Relational Distance

Research often describes observers as close to or distant from their objects, yet relational distance has several dimensions. A researcher can be geographically close and institutionally distant, socially embedded and analytically unfamiliar, linguistically fluent and historically removed, or professionally detached while maintaining long-term personal relations. A single continuum from insider to outsider therefore compresses distinct epistemic conditions.

Definition 6.114 (Relational distance profile). A *relational distance profile* is a claim-relative description of the researcher's proximity to or separation from relevant actors, practices, institutions, languages, histories, infrastructures, and consequences of the field under investigation.

Different distances generate different epistemic opportunities. Proximity can support tacit understanding, trust, rapid recognition of anomalies, and access to informal relations. Distance can support comparison, make normalized practices visible, reduce particular dependencies, and expose assumptions that insiders rarely articulate. Each can also create characteristic blind spots. Proximity may normalize local categories or increase relational obligations; distance may miss tacit context or interpret formal representations too literally.

GRE therefore avoids a universal ideal of optimal distance. The relevant question is whether the distance profile is appropriate to the target claim and whether complementary positions can correct predictable limitations. Longino's emphasis on critical interaction among differently situated knowers is relevant because positional diversity can become epistemically productive when there are actual channels for criticism and uptake (Longino 1990).

Proposition 6.115 (Complementarity of relational distance). *Where distinct positions provide access to different manifestations or interpretive resources, combining evidence across relational distances can increase warrant when disagreements, provenance, and translation conditions remain explicit.*

Complementarity should not be confused with simple averaging. Some positions can possess better evidence for a particular claim; others may be systematically constrained or strategically misinformed. The analytical task is to explain why a position matters and what evidential relation connects it to the target.

6.8.8 Cross-Field Researcher Position

Researchers move. They cross disciplines, institutions, countries, languages, communities, professional roles, and practical domains. Such movement changes position and can reveal relations that remain difficult to see from a stable location. It can also produce discontinuity, translation problems, loss of trust, or misapplication of concepts developed elsewhere.

Movement across fields is especially important for interdisciplinary inquiry. A concept can acquire new significance when transferred into another research domain,

yet its evidential and ontological commitments may not travel intact. Section 6.6 described recursive movement between research and application modes. Movement across fields is related but distinct: the researcher's relational coordinates change even when the dominant mode of praxis remains research.

Definition 6.116 (Positional transition across fields). A *positional transition across fields* is a change in the researcher's relational location produced by movement among disciplinary, institutional, linguistic, cultural, geographic, or practical fields, with corresponding changes in access, categories, authority, obligations, and interpretive resources.

Such transitions can be generative. A methodological practice learned in one field may become useful in another; a concept taken for granted in one discipline may appear contingent from another; an institutional comparison may reveal alternative arrangements. Gadamer's language of changing horizons provides one philosophical vocabulary for understanding how encounters can transform the conditions of interpretation (Gadamer 2004). GRE places this transformation within a wider relational account that also includes material and institutional movement.

Cross-field movement creates a specific methodological obligation: transfer should preserve a record of what changed. A researcher entering another field should identify which categories were retained, which meanings shifted, which relations became newly observable, and which forms of competence remain limited. This practice reduces the risk that mobility becomes a source of unacknowledged conceptual extraction.

Caution 6.117 (Mobility and transferable authority). Authority gained in one field does not automatically transfer to another. Cross-field inquiry should distinguish portable methodological skill from field-specific competence, access, and interpretive authority.

6.8.9 Transformation of the Researcher through Inquiry

The researcher is not positionally fixed over the life of an inquiry. Repeated encounters can change language, habits of attention, theoretical commitments, institutional relations, ethical sensitivities, technical skills, social networks, and judgments about which questions matter. Inquiry can therefore transform the researcher who later observes and interprets the field.

Dewey's account of experience emphasizes reciprocal transformation through interaction between organism and environment (Dewey 1925). Bourdieu's theory of practice likewise provides resources for understanding historically acquired dispositions rather than treating practical perception as context-free cognition (Bourdieu 1977). GRE uses these precedents to treat researcher transformation as an empirical and reflexive feature of research trajectories.

Definition 6.118 (Researcher transformation through inquiry). *Researcher transformation through inquiry* is a durable change in the researcher's interpretive repertoire, capacities, dispositions, relations, attention, or practical orientation generated through participation in the research process.

Transformation can improve inquiry. Researchers may acquire language competence, learn to recognize distinctions previously invisible to them, revise stereotypes, develop technical capability, or build relations that permit deeper access. Transfor-

mation can also generate new dependencies and blind spots. Long immersion may normalize local assumptions; theoretical investment can increase attachment to a framework; professional rewards can make a research programme difficult to abandon; emotionally significant relations can alter judgment in ways that require reflection rather than simple celebration or suppression.

The appropriate methodological response is longitudinal reflexivity. Researchers can record major changes in access, categories, commitments, and interpretation across phases of inquiry, especially when those changes alter the evidential field. Early notes, preregistered expectations where suitable, versioned conceptual maps, methodological memos, and preservation of rejected interpretations can make such transformations inspectable rather than reconstructing them only after the final argument has stabilized.

Proposition 6.119 (Researcher transformation and epistemic revision). *When inquiry materially transforms the researcher's capacities, relations, or interpretive categories, later judgments should distinguish changes attributable to newly available evidence from changes generated through the researcher's evolving position, while allowing the two processes to interact where separation is incomplete.*

This proposition completes the positional argument of the section. The researcher enters inquiry from a historical, institutional, linguistic, material, and power-laden position; encounters the field through specific relational distances; can move across fields; and can be transformed through the process of inquiry itself. Researcher position is therefore neither an external bias to be eliminated nor a sovereign standpoint from which reality is constituted. It is a changing part of the relational architecture through which evidence becomes accessible and knowledge becomes possible. The next section develops a complementary discipline at the level of ontology: inquiry can proceed with explicit and sufficient commitments while suspending claims whose settlement exceeds the requirements of the research problem.

6.9 Inquiry under Ontological Suspension

This section develops the practical implications of ontological suspension for research praxis. Chapter 4 introduced ontological suspension as a disciplined withholding of stronger ontological commitment where such commitment is neither warranted nor required by the explanatory task. The present section asks how that principle should operate while research is actually being designed, conducted, compared across domains, and revised. Its objective is to show how inquiry can construct workable objects, select sufficient commitments, compare multiple descriptions, and revise assumptions without requiring final settlement of every metaphysical question raised by the domain. The section proceeds through seven tasks: research without final ontological settlement, provisional objects, minimal ontological commitment, domain-specific commitment, multiple ontological descriptions, revision of ontological assumptions, and the practical limits of suspension. The method is methodological and comparative. It treats ontology as consequential for research while resisting the inference that every inquiry must begin from a completed metaphysical system. Philosophical precedents concerning ontological commitment, empirical adequacy, and suspension provide useful resources, although GRE's use of ontological suspension remains a narrower research discipline rather than an

adoption of any one broader philosophical programme (Quine 1948; Fraassen 1980; Husserl 2012).

Definition 6.120 (Inquiry under ontological suspension). *Inquiry under ontological suspension* is research practice that states and uses the ontological commitments required to identify its objects, relations, mechanisms, and evidential targets while withholding stronger commitments whose settlement is not presently necessary or warranted.

Definition 6.120 gives suspension a positive research role. It does not remove ontology from inquiry. Every empirical record, formal model, interview category, institutional archive, legal classification, historical narrative, or computational representation depends on distinctions concerning what kinds of objects can be identified, what counts as persistence, which relations are relevant, and what differences matter. The discipline lies in making those commitments proportionate to the research task and revisable when their consequences become operative.

6.9.1 Research without Final Ontological Settlement

Research frequently proceeds before the ultimate ontology of its objects has been settled. Economists can study money, firms, markets, expectations, assets, and institutions while disagreeing about the metaphysical status of social objects. Legal scholars can analyze offices, rights, obligations, and legal persons while holding different philosophies of normativity or institutional fact. Researchers can investigate memory, identity, trust, collective agency, artificial systems, ecological relations, or subjective continuity while deeper disputes about mind, personhood, agency, emergence, or social reality remain open. Inquiry becomes possible because the relevant local claims often require less than final ontological agreement.

The practical significance of this point is methodological. If research required prior resolution of every stronger ontological disagreement connected to its object, many research programmes would be unable to begin. Conversely, ignoring ontology altogether can hide assumptions in operational definitions, measurement instruments, classifications, and models. Ontological suspension provides a middle discipline: identify the ontological question, determine whether its resolution changes the target claim or research design, and proceed with explicitly bounded commitments where the stronger dispute remains non-operative.

Quine's classic formulation of ontological commitment emphasizes that theories carry implications about what they say there is (Quine 1948). GRE accepts the need to make such implications visible while distinguishing the commitments needed for a specific inquiry from a complete metaphysical inventory. Van Fraassen's constructive empiricism likewise provides one historical precedent for separating empirical adequacy from stronger realist commitment, although GRE does not reduce inquiry to observable phenomena and explicitly treats relational realities as possible epistemic targets under mediated access (Fraassen 1980). Husserl's language of suspension provides another historical lineage, but GRE's procedure is narrower than transcendental phenomenological epoché: it is a claim-specific discipline for research under incomplete ontological settlement rather than a suspension of the natural standpoint as such (Husserl 2012).

Proposition 6.121 (Operational sufficiency of suspended inquiry). *An inquiry can remain epistemically and methodologically substantive under unresolved stronger ontol-*

ogy when its operative objects, identity criteria, evidential targets, causal or relational claims, and inferential boundaries are sufficiently specified for the research problem.

The proposition places a burden on specification. Suspension cannot compensate for an undefined object or an incoherent measurement relation. A study of institutional trust, for example, may suspend whether trust is ultimately a psychological state, a social relation, an emergent property, or a mixed phenomenon only if it states what observable, relational, historical, or behavioral features count for the local claim. Where competing ontologies imply different observations, interventions, or identity conditions, the disagreement becomes operative and can no longer remain merely bracketed.

6.9.2 Provisional Objects

Research objects are often stabilized provisionally before their ontological boundaries are fully known. A “firm,” “community,” “market,” “household,” “algorithmic agent,” “public,” “crisis,” or “institution” may function as an object of inquiry because the research requires a manageable unit, even though its boundaries, internal heterogeneity, persistence conditions, or relation to neighboring objects remain contested. Treating such an object as provisional avoids two opposite errors: assuming that the research category transparently corresponds to a final ontological kind, and assuming that provisionality makes the category analytically arbitrary.

A provisional object is constituted through an explicit research relation. The analyst identifies a target, specifies the features and boundaries relevant to the inquiry, records exclusions and uncertainties, and remains prepared to revise the object when evidence shows that the initial construction is inadequate. The object can still refer to realities that exceed its representation. Giere’s purposive account of scientific representation is useful here because models and representations select aspects of a target for specified purposes rather than reproducing the target by identity (Giere 2004). GRE extends the same discipline to the construction of research objects more generally.

Definition 6.122 (Provisional research object). A *provisional research object* is a target of inquiry whose identity, boundary, or internal organization is specified sufficiently for a current research task while remaining explicitly open to revision when evidence, scale, history, or alternative descriptions materially alter that specification.

Provisionality should therefore be documented rather than merely asserted. Researchers can state which features determine inclusion, how temporal persistence is handled, which scale is privileged, what internal variation is suppressed, and what neighboring relations remain outside the present object. Such documentation becomes especially important when a provisional object later acquires administrative or theoretical authority. A category created for analysis can become embedded in datasets, policy systems, institutional records, or subsequent scholarship and thereby acquire performative effects that exceed its original research purpose.

Remark 6.123 (Provisionality and cumulative inquiry). A provisional object can support cumulative research when successive studies preserve enough provenance to show how its boundaries, identity criteria, and operational definitions have changed. Cumulativity does not require permanent category identity.

This remark connects ontological suspension to historical research practice. What a field calls the same object may change as instruments, institutions, classifications,

and theories change. Preserving these transformations helps later researchers determine whether apparent continuity reflects continuity of the object, continuity of the label, or a more complex historical relation between them.

6.9.3 Minimal Ontological Commitment

Ontological suspension requires some positive commitments. Research cannot identify an object, compare observations, infer persistence, or test a mechanism without assuming enough about what can exist and how relevant entities or processes can be distinguished. The appropriate standard is therefore not ontological neutrality. It is *minimal sufficient commitment*: the inquiry should commit to the least ontological structure adequate for the claim while making additional commitment when the research problem requires it.

Minimality is target-relative. A descriptive study of transaction records may need commitments about events, agents, institutional identifiers, and temporal ordering without requiring a theory of personhood. A study of responsibility in human–AI interaction may require a richer account of agency, delegation, authority, and subjecthood because those distinctions affect the interpretation of action. A longitudinal study of organizational continuity requires explicit persistence criteria. A model of ecological feedback may require commitments about entities, flows, environments, and causal dependence at more than one scale. The same research programme can therefore operate with different degrees of ontological commitment across its questions.

Definition 6.124 (Minimal sufficient ontological commitment). *A minimal sufficient ontological commitment is the least set of explicit assumptions concerning relevant objects, relations, identity conditions, persistence, and causal or generative capacities needed for a specified research claim to be coherent and assessable.*

Minimality should not become an aesthetic preference for conceptual austerity regardless of explanatory loss. An ontology that is too thin can obscure mechanisms, differences, or forms of agency that matter to the target. The discipline is economical rather than reductive: additional categories should be introduced when they improve the adequacy of the inquiry and withheld when they add stronger claims without changing what the evidence or explanation can support.

Proposition 6.125 (Commitment proportionality). *Ontological commitment should increase when additional distinctions materially change identification, explanation, prediction, comparison, intervention, or normative responsibility relevant to the research problem, and can remain suspended where stronger distinctions leave those tasks unchanged.*

Proposition 6.125 supplies a practical test. If two ontological accounts generate the same operational object, evidence interpretation, and explanatory consequences for the present inquiry, the stronger dispute can remain open. If they imply different identity criteria, causal expectations, or interventions, the dispute has become methodologically active and requires explicit treatment.

6.9.4 Domain-Specific Commitment

Research takes place within domains that already possess operational ontologies. Law uses persons, rights, duties, offices, jurisdictions, acts, and procedures. Eco-

nomics uses prices, assets, liabilities, firms, contracts, households, labor, and forms of capital. Biology, ecology, computation, psychology, education, engineering, and political science likewise employ objects and identity conditions shaped by their own histories and practical requirements. Ontological suspension should not flatten these domain distinctions into a generic vocabulary of relations.

Domain-specific commitment permits inquiry to use operationally meaningful objects while keeping their relation to stronger ontology open. A corporation can be treated as a legal and economic object with rights, liabilities, governance structures, and causal effects without deciding whether organizations possess agency in exactly the same ontological sense as human persons. A computational agent can be treated as a system that receives inputs, produces actions, and enters institutional relations without assuming equivalence between machine subjecthood and human subjectivity. A household can be analyzed as an economic unit for one question while another inquiry decomposes it into intra-household relations because distribution, care, or power makes the unitary representation inadequate.

Definition 6.126 (Domain-specific ontological commitment). A *domain-specific ontological commitment* is an explicit commitment to the objects, identity conditions, relations, and operational distinctions required by a particular field of inquiry, maintained without presuming that those commitments exhaust the object's possible descriptions at other scales or in other domains.

The definition has two implications for interdisciplinary research. First, translation into a common analytical vocabulary should preserve the domain distinctions that carry causal, legal, institutional, or practical significance. Second, interdisciplinary inquiry should record where a term changes meaning across domains. “Agent,” “value,” “capital,” “information,” “risk,” “responsibility,” and “identity” can function differently in economics, law, computation, psychology, or philosophy. Ontological suspension allows several uses to remain locally valid while requiring explicit adjudication when the differences become consequential for a shared claim.

Hacking's historical work is relevant because categories and objects of inquiry can emerge, stabilize, and transform through changing practices of classification and reasoning (Hacking 2002). A domain ontology should therefore be treated as historically situated rather than as an unchanging dictionary. Its operational force can be substantial even when its categories remain revisable.

Caution 6.127 (Domain ontology and practical authority). The operational necessity of a domain category does not establish its complete descriptive adequacy, ontological fundamentality, or normative legitimacy. Research should distinguish practical use from stronger claims about what the category ultimately captures.

6.9.5 Multiple Ontological Descriptions

Some objects can be described coherently through more than one ontology. A person can be described biologically, psychologically, legally, economically, narratively, relationally, or computationally for different research purposes. An institution can be described through rules, organizational roles, material infrastructures, repeated practices, symbolic classifications, or networks of dependence. A market can be represented through transactions, expectations, legal arrangements, infrastructures, strategic interaction, historical institutions, or distributed informational processes. Ontological suspension creates room for such plurality without converting plurality

into equivalence.

Multiple descriptions can be complementary when they select different aspects of the same target. They can also compete when they assign different identity conditions, explanatory priorities, or causal mechanisms. The research task is to determine what each description preserves, what it omits, and whether their disagreement changes the target claim. Perspectival accounts of scientific representation are helpful here because they emphasize that observations and models are produced from structured perspectives while remaining answerable to the world and to comparative criticism (Giere 2006). GRE extends this lesson by treating ontological descriptions themselves as potentially plural and target-relative.

Definition 6.128 (Ontological description set). An *ontological description set* is a specified collection of alternative or complementary accounts of the objects and relations relevant to an inquiry, together with their scopes, identity criteria, explanatory roles, and known incompatibilities.

The set concept discourages opportunistic switching. A researcher should not use one ontology to secure a result and another to avoid its consequences without explaining the transition. Where descriptions are jointly used, the mapping between them should state what is preserved. A legal person and an organizational network may correspond in some respects while diverging in responsibility, persistence, and authority. A psychological state and a behavioral measure may be related without being identical. A relational field model and an institutional classification may reveal different structures of the same setting.

Proposition 6.129 (Plural description discipline). *Multiple ontological descriptions can coexist within one research programme when their scopes and translation relations are explicit, their disagreements remain visible, and stronger incompatibilities are investigated whenever they generate different evidential, explanatory, or practical consequences.*

The proposition avoids both premature unification and unrestricted pluralism. Some descriptions will prove empirically inadequate; others may become obsolete; some may be useful only at one scale; still others may reveal structures that a dominant ontology systematically hides. Ontological plurality becomes epistemically productive when disagreement is inspectable and when evidence can bear on the consequences of the competing descriptions.

6.9.6 Revision of Ontological Assumptions

Ontological assumptions can become objects of revision during inquiry. A study may begin by treating actors as independent units and later discover that their identities depend on institutional positions. A longitudinal project may find that the criterion used to identify the “same” organization fails after merger, fragmentation, or legal transformation. A computational model may reveal that an assumed binary category obscures a continuous or multi-dimensional structure. Field research may show that participant distinctions differ from the categories imposed by an administrative dataset. Historical evidence may demonstrate that a supposedly stable object is a recent institutional formation.

Revision occurs when the current ontology stops supporting adequate reconstruction of the target. This can appear as persistent anomaly, category instability, unexplained residuals, contradictory observations, failed interventions, translation break-

down, or inability to preserve identity across relevant transformations. Because assumptions occur in clusters, evidence may leave open which commitment requires revision. The holist problems emphasized by Duhem and Quine remain relevant: empirical tension does not always identify a single assumption whose rejection will repair the account (Duhem 1954; Quine 1951). Research therefore requires comparative revision rather than automatic abandonment of whichever category is most visible.

Definition 6.130 (Ontological assumption revision). *Ontological assumption revision* is the documented modification of an inquiry's commitments concerning objects, identity, persistence, relations, levels, or capacities when evidence or explanatory failure shows that the previous commitments are inadequate for the research task.

A disciplined revision should preserve the history of the change. Researchers can record the earlier assumption, the evidence that made it problematic, alternative reconstructions considered, the new commitment adopted, and which results require reinterpretation. This record matters because changing ontology can change the meaning of earlier data. If a "household" is redefined, a time series may no longer compare the same unit. If an "event" becomes a process, timing and causal attribution may need revision. If an actor becomes a distributed configuration, responsibility and intervention targets can change.

Proposition 6.131 (Revision propagation). *When an ontological assumption materially organizes measurement, classification, identity, or causal attribution, revision of that assumption should trigger review of the downstream claims and representations that depended on it.*

Revision is thus generative within research praxis. A changed ontological assumption can reorganize instruments, datasets, questions, models, and institutional relations, creating a new epistemic field for subsequent inquiry. This recursive effect connects ontological revision to the broader account of research as generative practice developed earlier in the chapter.

6.9.7 Practical Limits of Suspension

Ontological suspension has practical limits. Research sometimes reaches questions for which stronger ontological commitment is unavoidable because action, measurement, responsibility, or interpretation depends on the answer. An ethics protocol may need a working account of who counts as a participant. A legal study of responsibility may need criteria for agency and attribution. A clinical or educational intervention may require operational criteria for the subject or condition being treated. A computational governance system may need to distinguish tool, agent, delegate, and accountable institution. An ecological study may require explicit organism, population, or system boundaries because the intervention changes with the level selected.

The relevant limit is reached when continued suspension would prevent coherent design or conceal consequential alternatives. A research programme can postpone stronger ontology only while the suspended dispute remains non-operative for the tasks at hand. When competing ontologies imply different measurements, inclusion criteria, causal mechanisms, risk assignments, intervention targets, or normative responsibilities, researchers must either adjudicate among them, design the inquiry to compare them, or state a provisional commitment strong enough to proceed.

Definition 6.132 (Operative ontological threshold). *The operative ontological threshold* is the point at which an unresolved ontological disagreement begins to produce

materially different research objects, evidential interpretations, mechanisms, decisions, interventions, or responsibilities within the inquiry.

This threshold is itself target- and phase-relative. Early exploratory research can often sustain wider suspension than later measurement or intervention. A descriptive project may defer a question that becomes unavoidable during causal attribution. Application-dominant praxis may require provisional closure because action cannot wait for final settlement. Conversely, new evidence can reopen a commitment that previously seemed adequate.

Suspension also has an institutional limit. Funding systems, databases, laws, ethics procedures, and technical infrastructures often require categorical decisions. Researchers may therefore be compelled to operationalize an object more sharply than their theory warrants. The appropriate response is to distinguish institutional closure from ontological completion. A working category can be adopted for coordination while its provisionality, exclusions, and uncertainty remain documented.

Proposition 6.133 (Practical discipline of ontological suspension). *Ontological suspension is methodologically appropriate while stronger disagreement remains non-operative for the target inquiry; once the disagreement crosses the operative ontological threshold, research should make the competing commitments explicit and adopt, compare, or provisionally adjudicate them in proportion to the practical and epistemic consequences involved.*

This proposition completes the section's practical account. Ontological suspension neither eliminates ontology nor converts it into an indefinitely postponed philosophical problem. It organizes the timing and scope of commitment. Research begins with sufficiently specified objects, uses minimal and domain-sensitive commitments, permits multiple descriptions where their relations are explicit, revises assumptions when evidence requires it, and lifts suspension when stronger disagreements become operative. The result is a research praxis able to remain metaphysically restrained while still constructing objects, choosing methods, producing evidence, and acting under finite conditions. The next section turns from this disciplined restraint to a different moment of inquiry: encounter, through which something in the field becomes available to research before its eventual significance has been fully determined.

6.10 Encounter in Research

Section 6.9 established ontological suspension as a discipline for inquiry that permits sufficiently specified objects and commitments while stronger metaphysical questions remain open. The present section turns to an earlier and more elementary moment of research praxis: encounter. Its role is to describe how something becomes available to inquiry before its importance, explanatory role, or theoretical significance has been settled. The objective is to distinguish several forms of encounter—with existence, contingency, difference, anomaly, repetition, and unexpected relation—and to identify the historical, relational, and instrumental conditions through which encounters become possible. The discussion treats encounter as an epistemically consequential event within research praxis while preserving the distinction between encounter, salience, significance, and warranted interpretation. This distinction prepares the transition to the next section, where the problem becomes how some encounters acquire salience before their significance is known.

Definition 6.134 (Research encounter). A *research encounter* is an event or episode within inquiry in which an object, trace, pattern, difference, absence, recurrence, or relation becomes available to a research praxis in a form capable of affecting subsequent attention, representation, interpretation, or investigation, whether or not its significance is immediately recognized.

Definition 6.134 is intentionally broader than planned observation. An encounter can arise through a designed experiment, an interview, archival work, field observation, a model residual, an instrument reading, a failed intervention, a repeated administrative irregularity, or a relation noticed across previously separated domains. Some encounters are actively sought; others emerge while the researcher is pursuing a different problem. Their epistemic role depends on what becomes available and on how the research process records, preserves, compares, and later interprets it.

6.10.1 Encounter with Existence

The most elementary research encounter is the encounter with something that resists being treated as merely hypothetical within the current inquiry. A trace is found in an archive; an instrument registers a signal; a participant describes a relation that had not entered the research design; a transaction appears in a dataset; a legal document establishes an institutional act; an observed practice persists despite expectations that it would disappear. Such encounters provide a practical sense that the inquiry is answerable to something beyond its existing conceptual organization.

Under ontological suspension, encounter with existence does not settle ultimate ontology. The relevant claim is narrower. Something has become evidentially available within a specified relation among object, observer, representation, and research setting. That availability can constrain inquiry even when the stronger ontological status of the encountered object remains open.

Definition 6.135 (Encounter with existence). An *encounter with existence* is a research encounter in which a manifestation, trace, resistance, or effect provides reason to treat some object, event, relation, or process as evidentially operative within the scope of inquiry.

This definition preserves the architecture developed in Chapters 4 and 5. Manifestation does not provide transparent access to ontological reality, and the presence of a trace does not by itself determine the relation that generated it. The encounter nevertheless matters because the field can constrain the researcher's expectations. Peirce's account of inquiry beginning from genuine doubt is relevant here: inquiry becomes substantive when an unsettled condition exerts pressure on belief rather than remaining a merely verbal question (Peirce 1877). Dewey's treatment of experience likewise emphasizes interaction with conditions that can interrupt established habits and reorganize subsequent inquiry (Dewey 1925).

Remark 6.136 (Existence and evidential resistance). An encounter can be epistemically important because it resists an existing representation while still leaving open several competing accounts of what the encountered object or relation is.

Encounter therefore precedes ontological closure. Its immediate contribution is to enlarge or disturb the evidential field.

6.10.2 Encounter with Contingency

Research also encounters contingency: events, conjunctions, opportunities, failures, or exposures whose occurrence was not entailed by the current research plan. Contingency in this sense is broader than randomness. A contingent encounter can be causally structured while remaining unforeseen, timing-dependent, or dependent on a conjunction of conditions that the research design did not anticipate.

A researcher may meet an informant because an interview is cancelled, discover a relevant archive while following a different citation, observe an institutional failure during an unusual transition, or notice a theoretical relation while working across disciplines. The epistemic importance of such events cannot be inferred from their accidental appearance alone. Their role arises from the interaction between the contingent event and an existing research configuration capable of recording, interpreting, and following it.

Definition 6.137 (Contingent research encounter). *A contingent research encounter is an encounter whose occurrence, timing, or accessibility depends on conditions that were not required by the active research design and whose research relevance emerges only through subsequent relation to the inquiry.*

Dewey's discussion of existence as containing precarious as well as stable conditions provides one philosophical precedent for treating contingency as a normal feature of inquiry rather than as an external disturbance (Dewey 1925). GRE adds a relational emphasis: contingency becomes epistemically productive through the relation among event, prepared concepts, available instruments, researcher attention, historical circumstance, and later interpretation.

Proposition 6.138 (Contingency and epistemic preparedness). *The research value of a contingent encounter depends partly on whether the surrounding praxis possesses sufficient conceptual, evidential, institutional, and recording capacity to preserve the encounter for later examination.*

Proposition 6.138 explains why the same event can remain irrelevant in one research setting and become generative in another. Preparedness does not predetermine meaning. It supplies conditions under which an unforeseen event can enter an inspectable research trajectory.

6.10.3 Encounter with Difference

Difference becomes research-relevant when an encounter reveals that cases, actors, relations, times, scales, or representations previously treated as equivalent behave differently in ways that matter to the inquiry. Difference can arise through comparison, translation, field movement, longitudinal observation, or the juxtaposition of heterogeneous evidence.

Research often begins with categories that compress variation. Such compression is necessary for description and comparison, yet an encounter may expose a remainder that the category suppresses. Two institutions classified identically can operate through different informal relations. The same legal rule can produce different practices across organizations. A variable with the same recorded value can arise from different processes. A concept transported across languages can acquire a different practical field of meaning.

Definition 6.139 (Difference encounter). *A difference encounter is a research en-*

counter in which a previously assumed equivalence, continuity, comparability, or shared category becomes insufficient for representing a contrast that is relevant to the research target.

Difference need not immediately invalidate the category. It may reveal a subcategory, a scale effect, a boundary condition, a historical transformation, or a different generative pathway. The appropriate response is therefore diagnostic. Researchers can ask which feature differs, whether the difference persists, what relation produces it, and whether the existing representation should be refined, localized, or replaced.

Hacking's historical work is relevant because objects and classifications can acquire different forms across changing styles of reasoning and institutional practices (Hacking 2002). A difference encounter can therefore reveal more than variation among stable objects; it can reveal that the conditions under which objects become comparable have themselves changed.

Caution 6.140 (Difference and premature taxonomy). An encountered difference should not automatically be converted into a new durable category. Its stability, explanatory relevance, scale, and historical conditions require examination before categorical institutionalization.

6.10.4 Encounter with Anomaly

An anomaly is a difference indexed to an expectation. It arises when an observation, trace, result, or event conflicts with what an active theory, model, classification, procedure, or background regularity leads the researcher to anticipate. The epistemic status of an anomaly therefore depends on both the encountered material and the expectation against which it appears anomalous.

Kuhn's analysis of scientific practice makes anomaly central to the historical dynamics of research, while also showing that anomalies do not automatically dissolve the frameworks within which they are recognized (Kuhn 1962). GRE adopts this restrained lesson. An anomaly can indicate measurement error, sampling variation, an unmodeled condition, a boundary failure, historical change, a new relation, or inadequacy in the current theoretical architecture. Its value lies in opening a disciplined diagnostic problem.

Definition 6.141 (Research anomaly). A *research anomaly* is an encounter whose manifestation is materially inconsistent with an expectation generated by the active evidential, classificatory, methodological, or theoretical organization of inquiry.

Anomalies differ in depth. A local residual may require a parameter adjustment; a repeated contradiction may expose an omitted relation; an unexpected historical sequence may challenge an assumed mechanism; a new object may require revision of the ontology through which the inquiry was constructed. The appropriate response depends on persistence, provenance, reproducibility where relevant, and comparison with alternative explanations.

Proposition 6.142 (Anomaly preservation). *When an anomalous encounter is sufficiently credible to challenge an active expectation, the anomaly and the expectation against which it was identified should both be preserved so that later inquiry can reconstruct whether the tension arose from evidence, representation, method, boundary, or theory.*

Preserving both sides of the tension is important. If later revisions erase the earlier

expectation, the historical generativity of the anomaly can become invisible.

6.10.5 Encounter with Repetition

Encounter is often associated with novelty, yet repetition can also become epistemically consequential. A single event may appear incidental, while recurrence across times, actors, sites, or instruments can make a relation newly available to inquiry. Repetition can reveal persistence, regularity, institutional reproduction, patterned omission, recurrent failure, or a stable manifestation process.

Repeated encounter does not establish identity or necessity. Section 120 showed that persistence requires an explicit identity criterion, and Chapter 5 treated repeated observation as distinct from historical continuity. The same discipline applies here. What repeats may be a surface manifestation generated by different relations, or different manifestations may express one persistent relation.

Definition 6.143 (Repetition encounter). A *repetition encounter* is the recognition that manifestations, traces, absences, practices, or relational configurations recur across observations in a way that makes their continuity, reproduction, or common generative conditions available for investigation.

Repetition can change the epistemic status of what was previously background noise. A recurring administrative discrepancy may indicate a routine practice; repeated testimony across differently positioned participants may reveal a distributed relation; persistent model residuals may signal structural misspecification; recurrent failures of an intervention may expose a constraint omitted from the design.

Remark 6.144 (Repetition and generative reproduction). Repeated manifestations can motivate inquiry into reproduction mechanisms, yet recurrence alone does not identify the relation or process that generates the repetition.

This distinction allows repetition to become a source of inquiry without turning regularity directly into explanation.

6.10.6 Encounter with Unexpected Relation

Some encounters reveal a relation between objects, domains, scales, histories, or practices that the research design had previously treated as separate. An unexpected relation can appear through comparative work, interdisciplinary movement, qualitative testimony, statistical association, archival coincidence, network reconstruction, or the juxtaposition of theories developed for different problems.

The encounter is epistemically distinctive because the novelty lies in the connection itself. A researcher may discover that an apparently technical classification reorganizes access to resources, that an economic pattern depends on a legal category, that a local practice is stabilized by a distant infrastructure, or that a recurring conceptual problem in one discipline has an analogue in another. Such encounters can generate new questions before they support new answers.

Definition 6.145 (Unexpected relational encounter). An *unexpected relational encounter* is the emergence within inquiry of a plausible connection among objects, processes, domains, scales, or representations whose relation was not part of the active research architecture.

Plausibility here is intentionally preliminary. An unexpected relation can be spu-

rious, metaphorical, scale-dependent, or produced by a shared third condition. The discovery of a possible connection therefore opens an evidential task: specify the relation, identify manifestations, examine alternatives, reconstruct relevant histories, and test whether the connection survives changes in boundary and representation.

Proposition 6.146 (Relational discovery and inferential restraint). *An unexpected relational encounter can justify expansion of inquiry before it justifies a substantive relational or generative claim. The evidential burden increases when the proposed connection moves from analogy or co-occurrence toward mechanism, persistence, or generative attribution.*

This proposition connects encounter to the epistemic standards of Chapter 5. Discovery enlarges the research space; warrant determines what can responsibly be claimed within that enlarged space.

6.10.7 Historical Conditions of Encounter

What researchers can encounter depends partly on historical conditions. Instruments become available, archives are preserved or destroyed, categories enter institutional use, new objects emerge, technologies create previously impossible traces, and disciplinary vocabularies make some differences easier to articulate. Encounter is therefore historically distributed even when the encountered relation has a history independent of the researcher's conceptual vocabulary.

Kuhn shows how paradigmatic organization structures the problems and observations available within scientific practice (Kuhn 1962). Hacking's account of historical ontology likewise emphasizes the emergence of concepts, classifications, and objects through historically specific practices (Hacking 2002). GRE uses these insights to distinguish the history of an object or relation from the history of its encounterability. A relation may operate before researchers possess the concepts or instruments needed to identify it.

Definition 6.147 (Historical encounter condition). *A historical encounter condition is a historically specific configuration of concepts, institutions, records, technologies, practices, and social relations that affects whether and how a target can become available to inquiry.*

Historical conditions can create both visibility and absence. A new administrative system can produce rich records while suppressing relations that fall outside its categories. Digital infrastructure can make interaction traceable at scale while creating forms of behavior optimized for the platform that records them. Archival preservation can reveal past institutions while systematically underrepresenting informal actors whose activities were weakly documented.

The methodological implication is that absence of encounter requires historical interpretation. Researchers should ask whether the target was absent, unrecorded, inaccessible, conceptually unavailable, institutionally excluded, or lost through preservation practices. Historical reconstruction of encounter conditions therefore becomes part of evidential provenance.

6.10.8 Relational Conditions of Encounter

Encounter is also relationally conditioned in the present. Access often depends on trust, gatekeeping, institutional membership, language, collaboration, timing, participant willingness, and the researcher's position described in Section 6.8. What appears to be an individual moment of discovery may therefore have a distributed relational infrastructure.

A fieldworker may encounter a practice because a participant grants access. An archival discovery may depend on cataloguing work performed by others. A dataset may become available through institutional agreements. An interdisciplinary connection may arise through a collaborator who translates concepts across fields. A computational anomaly may become visible because engineers preserved diagnostic logs. Encounter therefore has contributors whose role can disappear when discovery is narrated as the achievement of a single observer.

Definition 6.148 (Relational encounter condition). A *relational encounter condition* is a relation or configuration of relations that materially affects access to, recognition of, preservation of, or interpretive engagement with a potential research encounter.

Longino's account of knowledge production through critical interaction among differently positioned inquirers provides one relevant precedent for understanding epistemic work as socially organized (Longino 1990). For GRE, the stronger implication is generative: relations among researchers, participants, institutions, communities, and infrastructures can create the conditions under which new encounters become possible.

Caution 6.149 (Attribution of discovery). Narratives of discovery should distinguish the person who first articulates an encounter from the relational and infrastructural conditions that made the encounter possible, especially when access, preservation, translation, or interpretation was distributed across contributors.

This caution anticipates later questions of collective and distributed knowledge production while remaining focused on the immediate conditions of encounter.

6.10.9 Instrument-Mediated Encounter

Many research encounters occur through instruments. Instruments include laboratory devices, surveys, legal databases, archives, sensors, statistical procedures, visualization systems, computational models, machine-learning pipelines, and classificatory infrastructures. Instruments extend perception and comparison, yet they also select, transform, aggregate, and represent what becomes available.

Instrument mediation therefore creates a double epistemic task. Researchers need to understand what the instrument makes accessible and how the instrument participates in producing the form of the encounter. A sensor samples at a specified resolution; a survey supplies response categories; an archive preserves selected records; a network model represents relations as edges; an algorithmic detector identifies patterns according to training data and design choices. The resulting encounter is neither a transparent copy of reality nor merely an artifact of the instrument. Its warrant depends on reconstructing the mediation.

Definition 6.150 (Instrument-mediated encounter). An *instrument-mediated encounter* is a research encounter whose accessibility or form depends materially on a device, procedure, representational system, or computational infrastructure that

transforms aspects of the target into inspectable traces.

Instrument-mediated encounter connects directly to the epistemology of manifestation and representation in Chapter 5. The instrument can make previously inaccessible relations observable while introducing resolution limits, missingness, thresholds, classification effects, or feedback into the field. When instruments change historically, the space of possible encounters can change with them.

Proposition 6.151 (Instrument provenance in encounter). *When an encounter depends materially on an instrument, the instrument's relevant selection, transformation, resolution, and error conditions should remain part of the provenance of the resulting research object or trace.*

Instrument provenance becomes especially important when a surprising result is visible only under one pipeline or representation. Replication may then require reproduction of the mediating conditions as well as access to the underlying target.

6.10.10 Encounter without Immediate Significance

A research encounter can occur without becoming immediately important. A detail may be recorded and ignored, a discrepancy may remain unexplained, a fieldnote may acquire relevance years later, or an association may appear trivial until another theory makes its structure intelligible. Encounter and significance therefore belong to different moments of praxis.

This temporal separation is epistemically important. If research preserves only what already appears meaningful, later inquiry inherits an evidential field filtered by earlier judgments of relevance. At the same time, unlimited preservation is impossible: recording has costs, ethical constraints, privacy consequences, and practical limits. The methodological problem is therefore selective preservation under uncertainty about future significance.

Definition 6.152 (Deferred significance). *Deferred significance* is the condition in which a recorded encounter acquires research importance only after later evidence, concepts, comparisons, historical developments, or relational reconstructions alter its interpretive context.

Deferred significance connects encounter to the book's broader account of historical re-epistemization. Later knowledge can make an earlier trace newly interpretable without implying that its later meaning was already fully contained in the original encounter. The relation between encounter and significance can itself be historically generated.

Proposition 6.153 (Preservation under uncertain significance). *Research practices should preserve encounters beyond their currently recognized significance when the expected future epistemic value, uniqueness, or irreproducibility of the trace justifies the material, ethical, and governance costs of preservation.*

The proposition is intentionally conditional. Some traces should be discarded, anonymized, or left uncollected because preservation would impose disproportionate risk. Others merit preservation precisely because they cannot easily be encountered again. The key is to make the selection logic inspectable rather than allowing present salience to function as an invisible filter on the future evidential field.

Encounter therefore marks an opening rather than a completed judgment. Some-

thing becomes available: an existence, contingency, difference, anomaly, repetition, unexpected relation, or instrumentally mediated trace. Historical and relational conditions shape whether that encounter occurs and whether it survives. Its significance may remain unknown. The next section examines the intermediate problem that follows: how some encounters become salient enough to attract attention before their eventual epistemic, theoretical, practical, or normative significance has been established.

6.11 Salience before Significance

Section 6.10 distinguished encounter from later judgments of importance and showed that a research object, anomaly, recurrence, or relation can enter inquiry before its significance is known. The present section examines the intermediate process through which some encounters become sufficiently prominent to attract sustained research attention. Its role is to separate *salience* from both mere availability and attributed significance. The objective is to identify several conditions through which salience can arise—attention, surprise, contrast, repetition, and anomaly—while also showing why salience can diverge from epistemic, theoretical, practical, or normative importance. The final subsections widen the analysis from individual attention to the historical and institutional distribution of attention. The discussion therefore treats salience as a relational and historically organized condition of research praxis rather than as a reliable indicator of what ultimately deserves inquiry. This prepares Section 145, where the problem shifts from what attracts attention to how researchers judge significance, worthiness, and generative promise.

Definition 6.154 (Research salience). *Research salience* is the condition in which an encountered object, trace, pattern, difference, relation, or question acquires sufficient prominence within a research praxis to attract or sustain attention before its epistemic, theoretical, practical, or normative significance has been established.

Definition 6.154 deliberately places salience between encounter and judgment. An encounter can remain weakly noticed; a salient encounter can later prove unimportant; and an important phenomenon can remain non-salient for long periods. Chapter 2 reconstructed psychological, phenomenological, and economic lineages of attention and salience in its section on appearance, perception, and salience. The present section uses that groundwork more narrowly for research praxis: it asks how selective prominence organizes what researchers follow, preserve, compare, formalize, and eventually judge.

6.11.1 Salience of Encounter

An encounter becomes salient when it stands out sufficiently within the active research field to reorganize attention. The relevant field can include observations, concepts, cases, instruments, hypotheses, anomalies, conversations, archival materials, model outputs, or unresolved practical problems. Salience therefore concerns relative prominence within a configuration rather than an intrinsic property carried by an object independently of context.

This relational character is important. The same observation can be salient in one research configuration and ordinary in another. A small discrepancy can become

prominent when a theory predicts near identity, while a much larger difference may remain unsurprising in a highly variable field. An archival phrase can become salient after a conceptual distinction has been learned. A familiar institutional practice can become newly prominent when comparison with another site reveals that it is historically contingent rather than necessary. Salience can therefore be generated by changes in the object, the surrounding comparison field, or the researcher's conceptual and practical orientation.

Definition 6.155 (Salience relation). A *salience relation* is a relation between an encountered element and a research configuration through which that element becomes comparatively prominent for attention, recording, comparison, or follow-up inquiry.

The definition helps prevent an object-centered interpretation of salience. What stands out does so against a background. Merleau-Ponty's treatment of figure-ground organization provides one relevant philosophical lineage for this contextual structure of perception (Merleau-Ponty 2012). GRE does not import the full phenomenological theory into research methodology. The narrower inheritance is that prominence depends partly on an organized field within which something can become figure rather than remain background.

Remark 6.156 (Salience and significance). Salience identifies a condition of selective prominence. Significance requires a further judgment concerning why the salient object matters and for which epistemic, theoretical, practical, or normative purpose.

This distinction makes salience epistemically useful without allowing attention itself to certify importance.

6.11.2 Attention

Salience becomes practically consequential through attention. Research fields usually contain more potentially relevant material than an individual or institution can examine simultaneously. Attention therefore operates as a selective resource: some encounters are followed, recorded, discussed, replicated, formalized, or funded, while others remain peripheral.

William James's classical treatment of attention emphasizes selective focalization among simultaneously possible objects or trains of thought (James 1890). Simon later expressed a related organizational problem in information-rich environments: abundance of information consumes the scarce attention of recipients and creates a need to allocate that attention (Simon 1971). These accounts differ in level and purpose, yet both support a basic research-praxis point. Increased informational availability does not remove selection; it can intensify the problem of selection.

Definition 6.157 (Research attention allocation). *Research attention allocation* is the distribution of finite observational, interpretive, temporal, computational, and institutional effort among potentially research-relevant encounters, objects, questions, and relations.

Attention allocation is broader than conscious concentration by an individual researcher. Search interfaces, literature databases, conference programmes, citation systems, review procedures, laboratory schedules, grant calls, journal scopes, data pipelines, and institutional priorities can all participate in determining what receives sustained attention. The resulting allocation may be explicit or emerge from many lo-

cal decisions.

Attention also has temporal structure. A phenomenon can receive a brief burst of attention without generating sustained inquiry, while another can acquire durable salience through repeated observation, institutional commitment, or cumulative evidence. Research praxis therefore needs to distinguish immediate attentional capture from longer-term allocation of investigative effort.

Proposition 6.158 (Attention and research trajectory). *Because sustained inquiry requires selective allocation of finite effort, patterns of attention can materially condition which encounters develop into articulated problems, preserved evidence, mature theories, or practical interventions.*

Proposition 6.158 does not imply that attention creates the truth of what is studied. It states that attention helps organize which parts of a partially accessible field receive the work required for stronger warrant.

6.11.3 Surprise

Surprise is one route through which an encounter becomes salient. A result differs from expectation; a participant gives an unanticipated answer; a model fails in an unexpected region; a historical sequence violates an assumed trajectory; an institution behaves differently from analogous cases. Surprise directs attention because an active expectation has been disturbed.

Surprise is therefore relational to an expectation structure. The same event can be surprising to one theoretical framework and unsurprising to another. A novice may be surprised by a regular feature that experts already anticipate, while an expert may notice a subtle deviation invisible to a novice. Surprise consequently provides information about the relation between encounter and prior expectation as well as about the encountered object itself.

Definition 6.159 (Research surprise). *Research surprise* is a salience-generating discrepancy between an encounter and an active expectation, representation, prediction, habitual classification, or anticipated relation within inquiry.

This definition links surprise to the researcher's epistemic-theoretical system developed in Section 137. A surprise can expose a local prediction failure, an omitted variable, a category mistake, an unmodeled boundary condition, a historically novel process, or a more fundamental inadequacy in the current theory. The appropriate interpretation remains open at the moment of salience.

Caution 6.160 (Surprise and novelty). Surprise should not be treated as direct evidence that the encountered phenomenon is objectively novel, theoretically deep, or historically unprecedented. It can arise from limited prior knowledge, local expectation, instrumentation, or an inappropriate comparison class.

Surprise therefore invites inquiry rather than completing it. Its research value lies partly in making expectation structures inspectable.

6.11.4 Contrast

Contrast produces salience when an encounter stands out relative to neighboring cases, alternatives, baselines, or representations. Differences in magnitude, direction, category, timing, spatial position, relational role, or visual form can all make

something prominent. Contrast is especially important because research often depends on comparative organization: without a background or reference class, many differences cannot become perceptually or analytically salient.

Behavioral-economic salience theory offers a specific formal example in which attributes that stand out relative to alternatives receive disproportionate decision weight (Bordalo et al. 2012). GRE uses *research salience* more broadly and does not assume the same mechanism. The comparison is nevertheless useful because it emphasizes that salience can depend on relational contrast rather than absolute magnitude.

A contrast can be generated by research design. Comparative cases, counterfactual models, visualizations, standardized measures, difference-in-differences structures, historical periodization, or alternative textual interpretations can make previously diffuse variation visible. Design therefore participates in the production of salience. A researcher who changes the comparison set can change what stands out even when the underlying observations remain unchanged.

Definition 6.161 (Contrast-generated salience). *Contrast-generated salience* is prominence produced through the relation between an encounter and a comparison structure that makes a difference more inspectable than it was within the previous research configuration.

The epistemic implication is double. Deliberate comparison can reveal important structure, yet poorly chosen contrasts can manufacture prominence around incidental differences. Comparison design therefore belongs to the provenance of salience.

6.11.5 Repetition

Section 6.10 treated repetition as a form of encounter. Repetition can also generate salience. An isolated irregularity can be dismissed as noise, while recurrence across observations, sites, actors, periods, or instruments can make the pattern difficult to ignore. The research significance of repetition, however, depends on more than frequency alone.

Repeated exposure can operate in several directions. Recurrence may increase salience because it suggests persistence or reproduction. It may also reduce salience through habituation: a phenomenon becomes so familiar that it recedes into the background. Routine administrative exclusion, chronic infrastructural failure, persistent unpaid work, or stable measurement bias may become less noticeable precisely because they are ordinary. Repetition therefore has an ambiguous relation to attention.

Proposition 6.162 (Dual effect of repetition on salience). *Repetition can increase salience when recurrence becomes evidence of a pattern requiring explanation, while repeated familiarity can also normalize a phenomenon and reduce its attentional prominence.*

This dual effect matters for research praxis. A method designed only to detect unusual deviations may systematically under-attend to persistent conditions that are important because they are stable. Conversely, a method that treats every recurrence as evidence of common generation can confuse repeated manifestation with shared mechanism. The epistemic task is to reconstruct what the repetition represents and how the attention regime responds to familiarity.

Remark 6.163 (Ordinariness as a research problem). The absence of surprise should

not be treated as evidence of the absence of significance. Durable relations can become epistemically backgrounded through familiarity, institutional normalization, or routine measurement.

This point prepares the later discussion of importance without initial salience.

6.11.6 Anomaly

Anomaly is another route from encounter to salience. Section 143 described an anomaly as an encounter that sits uneasily with an active expectation, category, model, or procedure. Here the focus shifts to what happens when that mismatch captures research attention.

Kuhn's historical account of normal science is relevant because anomalies acquire meaning within paradigmatically organized puzzle-solving rather than as theory-independent facts announcing their own importance (Kuhn 1962). GRE retains this contextual lesson while avoiding a direct transfer of Kuhn's larger historical model. An anomaly becomes salient relative to a research architecture that specifies what counts as expected, residual, failed, or unresolved.

Some anomalies deserve sustained attention because they reveal a systematic mismatch. Others disappear after correction of coding errors, instrument calibration, sampling artifacts, or misclassification. Still others remain unresolved for long periods without becoming decisive. Salience is therefore an invitation to diagnostic work rather than a verdict on theoretical status.

Definition 6.164 (Anomaly salience). *Anomaly salience* is the prominence acquired by an encounter because it conflicts with, escapes, or remains insufficiently represented by an active expectation, category, model, or research procedure.

Proposition 6.165 (Anomaly triage). *The appropriate response to a salient anomaly is to discriminate among possible sources of mismatch—including data production, instrumentation, representation, boundary choice, model specification, historical transformation, and the target process itself—before assigning broader theoretical significance.*

Anomaly triage keeps the research process open to revision while preventing every mismatch from being inflated into a foundational crisis.

6.11.7 Salience without Importance

Salient objects can be unimportant. Novelty, vividness, controversy, large effect size, visual contrast, institutional publicity, or technical sophistication can attract attention without corresponding to the most consequential research problem. The gap between salience and importance is therefore not an exceptional failure; it is a structural possibility whenever attention is selectively organized.

Research salience can be amplified by publication incentives, available datasets, methodological fashion, dramatic cases, reputational competition, or the ease with which a phenomenon can be represented. A highly measurable problem may receive more attention than a difficult-to-measure relation whose effects are more consequential. A spectacular failure can dominate discussion while routine processes generate larger cumulative effects. A technically challenging question can attract effort because it is tractable within existing methods even when its substantive importance remains modest.

Definition 6.166 (Salience–significance gap). A *salience–significance gap* occurs when the degree of attention attracted by an encounter or problem diverges materially from the significance later warranted for the relevant epistemic, theoretical, practical, or normative purpose.

The definition is retrospective only in part. Researchers can often identify reasons to suspect such a gap before significance is settled: attention may be driven by media visibility, instrument convenience, novelty, disciplinary fashion, or one unusually dramatic case. These signals do not justify dismissing the salient object. They justify making the source of salience explicit.

Caution 6.167 (Attentional prominence). Attentional prominence should not be used as a proxy for explanatory depth, social importance, normative urgency, or generative potential without an additional argument connecting the source of salience to the relevant criterion of significance.

Section 145 will develop that additional judgment problem.

6.11.8 Importance without Initial Salience

The converse problem is equally important. A phenomenon can matter greatly while initially attracting little attention. Its effects may be slow, distributed, familiar, weakly represented, institutionally inconvenient, difficult to measure, or located outside established disciplinary categories. Importance can therefore precede salience in the world even when recognition of importance follows salience in the research process.

Several classes of case are especially vulnerable to low initial salience. Background infrastructures can be noticed mainly when they fail. Maintenance work can disappear behind visible innovation. Long-horizon ecological change can be difficult to perceive within short research cycles. Informal relations can leave fewer administrative traces than formal transactions. Distributed contributions can be overshadowed by visible outcome points. Common experiences can be treated as analytically uninteresting because they lack contrast. These examples differ substantively, yet they share a research-praxis problem: what matters may not automatically solicit attention.

Definition 6.168 (Latent research importance). *Latent research importance* is the condition in which an object, relation, process, or problem possesses potentially substantial epistemic, theoretical, practical, or normative relevance while remaining weakly salient within the active attention regime of inquiry.

Latent importance is difficult to detect precisely because the relevant object is not already prominent. Methodological pluralism, historical comparison, participation by differently positioned researchers and communities, long-horizon observation, preservation of low-salience traces, and deliberate examination of background conditions can all enlarge the chance that such objects become available for judgment. Longino's emphasis on critical interaction among differently positioned inquirers is relevant here because heterogeneous perspectives can expose background assumptions and neglected evidence that remain invisible within a more homogeneous research community (Longino 1990).

Proposition 6.169 (Search beyond salience). A *research praxis concerned with generative and relational processes* should allocate some investigative capacity to low-

salience background relations, slow transformations, ordinary practices, and weakly represented phenomena when there are reasons to suspect that conventional attention mechanisms systematically under-register them.

The proposition does not require indiscriminate search. It requires awareness that attention regimes have blind spots and that some research effort may need to be directed toward what does not naturally stand out.

6.11.9 Historical Distribution of Attention

Research attention is historically distributed. The same object can be central in one period and peripheral in another because instruments, concepts, public problems, political conditions, disciplinary structures, or available archives change. Historical shifts can also reorganize the background against which salience is produced. A phenomenon that once appeared ordinary can become newly problematic; an older controversy can lose attention despite remaining unresolved; new categories can make previously dispersed evidence mutually legible.

Kuhn's account of normal science illustrates one way in which historically organized research traditions structure puzzle selection and expectations (Kuhn 1962). Hacking's historical work on categories and styles of reasoning provides another relevant lineage for understanding how objects of inquiry become available through historically formed conceptual and classificatory conditions (Hacking 2002). GRE adds a praxis emphasis: historical conditions distribute not only concepts but also attention, instruments, time, repositories, career incentives, and pathways through which encounters can become sustained research problems.

Definition 6.170 (Historical attention regime). *A historical attention regime is a temporally situated configuration of concepts, problems, instruments, institutions, practices, and expectations that conditions which research encounters are likely to become salient and which are likely to remain backgrounded.*

Historical attention regimes can create cumulative advantages. Once a problem receives sustained study, it generates methods, datasets, terminology, specialized journals, trained researchers, and funding structures that make further work easier. Another problem of comparable or greater importance may remain difficult to study because it lacks such infrastructure. This path dependence does not make established research illegitimate. It makes the historical production of salience relevant to understanding why some knowledge domains become dense while others remain sparse.

Remark 6.171 (Retrospective salience). Later historical developments can make earlier traces newly salient. Such retrospective salience should be distinguished from the attention actually available to historical actors at the time.

The distinction protects historical interpretation from projecting present priorities backward while still allowing later research to reorganize the evidential field.

6.11.10 Institutional Distribution of Attention

Attention is also institutionally distributed. Research organizations, funders, journals, universities, laboratories, data infrastructures, professional associations, states, firms, communities, and digital platforms participate in selecting which questions receive resources and visibility. Institutional attention is not reducible to intentional

agenda setting by a single actor. It can emerge from funding rules, evaluation metrics, administrative categories, publication formats, infrastructure investments, ethical restrictions, proprietary access, or accumulated disciplinary routines.

Simon's analysis of attention under information abundance is especially relevant at this organizational level because institutions must allocate scarce attentional capacity among competing informational demands (Simon 1971). The allocation becomes epistemically consequential when it determines which encounters are investigated deeply enough to produce cumulative evidence. Institutional organization can therefore amplify salience through repeated calls, dedicated programmes, specialist venues, standardized indicators, or data availability.

Definition 6.172 (Institutional attention allocation). *Institutional attention allocation* is the distribution of organizational visibility, time, resources, infrastructure, evaluative recognition, and access across research objects, questions, methods, and communities.

Institutional allocation can productively concentrate effort. Complex scientific problems often require durable infrastructures and coordinated communities. Concentration nevertheless has opportunity costs. Resources directed toward one research trajectory are unavailable elsewhere, and institutional categories can make some problems easier to articulate than others. A relational account therefore examines both the knowledge generated by concentrated attention and the alternatives left weakly developed.

Proposition 6.173 (Institutional salience and epistemic plurality). *When institutional attention is strongly concentrated, maintaining epistemic plurality requires channels through which low-salience questions, alternative representations, minority interpretations, and emerging objects can remain visible enough to receive critical examination.*

This proposition connects attention to the later sections on methodological pluralism, researcher power, epistemic justice, collective knowledge production, and open cumulative research practice. Its immediate point is narrower: salience is partly produced by institutional relations, and those relations shape the future research field.

The distinction established across this section can now be stated clearly. Encounter concerns what becomes available to inquiry. Salience concerns what becomes sufficiently prominent to attract or sustain attention. Significance concerns the further judgment that an encountered and perhaps salient object matters according to specified epistemic, theoretical, practical, aesthetic, or normative criteria. Surprise, contrast, repetition, and anomaly can generate salience, yet none guarantees importance. Historical and institutional arrangements distribute attention unevenly, making some objects highly visible and leaving others weakly attended despite possible importance. Research praxis therefore requires both responsiveness to salience and disciplined distance from it. Section 145 turns to the next problem: the forms of judgment through which researchers attribute significance, select worthy questions, and evaluate generative promise.

6.12 Judgment in Research

Section 6.11 distinguished encounter, salience, and significance. An encounter can become prominent without thereby becoming important, while an important relation or problem can remain weakly salient within an established attention regime. The

present section develops the mediating problem of judgment. Its role is to explain how researchers move from selective prominence toward provisional assessments of epistemic, theoretical, practical, aesthetic, or normative significance. The objective is neither to reduce judgment to subjective preference nor to turn it into an algorithmic ranking procedure. Instead, the section treats research judgment as a historically situated, relationally conditioned, evidence-constrained, and revisable moment of praxis. The discussion distinguishes aesthetic, epistemic, and normative judgment; examines the attribution of significance and the worthiness of questions; separates difficulty from importance; analyzes elegance, surprise, and generative promise; and concludes with the plurality, conflict, and revisability of research judgment. This prepares Section 146, where judgment begins to orient the selection and sustained organization of inquiry.

Definition 6.174 (Research judgment). A *research judgment* is a provisional assessment through which an encounter, question, representation, explanation, method, or research trajectory is evaluated relative to one or more epistemic, theoretical, practical, aesthetic, or normative criteria within a specified research context.

Definition 6.174 makes judgment broader than verification. Some judgments concern whether evidence warrants a claim; others concern whether a question is worth sustained inquiry, whether a representation exhibits useful simplicity or coherence, whether a research trajectory is ethically acceptable, or whether an unexpected finding has sufficient generative promise to preserve and develop. These judgments can interact while remaining analytically distinct.

6.12.1 Aesthetic Judgment

Aesthetic judgment enters research when researchers experience or assess qualities such as elegance, economy, symmetry, simplicity, depth, surprising fit, explanatory shape, or a sense that disparate elements belong together. Such judgments can arise before a complete evidential account is available. A conjecture can appear beautiful before it is proved; a model can appear elegant before its empirical limits are known; a research question can feel generative before its tractability is established.

Kant's analysis of aesthetic judgment provides a classical philosophical vocabulary for distinguishing judgments of taste from straightforward determinations of objective properties, while emphasizing their distinctive claim to communicability (Kant 1987). GRE does not import Kant's aesthetics as a general theory of scientific judgment. The relevant lesson is narrower: an aesthetic response can have a recognizable structure without functioning as a direct measurement of truth. Dewey's processual account of aesthetic experience is also pertinent because it places aesthetic quality within temporally organized interaction rather than treating beauty as a detached property of an isolated object (Dewey 1934).

Definition 6.175 (Aesthetic research judgment). An *aesthetic research judgment* is an assessment of the form, coherence, economy, elegance, surprise, felt fit, or generative appeal of a research object, question, representation, explanation, or trajectory, made without treating those qualities as sufficient evidence of truth or normative desirability.

Aesthetic judgment can be epistemically productive because it helps allocate attention. A researcher may notice an unexpectedly compact relation, a symmetry among cases, a striking mismatch, or an elegant reformulation that makes previously discon-

nected observations mutually intelligible. The judgment can motivate further investigation even when its evidential status remains provisional.

Scientific history also cautions against treating aesthetic preference as timeless. McAllister's analysis of aesthetic evaluations in science shows that criteria of beauty and preference in theory assessment can themselves have histories and can shift during scientific change (McAllister 1996). Aesthetic judgment can therefore be research-generative while remaining historically formed and open to correction.

Caution 6.176 (Aesthetic warrant). Aesthetic attractiveness can justify attention, preservation, comparison, or further inquiry, yet it does not by itself establish empirical adequacy, explanatory correctness, causal attribution, or normative legitimacy.

6.12.2 Epistemic Judgment

Epistemic judgment concerns whether a claim, explanation, representation, or method is sufficiently supported for the purpose at hand. It draws on the architecture developed in Chapter 5: provenance, manifestation, boundary and scale, uncertainty, alternative explanations, historical conditions, and revisability all affect what can responsibly be claimed.

Definition 6.177 (Epistemic research judgment). An *epistemic research judgment* is an assessment of the warrant, reliability, explanatory adequacy, inferential reach, uncertainty, or revisability of a research claim or representation relative to specified evidence and scope conditions.

Epistemic judgment is required because evidence rarely interprets itself. Researchers decide whether a discrepancy is material, whether a representation is sufficiently adequate for its target, whether an inference exceeds its evidential base, whether alternative explanations remain live, and whether a claim is mature enough for provisional acceptance. Such judgments can be disciplined without becoming mechanical.

Longino's account of scientific objectivity as depending partly on critical interaction is relevant because it locates epistemic evaluation within practices of criticism, uptake, and heterogeneous perspectives rather than within isolated individual cognition alone (Longino 1990). Popper's emphasis on criticism and continuing exposure of theories to possible refutation provides another important lineage for treating epistemic judgment as provisional rather than final (Popper 2002). GRE retains this revisability while allowing that different claims require different evidential architectures.

Proposition 6.178 (Scope-sensitive epistemic judgment). *The adequacy of an epistemic judgment depends on the relation among the claim, evidence, representation, boundary, scale, temporal horizon, and uncertainty profile rather than on a context-free level of confidence alone.*

Proposition 6.178 prevents strong local warrant from being silently transported to broader claims. A finding can be well supported within one setting while remaining uncertain across another population, historical period, scale, or relational configuration.

6.12.3 Normative Judgment

Research judgment also has normative dimensions. Researchers and institutions assess whether questions should be pursued, whether methods impose acceptable burdens, whether classifications are harmful, whether data access is legitimate, whether participation is fair, whether foreseeable uses require caution, and whether some knowledge should be preserved, restricted, or contested. These judgments are distinct from judgments of truth while remaining capable of shaping what research becomes possible.

Definition 6.179 (Normative research judgment). A *normative research judgment* is an assessment concerning the permissibility, responsibility, fairness, value, priority, or practical acceptability of a research object, question, method, relation, representation, or foreseeable consequence.

Dewey's theory of valuation is useful here because it treats valuation as situated activity involving desires, ends, appraisals, and consequences rather than as the passive recognition of fixed value properties (Dewey 1939). GRE extends this situated orientation by asking which relations and generative effects participate in the formation of research values and priorities.

Normative judgment does not authorize researchers to replace evidence with preferred outcomes. A method can be normatively attractive while producing weak evidence, and an empirically robust finding can arise from a research process that raises serious ethical concerns. Maintaining this distinction is necessary for transparent research praxis.

Remark 6.180 (Normative conditions and epistemic consequences). Normative constraints can have epistemic consequences because they alter access, participation, admissible intervention, data preservation, and representational practice. Their epistemic effects should therefore be analyzed without reducing the normative judgment itself to an epistemic one.

The broader relation between aesthetic and normative conditions across research- and application-dominant praxis will be developed later in Section 159. The present section remains focused on how such judgments operate within research significance and question selection.

6.12.4 Attribution of Significance

Significance is attributed when a researcher or research community judges that an encounter, relation, anomaly, question, result, or representation matters relative to a specified horizon. The horizon may be epistemic, theoretical, methodological, practical, historical, normative, or aesthetic. Attribution is therefore stronger than salience and more structured than immediate interest.

Definition 6.181 (Research significance attribution). A *research significance attribution* is a provisional judgment that an encounter, object, question, relation, finding, or representation warrants sustained attention because of its expected or demonstrated relevance to one or more specified research aims or value horizons.

Significance attribution should identify the relevant criterion. A result may matter because it challenges a central assumption, opens a new measurement pathway, connects previously separated literatures, reveals a neglected population, threatens an established intervention, preserves a historically fragile trace, or exposes a relation

with large downstream consequences. These are different grounds for significance and should not be compressed into a single language of “importance.”

The distinction also creates room for uncertainty. Significance can be attributed prospectively, before its consequences are known, or retrospectively, after later developments reveal that an earlier encounter mattered more than initially recognized. Deferred significance from Section 143 is one case of such retrospective reorganization.

Proposition 6.182 (Explicit significance criterion). *When significance influences substantial allocation of research attention, resources, representation, or institutional support, the principal criterion or criteria through which significance is being attributed should be made as explicit and contestable as the research context reasonably permits.*

This requirement does not eliminate judgment. It makes the basis of judgment available for criticism and later revision.

6.12.5 Worthiness of Questions

A research question can be grammatically well formed, technically tractable, and answerable with available methods while still being judged unworthy of sustained inquiry. Conversely, a difficult or presently unanswerable question can be worth preserving because it exposes a deep conceptual tension, opens a new empirical domain, connects otherwise separated problems, or may become answerable under future methods and evidence.

Peirce’s insistence that genuine inquiry begins from real and living doubt is relevant here because it distinguishes substantive uncertainty from merely placing propositions into interrogative form (Peirce 1877). Dewey similarly treats inquiry as emerging from problematic situations that require reconstruction rather than from questions detached from lived or intellectual difficulty (Dewey 1910).

Definition 6.183 (Question worthiness judgment). *A question worthiness judgment is a provisional assessment that a research question deserves preservation, formulation, or sustained inquiry because of its potential contribution to knowledge, explanation, methodological development, practical understanding, normative clarification, or future generative possibility.*

Question worthiness is not identical to immediate utility. Some questions matter because they reorganize a field, reveal the inadequacy of existing categories, or prepare conceptual resources whose later uses cannot yet be specified. Nor is worthiness identical to novelty. A familiar question can become newly worthy when historical conditions change, new evidence becomes available, or neglected relations become visible.

Caution 6.184 (Question prestige). The prestige of a question, the reputation of those pursuing it, or the institutional resources already attached to it should not be treated as sufficient evidence of its research worthiness.

The judgment of worthy questions therefore links the current section to Section 146, where inquiry becomes oriented through selection and sustained commitment.

6.12.6 Difficulty without Significance

Research cultures can easily conflate technical difficulty with intellectual significance. A proof may be extraordinarily hard, a model computationally demanding, an experiment expensive, or a dataset difficult to obtain. These features can indicate genuine methodological achievement, yet they do not establish that the underlying question matters according to epistemic, theoretical, practical, or normative criteria.

Difficulty is relational to available capacities. A problem can be hard because methods are immature, data are inaccessible, institutions impose friction, or the object is genuinely complex. Conversely, a consequential question can become technically easy once a suitable representation or instrument is developed. Difficulty therefore measures a relation among problem, method, infrastructure, and current capability rather than significance itself.

Definition 6.185 (Research difficulty). *Research difficulty* is the degree of intellectual, technical, evidential, computational, organizational, or material demand imposed by a research task relative to the capacities and infrastructures available to a specified research configuration.

Proposition 6.186 (Difficulty–significance separation). *Research difficulty and research significance should be evaluated on distinct dimensions because a task can be difficult yet weakly significant, or highly significant yet comparatively tractable under current conditions.*

This separation matters especially under scarce attention. If difficulty itself becomes a prestige signal, research systems can allocate disproportionate effort toward technically impressive but weakly generative problems while background questions with substantial long-horizon importance remain neglected. The opposite error is also possible: technically modest work can be underestimated despite providing crucial descriptive, archival, maintenance, replication, or integrative functions.

Difficulty can still matter indirectly. Solving a difficult problem can generate methods, instruments, datasets, or concepts with broader applicability. In that case, significance arises from the generated capacities or relations, not from difficulty alone.

6.12.7 Elegance, Surprise, and Generative Promise

Elegance and surprise can become especially powerful research signals when they suggest that a small conceptual change may reorganize a larger problem-space. A compact model can connect previously separated observations; an unexpected symmetry can reveal a hidden relation; a surprising empirical result can expose a new mechanism; an elegant question can make a previously diffuse domain investigable.

McAllister’s work on aesthetic evaluation in science is relevant because it documents the role of aesthetic criteria in theory assessment while emphasizing their historical variability (McAllister 1996). GRE adds the idea of *generative promise*: an aesthetic or surprising encounter can matter because it appears capable of generating further questions, representations, methods, explanations, or research relations.

Definition 6.187 (Generative promise in research). *Generative promise in research* is a provisional judgment that an encounter, question, concept, representation, or result may generate a comparatively rich set of subsequent inquiries, distinctions, methods, explanations, or empirical access pathways if developed further.

Generative promise is prospective. It cannot be fully known at the time of judg-

ment because the future trajectory has not yet occurred. A researcher may therefore preserve or develop an elegant conjecture because of the possibilities it opens while clearly distinguishing this prospective judgment from present epistemic warrant.

Proposition 6.188 (Generative-promise discipline). *Judgments of generative promise are most useful when the anticipated forms of further generation are articulated sufficiently to permit later comparison with the trajectory that actually develops.*

This proposition transforms vague enthusiasm into a revisable research expectation. A question thought promising because it may connect domains, expose mechanisms, create data, or generate new formalizations can later be assessed against those anticipated pathways.

6.12.8 Historical Formation of Research Taste

Researchers do not encounter elegance, importance, rigor, or promising questions from outside history. Disciplinary training, canonical examples, available instruments, dominant theories, funding systems, publication conventions, and prior successes all contribute to the formation of research taste. What appears obvious, beautiful, trivial, profound, rigorous, or fashionable can therefore vary across periods and communities.

Kuhn's analysis of normal science shows how paradigmatic commitments help organize exemplary problems, standards, and puzzle selection within scientific communities (Kuhn 1962). Bourdieu's analysis of taste, although developed in a wider sociological context, provides a useful counterweight to accounts that treat evaluative preference as socially unconditioned (Bourdieu 1984). McAllister's history of aesthetic evaluation in science provides a more domain-specific precedent for treating scientific aesthetic criteria themselves as historically formed (McAllister 1996).

Definition 6.189 (Research taste). *Research taste* is a historically and relationally formed disposition through which researchers or research communities tend to recognize some questions, forms, explanations, methods, and styles of evidence as especially elegant, interesting, important, promising, or worthy of attention.

Research taste is neither pure arbitrary preference nor a transparent reading of intrinsic significance. It can embody accumulated practical wisdom while also reproducing blind spots. A mature research community may recognize fruitful problem forms rapidly because experience has sedimented into judgment; the same sedimentation can make unfamiliar forms difficult to appreciate.

Remark 6.190 (Taste and inheritance). Research taste should be examined both as a potential repository of historically accumulated judgment and as a possible mechanism through which inherited exclusions, prestige structures, and methodological habits are reproduced.

This double character explains why plurality and revisability become central in the remaining subsections.

6.12.9 Relational Conditions of Judgment

Judgment is conditioned by relations among researchers, institutions, communities, objects, infrastructures, and audiences. Peer review, mentorship, collaboration, disciplinary competition, publication incentives, funding structures, participant relations,

and public controversy can all influence what appears credible, elegant, urgent, or worthwhile. The relational condition of judgment extends the account of researcher position from Section 141 and institutional attention from Section 144.

Definition 6.191 (Relational judgment conditions). *Relational judgment conditions* are the interpersonal, institutional, infrastructural, disciplinary, and historical relations that shape the formation, expression, contestation, uptake, and revision of research judgments.

Longino's emphasis on critical interaction is particularly relevant because judgments can be strengthened when assumptions and standards are exposed to criticism from differently positioned inquirers (Longino 1990). Relational conditioning, however, also creates asymmetry. Junior researchers may suppress judgments that conflict with powerful supervisors; communities with weak institutional representation may struggle to make significance claims visible; proprietary infrastructures can privilege some evaluative standards over others.

The existence of relational conditioning does not imply that judgments reduce to social power. Evidence, internal coherence, reproducibility where appropriate, historical adequacy, explanatory performance, and practical consequences can constrain evaluative communities. The point is that these constraints are interpreted and acted upon through relations.

Proposition 6.192 (Contestable judgment conditions). *Research judgment is strengthened when the conditions through which evaluations are formed and authorized remain sufficiently visible and contestable for alternative evidence, interpretations, and value perspectives to enter critical examination.*

6.12.10 Plurality of Judgment

A single research object can support several legitimate forms of judgment. A model may be elegant yet empirically fragile. A question may be epistemically important but normatively risky. A method may be highly reliable for one target while too costly or exclusionary for another. A result may be theoretically modest but practically consequential. Plurality therefore concerns both multiple criteria and multiple evaluative positions.

Definition 6.193 (Judgment profile). *A judgment profile* is an explicit representation of the distinct aesthetic, epistemic, theoretical, practical, and normative evaluations attached to a research object or trajectory, together with their principal grounds and uncertainties.

The profile prevents premature compression into a single overall score. It also makes disagreement more informative. Two researchers may agree on evidential strength while differing on normative priority, or agree on importance while differing on elegance or methodological feasibility. Making these dimensions explicit can reveal where disagreement actually lies.

Plurality also allows research systems to preserve heterogeneous projects. Some work may prioritize foundational theory, some empirical description, some archival preservation, some instrument building, some replication, some normative analysis, and some application-oriented knowledge. Their significance need not be rendered commensurable through one evaluative metric.

Remark 6.194 (Plurality and commensurability). Plural judgment does not require

that all evaluative dimensions be reducible to a common metric. Comparison can proceed through articulated trade-offs, thresholds, incompatibilities, and domain-specific criteria.

6.12.11 Conflict among Forms of Judgment

Judgments can conflict. An aesthetically elegant model may require assumptions that weaken empirical adequacy. A normatively urgent problem may lack mature methods. A theoretically deep question may offer little immediate practical value. A practically useful classification may obscure relations that matter for explanation or justice. Such conflicts are normal features of research praxis rather than defects that can always be eliminated through better information.

Definition 6.195 (Research judgment conflict). *A research judgment conflict occurs when two or more evaluative dimensions support materially different orientations toward the same research object, question, representation, method, or trajectory.*

Conflict requires articulation of what is being traded off. If an elegant model is retained despite known empirical limitations because it generates useful hypotheses, that role should be stated. If a high-risk line of inquiry is restricted despite epistemic promise, the normative basis should be explicit. If a difficult question is pursued for long-horizon theoretical reasons, immediate utility should not be retroactively invented as justification.

Proposition 6.196 (Non-substitution among judgments). *When aesthetic, epistemic, practical, and normative judgments conflict, strength on one dimension should not be used silently as evidence on another dimension; the relation among the competing judgments should be made explicit.*

This principle is especially important for aesthetic judgment. Elegance can motivate inquiry without substituting for evidence. Normative urgency can motivate resource allocation without establishing causal claims. Empirical robustness can establish a finding without settling whether the research trajectory should receive priority.

6.12.12 Revisability of Research Judgment

Research judgment is revisable because evidence, concepts, methods, values, historical conditions, and downstream consequences change. A question dismissed as trivial can later become central; an elegant theory can lose appeal when its hidden assumptions become visible; an initially marginal method can become indispensable after new data or instruments appear; a normatively accepted research practice can later be reassessed as affected communities acquire greater representational authority.

Definition 6.197 (Revisable research judgment). *A revisable research judgment is an evaluation whose grounds, scope, historical conditions, and relevant alternatives remain sufficiently inspectable that later evidence, criticism, conceptual change, or practical consequences can alter the judgment without erasing its earlier rationale.*

Revisability does not require indecision. Research communities need provisional commitments in order to allocate attention, resources, and time. The requirement is that commitment preserve enough provenance for later reconstruction. Why was a question judged worthy? Which criteria made a theory elegant? Which uncertainties were accepted? Which alternatives were rejected? Which normative concerns

were considered? Such records make later re-epistemization and institutional learning possible.

Proposition 6.198 (Judgment provenance). *Research judgments that materially shape long-horizon attention, exclusion, resource allocation, or theoretical closure should preserve sufficient provenance for later inquiry to reconstruct the principal criteria, evidence, uncertainties, and relational conditions under which the judgment was made.*

The argument of this section can now be summarized. Salience does not become significance automatically. Significance is attributed through forms of judgment that can be aesthetic, epistemic, normative, theoretical, and practical. These judgments have different criteria and should remain distinguishable even when they interact. Worthy questions are not reducible to difficult questions; elegance and surprise can indicate generative promise without establishing truth; research taste has histories and relational conditions; multiple judgments can coexist or conflict; and judgment remains revisable through preserved provenance and criticism. Section 146 therefore turns from evaluation to orientation: how provisional judgments begin to organize which problems are formulated, which questions receive sustained effort, and how inquiry is directed under uncertain future value.

6.13 Orientation of Inquiry

Section 6.12 established that research judgment mediates between salience and significance. The present section develops the next moment of praxis: orientation. Its role is to explain how provisional judgments begin to organize which problems are formulated, which questions are sustained, which forms of attention are protected, and where finite intellectual and institutional resources are committed. The objective is to make selection visible as part of research rather than treating a research agenda as given before inquiry begins. The discussion proceeds from selection, problem formation, and question formation to attention, intellectual effort, institutional resources, long-horizon commitment, inquiry beyond immediate utility, plural research orientations, and orientation under uncertain future value. The method is relational and historical. Orientation is treated as a configuration among judgments, researchers, institutions, available concepts, infrastructures, time horizons, and anticipated possibilities. This prepares Section 147, where the problem shifts from what receives sustained inquiry to the plurality of methods through which an oriented inquiry can proceed.

6.13.1 Selection before Investigation

Investigation begins within a field that has already been selectively organized. Some phenomena have been named, some records preserved, some variables measured, some anomalies remembered, and some questions granted institutional legitimacy. Even an apparently open-ended inquiry therefore begins after earlier acts of selection. At the level of an individual researcher, selection concerns which encounter is pursued, which doubt is sustained, which literature is read, and which alternative is deferred. At the level of a research institution, selection also concerns funding, staffing, infrastructure, access, publication, and the preservation of work that may matter later.

The selectivity of inquiry follows from finite attention and finite practical capacity. Simon's account of information-rich environments is useful here because it identifies attention as a scarce resource when informational inputs are abundant (Simon 1971). Research faces an analogous condition. The space of possible observations, hypotheses, questions, models, archives, and comparisons is larger than the set that can receive sustained investigation. Selection therefore occurs even where explicit prioritization is absent.

Definition 6.199 (Research orientation). *A research orientation is a provisionally stabilized configuration of judgments, commitments, attention, questions, and resource allocations that directs inquiry toward some problems, objects, relations, and possible futures while leaving others weakly pursued, deferred, or outside the active research horizon.*

Orientation is broader than a topic choice. Two researchers may study the same empirical domain while orienting inquiry toward different relations: one toward mechanism, another toward historical transformation, another toward classification, another toward normative consequences. Likewise, a single orientation can traverse several objects if the organizing problem concerns a relation that appears across them.

Proposition 6.200 (Selection antecedence). *Because sustained investigation requires finite attention, time, and material support, the selection of research objects and problems is analytically prior to many later methodological choices, even when that selection remains revisable during inquiry.*

This proposition gives orientation an epistemic status without treating initial selection as final. Research can encounter evidence that reorganizes its own agenda. The important point is that selection is already active before method selection, measurement, or formal explanation begins.

6.13.2 Problem Formation

A research problem is more structured than an encounter and more open than a determinate research question. It organizes a field of concern by identifying a tension, inadequacy, unexplained pattern, missing relation, practical difficulty, or conceptual instability that deserves sustained inquiry. Dewey's account of reflective thought is especially relevant because a problematic situation requires transformation before it becomes sufficiently determinate for investigation (Dewey 1910). The problem is formed through inquiry into what the difficulty consists in.

Problem formation includes boundary work. A researcher deciding that declining participation is a problem of institutional trust, economic insecurity, administrative burden, demographic change, or measurement can direct the subsequent inquiry toward different relations and evidence. These formulations may overlap, but they do not produce identical research trajectories. Scale and temporal horizon matter as well. A phenomenon framed as a short-run behavioral response can become a different problem when situated within a longer institutional history.

Definition 6.201 (Research problem formation). *Research problem formation is the process through which an indeterminate difficulty, encounter, tension, absence, or possibility is organized into a sufficiently articulated field of inquiry with provisional boundaries, relevant relations, historical context, and criteria for further question formation.*

Problem formation therefore carries inherited assumptions. Concepts determine which differences can be named; archives determine which histories can be reconstructed; measurement systems determine which patterns become visible; institutional classifications determine which populations or events are legible. Section 6.9 established that such working commitments can remain under ontological suspension. The same discipline applies here: a problem can be formulated strongly enough for inquiry without converting its initial representation into a final account of the object.

Remark 6.202 (Problem provenance). For consequential or long-horizon projects, recording how a problem was initially formed can support later revision by making visible the boundaries, concepts, excluded alternatives, and practical concerns that organized the original inquiry.

This record becomes especially important when later evidence reveals that an initially peripheral relation was constitutive of the problem itself.

6.13.3 Question Formation

Question formation narrows a problem into a form that can guide a particular movement of inquiry. A question can seek description, comparison, explanation, mechanism, historical reconstruction, interpretation, evaluation, formal characterization, or practical understanding. Several questions can therefore arise from one problem, and a single question can be reformulated as the relational field becomes better understood.

Peirce's distinction between living doubt and merely verbal questioning remains useful because an interrogative sentence does not by itself establish an active inquiry (Peirce 1877). Dewey similarly treats the determination of a problem as part of reflective investigation rather than as a ready-made input (Dewey 1910). Research on problem finding adds another precedent for distinguishing the generation of a problem from solving a task whose terms are already fixed (Getzels and Csikszentmihalyi 1976).

Definition 6.203 (Research question formation). *Research question formation* is the articulation of a provisional interrogative structure that specifies which property, relation, mechanism, trajectory, interpretation, or evaluation within a research problem is to be investigated and what kind of epistemic advance would count as a meaningful response.

Question formation depends on available representational resources. A new concept can make a previously diffuse relation askable; a new instrument can turn an imperceptible difference into an empirical question; digitized archives can permit comparisons that earlier researchers could not feasibly formulate. Question formation is therefore generative: it can expand the space of subsequent inquiry.

Questions also inherit exclusions. A question framed around average treatment effects can obscure heterogeneous pathways; a question framed around institutional compliance can background lived experience; a question framed around individual preference can exclude relation-level formation of preference. Such limitations do not automatically invalidate the question. They make its orientation explicit and create grounds for complementary questions.

Proposition 6.204 (Question plurality within a problem). *A research problem can sup-*

port several materially different questions whose coexistence reveals distinct epistemic targets rather than a defect requiring immediate reduction to one canonical formulation.

This plurality becomes one basis for the methodological pluralism developed in Section 147.

6.13.4 Research Attention

Salience can initiate attention, but orientation concerns whether attention becomes sustained, organized, and protected over time. Research attention is therefore distinct from momentary notice. It includes repeated return to an object, maintenance of records, reading across a literature, development of instruments, cultivation of expertise, and willingness to preserve unresolved questions through periods of weak immediate payoff.

The scarcity of attention becomes especially consequential when candidate information is abundant (Simon 1971). Research communities can generate more papers, datasets, anomalies, hypotheses, and computational outputs than any individual or institution can examine deeply. Under such conditions, orientation increasingly concerns the governance of sustained attention rather than access to information alone.

Definition 6.205 (Research attention commitment). *A research attention commitment* is a provisional allocation of sustained cognitive and interpretive focus to a problem, question, object, or relation across a specified period, together with practices that preserve continuity of observation, memory, and revision.

Attention commitments can be weak or strong. A low-cost exploratory scan may preserve many possibilities. A strong commitment may involve years of specialist training, repeated field access, or maintenance of a longitudinal dataset. The strength of commitment should therefore be distinguished from the significance initially attributed to the problem. High significance can justify exploration without yet justifying deep commitment, while modest early salience can later develop into a durable programme.

Attention also has opportunity costs. Sustained focus on one line of inquiry can reduce sensitivity to others. Section 6.11 showed that institutional attention regimes can amplify this effect. Research orientation should therefore include some capacity to review what sustained attention is displacing.

6.13.5 Allocation of Intellectual Effort

Intellectual effort includes more than time spent reading or writing. It includes conceptual development, model construction, archival reconstruction, language acquisition, instrument learning, replication, coding, field immersion, negative-result analysis, and the difficult work of maintaining questions whose answers remain uncertain. Allocation of such effort gives orientation a practical form.

Definition 6.206 (Intellectual effort allocation). *Intellectual effort allocation* is the distribution of finite cognitive, interpretive, technical, and learning capacity across research problems and activities in light of their judged significance, uncertainty, feasibility, generative promise, and opportunity costs.

This allocation rarely follows a single metric. A highly significant question may re-

ceive modest effort because evidence is currently inaccessible. A technically tractable subproblem may receive concentrated effort because solving it creates infrastructure for later work. A replication may deserve attention despite low novelty because it stabilizes a field. An exploratory project may deserve limited resources because its expected informational gain is high even though its probability of success is uncertain.

The allocation problem is therefore dynamic. Learning can change feasibility, and feasibility can change significance. A researcher who acquires a language or method may suddenly gain access to a domain that had previously been too costly to investigate. Conversely, a project can become less worthy of continued effort when its assumptions fail repeatedly or when another research group resolves the core uncertainty.

Proposition 6.207 (Revisable effort allocation). *Intellectual effort should be treated as a revisable commitment whose continuation depends partly on evidence generated during the research trajectory, rather than as a sunk justification for preserving an orientation unchanged.*

This reduces the pressure to defend an existing project merely because substantial effort has already been invested in it.

6.13.6 Allocation of Institutional Resources

Research orientation becomes institutional when it allocates laboratories, archives, compute, grants, staff, field access, publication space, data infrastructure, and durable organizational attention. These allocations can shape the future research field because resources affect which questions become feasible and which capabilities survive between projects.

The sociology of undone science provides a particularly direct precedent. Frickel and colleagues show that socially identified research needs can remain unfunded, incomplete, or institutionally neglected, making patterns of non-knowledge visible as objects of analysis (Frickel et al. 2010). Kuhn's account of normal science likewise shows that disciplinary organization supports some legitimate problem forms and standards while leaving others peripheral (Kuhn 1962). Longino's emphasis on critical interaction adds the importance of institutional conditions that allow alternative assumptions and evidence to enter effective scrutiny (Longino 1990).

Definition 6.208 (Institutional research allocation). *Institutional research allocation* is the distribution of organizational resources, infrastructures, access rights, evaluative attention, and preservation capacity among competing or complementary research orientations.

Institutional allocation has a generative effect. A funded instrument creates future measurement possibilities. A maintained archive enables questions that can be asked decades later. A training programme creates communities capable of interpreting specialized evidence. Conversely, discontinuing an infrastructure can close future inquiry even when its present output appears modest.

Proposition 6.209 (Resource-generativity). *Institutional research allocations should be evaluated partly by the capacities, access pathways, archives, communities, and future research options they generate or maintain, in addition to their immediate outputs.*

This proposition does not imply that every infrastructure deserves indefinite con-

tinuation. It requires that closure decisions consider the loss of future capability as well as current utilization.

6.13.7 Long-Horizon Commitment

Some inquiries require commitment across a horizon longer than ordinary evaluation cycles. Longitudinal observation, language acquisition, preservation of endangered archives, slow theoretical development, ecological monitoring, replication programmes, and institution-building can produce little visible output during early phases. Their epistemic value depends partly on continuity.

Definition 6.210 (Long-horizon research commitment). *A long-horizon research commitment is a sustained orientation toward a problem, infrastructure, evidential field, or capability whose expected epistemic or generative contribution depends materially on continuity across a period longer than short-cycle project evaluation.*

Long-horizon commitment creates two opposing risks. Premature withdrawal can destroy accumulated capability and make certain questions impossible to answer. Excessive persistence can produce lock-in, insulating inherited questions or methods from counterevidence. The solution is not continuous instability. Long-horizon projects often require stable rules, personnel, and infrastructures precisely so that they can generate interpretable histories.

A disciplined long-horizon commitment therefore combines continuity with periodic review. Review can ask whether the original problem remains significant, whether the evidence trajectory supports continued investment, whether the project has generated unexpected capabilities, whether neglected alternatives have become more compelling, and whether the conditions under which the commitment was made have changed.

Proposition 6.211 (Continuity with review). *Long-horizon inquiry is strengthened when continuity of core evidential or infrastructural functions is paired with explicit intervals for revising the problem formulation, evaluative criteria, and justification for continued commitment.*

This arrangement preserves cumulative possibility while keeping research judgment revisable.

6.13.8 Inquiry beyond Immediate Utility

Research orientation cannot be exhausted by presently specifiable utility. Some inquiries begin from curiosity, conceptual tension, historical interest, aesthetic attraction, or a desire to understand a relation whose later consequences are unknown. Veblen's discussion of "idle curiosity" provides an early economic-social account of knowing that is not ordinarily directed by an immediate utilitarian aim, while also recognizing that knowledge acquired through such inquiry can later become technologically consequential (Veblen 1914).

Inquiry beyond immediate utility should not be romanticized. Finite resources, ethical risk, opportunity cost, and public responsibility still apply. The point is that present utility is only one evaluative dimension. A project can be worthy because it preserves evidence, clarifies a conceptual problem, creates a method, generates unexpected connections, or enlarges the future space of questions even when a direct

application cannot yet be named.

Definition 6.212 (Inquiry beyond immediate utility). *Inquiry beyond immediate utility* is research whose present justification rests substantially on epistemic, conceptual, historical, exploratory, aesthetic, or generative grounds whose future practical uses remain unspecified or uncertain at the time of commitment.

The distinction between immediate utility and eventual use matters. Later application does not retroactively transform the original motivation into an instrumental one. Conversely, the possibility of unforeseeable future use is too weak to justify every speculative project. Orientation still requires judgment concerning significance, cost, risk, neglected alternatives, and the kind of possibility the inquiry is expected to preserve or generate.

Remark 6.213 (Non-instrumental justification and responsibility). A research orientation can be justified without immediate application while remaining answerable to ethical constraints, resource limits, and the consequences generated by the practices through which inquiry is conducted.

This preserves exploratory freedom within the broader field of praxis established in Section 6.1.

6.13.9 Plural Research Orientations

A healthy research field can contain several orientations at once. Some work can be descriptive, some explanatory, some interpretive, some historical, some formal, some methodological, some archival, some critical, some normative, and some application-directed. Their contributions can unfold on different timescales and through different kinds of output. The plurality of research judgment established in Section 6.12 therefore has an institutional analogue: a research system need not compress all orientations into one ranking criterion.

Longino's account of social epistemology provides one basis for valuing heterogeneous perspectives within critical communities (Longino 1990). Habermas's analysis of knowledge and human interests, despite belonging to a different theoretical tradition, also illustrates how inquiry can be organized by distinct epistemic orientations rather than one uniform relation to knowledge (Habermas 1971). GRE does not adopt either framework as a complete taxonomy. Their relevance lies in resisting the assumption that all research must be justified through one orientation.

Definition 6.214 (Research orientation portfolio). A *research orientation portfolio* is a deliberately plural configuration of research commitments whose differences in target, method, time horizon, evidential form, and evaluative criterion are preserved while their complementarities, tensions, and resource demands remain open to comparison.

Plurality reduces some forms of epistemic fragility. If an entire field follows the same fashionable problem, uses the same dataset, and shares the same horizon of value, it can become highly productive while remaining blind to alternative objects and histories. Heterogeneous orientations preserve paths through which overlooked evidence or concepts can later re-enter inquiry.

Plurality also has limits. Unlimited diversification can fragment expertise and make cumulative work difficult. Orientation therefore involves composition: deciding which differences should be maintained, which infrastructures can be shared,

where duplication is useful, and which forms of coordination enable heterogeneous work without forcing premature unification.

6.13.10 Orientation under Uncertain Future Value

Research orientation reaches its most difficult form when the future value of inquiry is uncertain. The future epistemic importance of a concept, dataset, archive, instrument, or theory can depend on developments that are currently unforeseeable. Even the criteria by which future communities evaluate research can change. Orientation therefore cannot always maximize a known future payoff.

Definition 6.215 (Uncertain future research value). *Uncertain future research value* is the condition in which the later epistemic, methodological, practical, historical, or generative contribution of a research orientation cannot be specified with sufficient confidence at the time when attention or resources must nevertheless be allocated.

This condition does not eliminate judgment. It changes the form of judgment. Present evidential grounding still matters. So do generative promise, neglectedness, preservation costs, reversibility of commitment, complementarity with other work, potential harms, and the capacity of a project to generate reusable knowledge or infrastructure. A high-uncertainty orientation can sometimes justify a staged commitment: enough support to preserve and explore the possibility, followed by later review as evidence accumulates.

The problem becomes sharper when systems can cheaply generate many candidate hypotheses, analyses, or questions. Abundance of candidates increases the relative importance of orientation because human and institutional capacities for validation, interpretation, sustained attention, and responsible commitment remain limited. The dedicated discussion of AI-assisted research later in this chapter will examine those conditions more directly. At the present stage, the point is structural: reduction in the cost of candidate generation does not remove the scarcity of orientation.

Proposition 6.216 (Orientation under uncertain future value). *When future research value is materially uncertain, a defensible orientation combines explicit present grounds for significance with staged or revisable commitment, preservation of provenance, attention to generated capabilities and foreclosed alternatives, and sufficient plurality to avoid making one uncertain forecast govern the whole research field.*

This proposition completes the movement from judgment to orientation. Research praxis must select before it can investigate exhaustively; form problems before it can pose determinate questions; allocate attention and resources before future value is fully known; and preserve plural orientations when uncertainty is irreducible. Orientation therefore establishes the practical field within which methods are subsequently chosen. Section 147 turns to that next problem. Once a question has acquired sufficient orientation to justify inquiry, methodological pluralism concerns how different modes of epistemic access can be selected, combined, compared, and allowed to correct one another without assuming that one method possesses universal priority.

6.14 Methodological Pluralism

Section 6.13 established that research orientation organizes which problems and questions receive sustained attention before the future value of inquiry is fully

known. The present section turns from orientation to the methodological constitution of inquiry. Its role is to explain why Generative Relational Theory requires methodological plurality while preserving standards of evidential warrant, conceptual precision, and mutual criticism. The objective is to distinguish plural epistemic access from unrestricted methodological permissiveness. The discussion proceeds through plural modes of access, partial irreducibility, question-first and object-sensitive method selection, historical and relational sensitivity, complementarity, productive methodological tension, and the limits of methodological unification. The method is comparative and relational: methods are evaluated by the kinds of objects, relations, histories, manifestations, and inferential tasks they can render accessible, together with the characteristic remainders they leave. This prepares Section 148, where the principal inquiry modes used throughout the book are differentiated more concretely.

6.14.1 Plural Modes of Epistemic Access

A research object can become epistemically accessible through several different relations. Archival records can disclose historical sequences. Interviews can disclose situated interpretations and remembered relations. Ethnographic observation can disclose interactional organization that remains weakly represented in official documents. Quantitative data can disclose distributions, covariation, heterogeneity, or change across populations and periods. Formal models can make assumptions and structural consequences inspectable. Network representations can disclose patterned relational configurations. Legal and institutional materials can disclose formally recognized rights, obligations, classifications, and procedures. None of these forms of access is simply identical with the object itself.

This plurality follows from the epistemology developed in Chapter 5. Manifestations and traces are mediated, observation is partial, and relational reconstruction depends on boundary, scale, representation, and historical conditions. Different methods therefore enter the evidential field through different trace-production processes. A method can increase visibility along one dimension while leaving another weakly accessible. The possibility of several modes of access does not imply that each mode is equally informative for every claim.

Definition 6.217 (Methodological pluralism). *Methodological pluralism* is the disciplined use and preservation of multiple modes of epistemic access when the research object, question, or evidential field contains properties that cannot be adequately reconstructed through one methodological relation alone.

The definition places the justification for plurality in the relation among object, question, evidence, and method. Pluralism is therefore stronger than the practice of merely adding several techniques to a project. A study can use interviews, regressions, archival documents, and simulations while still imposing one interpretive logic on all of them. Conversely, a project can remain methodologically plural even when one method is dominant if it preserves the possibility that another mode of access can reveal a remainder, counterevidence, or alternative reconstruction that the dominant method cannot absorb.

Longino's account of scientific objectivity is relevant because it locates epistemic strength partly in critical interaction among differently situated perspectives rather than in insulation from such plurality (Longino 1990). GRE extends this intuition to

methodological relations: heterogeneous access can become a source of correction when the differences among methods remain visible.

Proposition 6.218 (Plural access condition). *Methodological plurality is epistemically warranted when materially relevant properties of the research target are differentially accessible through distinct evidential or representational relations and when those differences can alter the warranted form, scope, or confidence of the resulting claim.*

This condition keeps plurality connected to research need. It also opens the question of whether the distinct modes can be fully translated into one another.

6.14.2 Partial Irreducibility of Methods

Methodological plurality becomes theoretically important when methods are only partially reducible to one another. Reduction is possible in some cases. Narrative material can sometimes be coded into variables; qualitative categories can sometimes be operationalized for measurement; a historical sequence can sometimes be represented through a state-transition model. Yet these translations can alter what is retained, what is backgrounded, and what counts as evidence. Section 151 will examine those translation problems directly. The present concern is prior: whether different methods can remain epistemically non-equivalent even when translation is technically possible.

Historical inquiry, for example, can reconstruct sequence, contingency, and category transformation in ways that a cross-sectional statistical representation may not preserve. Statistical inquiry can reveal population-level regularities that local interpretive work may not establish. Ethnographic inquiry can disclose tacit coordination and practical meaning that administrative datasets do not record. Formalization can expose logical dependencies and hidden assumptions that remain diffuse in prose, while formal exactness does not by itself establish that the represented relations correspond adequately to the historical world.

Definition 6.219 (Partial methodological irreducibility). *Partial methodological irreducibility* is the condition in which two methods can overlap in evidential target or representational content while retaining epistemically relevant capacities, distinctions, or remainders that cannot be transferred between them without material loss or transformation.

The term *partial* matters. It resists two symmetrical exaggerations. One would assume complete commensurability, as though every valid historical, interpretive, formal, and empirical claim could ultimately be restated in one universal methodological language. The other would treat methods as isolated worlds lacking grounds for comparison or mutual criticism. GRE adopts neither position. Methods can share objects, evidence, and inferential questions while preserving differences that remain analytically consequential.

Ricoeur's treatment of explanation and understanding provides one precedent for resisting a simple opposition between methodological modes while preserving their distinct contributions (Ricoeur 1991). Anderson's argument that higher levels of organization can require concepts not exhausted by lower-level description offers a structurally analogous caution against premature reduction (Anderson 1972). GRE does not identify methodological levels with physical levels; the relevance lies in the general discipline of preserving analytically productive remainder.

Remark 6.220 (Irreducibility and comparison). Partial irreducibility limits complete translation. It does not eliminate comparison. Methods can still be compared with respect to the claims they support, the assumptions they require, the evidence they preserve, and the failure modes to which they are exposed.

This makes the choice among methods a problem of fit rather than allegiance.

6.14.3 Research Questions before Method Preference

Research communities often inherit favored techniques. Training pathways, journals, software, datasets, laboratories, and disciplinary evaluation can make some procedures easier to imagine, execute, and publish than others. Such inheritances can generate accumulated expertise, but they can also reverse the order of inquiry: a method is selected first and a question is subsequently formulated in a form that the preferred method can answer.

Section 6.13.3 treated question formation as the articulation of an epistemic target within a broader problem. Method selection should normally follow that articulation closely enough that the method can be evaluated against the target rather than merely against disciplinary convention. A question about historical category formation differs from a question about current prevalence. A question about lived interpretation differs from a question about causal contribution. A question about structural possibility differs from a question about predictive performance. Each can require different evidence and different standards of adequacy.

Definition 6.221 (Question–method fit). *Question–method fit* is the degree to which a method’s observational, representational, and inferential capacities correspond to the epistemic target specified by a research question, including its relevant boundary, scale, temporal horizon, and uncertainty.

Question-first selection does not mean that questions are formed in methodological innocence. Available methods can generate new questions, as Section 6.13.3 already noted. A telescope, archive, database, simulation environment, or new statistical estimator can make previously inaccessible questions researchable. The relation is therefore recursive: questions orient methods, while methods can expand the question space. The discipline lies in preventing available technique from silently defining significance.

Dewey’s account of inquiry is relevant because methods arise within the transformation of a problematic situation rather than functioning as detached procedures applied independently of the problem (Dewey 1910). Kuhn’s historical account provides a complementary warning: mature research traditions can organize puzzle selection around inherited exemplars and accepted procedures (Kuhn 1962). Such organization can support cumulative inquiry while also narrowing which questions appear methodologically legitimate.

Proposition 6.222 (Question-priority principle). *Where a research question has been sufficiently specified, methodological justification should proceed primarily from the epistemic demands of that question and its object, while methodological availability, expertise, cost, and institutional feasibility remain explicit practical constraints rather than hidden substitutes for epistemic fit.*

The principle is intentionally qualified. Feasibility matters. A theoretically ideal method that cannot be executed safely, ethically, or reliably is not automatically

preferable. This leads from the question to the properties of the object itself.

6.14.4 Object-Sensitive Method Selection

The same question form can require different methods when the object changes. A relation may be observable directly in one domain and only through indirect traces in another. Some relations are institutionally documented; others are tacit or strategically concealed. Some processes occur rapidly enough for prospective observation; others unfold over generations. Some systems permit intervention; others make experimental manipulation ethically unacceptable or practically impossible. Method selection therefore depends on how the target relation becomes manifest and how research access is organized.

Definition 6.223 (Object-sensitive method selection). *Object-sensitive method selection* is the choice or composition of methods in response to the target object's relational structure, manifestation processes, temporal organization, accessibility, scale, historical constitution, and ethically permissible forms of inquiry.

Object sensitivity also protects inquiry against reifying method-generated objects. A dataset can make entities appear naturally discrete because rows require units. A network model can foreground edges and nodes. A legal archive can privilege formally recognized subjects and categories. An interview protocol can organize experience through the concepts built into its questions. These representations can be useful while still contributing to the apparent form of the object.

Bourdieu and Wacquant's methodological relationalism provides a relevant precedent for resisting substantialist treatment of social objects and for reconstructing positions through relations within fields (Bourdieu and Wacquant 1992). Hacking's historical work similarly demonstrates that classificatory objects and styles of reasoning can have histories that matter for how they become available to investigation (Hacking 2002). GRE draws from these lineages without requiring every object to be reconstructed through one sociological or historical vocabulary.

Proposition 6.224 (Object–method reciprocity). *A method is adequate only relative to a provisional account of how the target object can be accessed and represented; because the method can in turn revise that account, object specification and method selection should remain reciprocally revisable during inquiry.*

This reciprocity prevents object sensitivity from becoming static. A method may reveal that the object initially specified was too narrow, that a relation assumed to be local crosses scales, or that the relevant category changed historically. Historical sensitivity is therefore a specific requirement within object-sensitive selection.

6.14.5 Historical Sensitivity

Methods encounter objects at particular historical moments, but many research targets carry trajectories longer than the observational window. Categories, institutions, measurement systems, technologies, and social practices can change while retaining names that suggest continuity. A method that treats the present representation of an object as timeless can therefore generate precise estimates of a historically unstable category.

Historical sensitivity concerns more than adding contextual background to an oth-

erwise unchanged design. It asks whether the object, variable, relation, or evidential rule itself has transformed. The meaning of an administrative category can change after legal reform. The composition of a population can change after migration, institutional restructuring, or technological adoption. A measure can preserve its numerical definition while the process generating the measured data changes. Historical inquiry can therefore correct assumptions embedded in contemporary measurement.

Definition 6.225 (Historical methodological sensitivity). *Historical methodological sensitivity* is the capacity of a research design to identify and respond to changes in the categories, relations, institutions, evidence-production processes, and temporal dependencies through which its object becomes researchable.

Sewell's account of structural transformation through consequential events provides a useful precedent for treating historical sequence as potentially constitutive rather than decorative (Sewell 1996). Hacking's historical ontology likewise illustrates how categories and objects of knowledge can emerge within historically specific practices (Hacking 2002). These perspectives support an important methodological caution: apparent longitudinal comparability can fail when the underlying category or manifestation relation has changed.

Historical sensitivity also constrains causal interpretation. A relation observed repeatedly across periods may be generated by different mechanisms in each period. Conversely, a mechanism may persist while its manifestations change. Methodological pluralism therefore preserves space for historical reconstruction alongside contemporary measurement and formal analysis.

Remark 6.226 (Temporal portability). The portability of a method or measure across periods should be treated as an empirical and interpretive question whenever the object, category, institution, or evidence-production process is historically variable.

The same logic extends from history to relational position.

6.14.6 Relational Sensitivity

A method can be historically sensitive while still treating its units as analytically isolated. GRE requires an additional discipline: attention to whether properties attributed to entities are partly generated through relations, positions, fields, institutions, or cross-scale configurations. This does not imply that every research question must become a network analysis. It means that method selection should test whether the target property can be adequately investigated without reconstructing the relations through which it emerges or changes.

A survey can estimate attitudes while missing the institutional relations that formed the available options. An experiment can identify a local response while bracketing the longer relational history that made the treatment meaningful. Ethnography can disclose interactional mechanisms while providing limited grounds for population-level prevalence. A formal model can represent interdependence elegantly while omitting historically specific relations that determine which interactions are feasible. Relational sensitivity therefore concerns both inclusion and omission.

Definition 6.227 (Relational methodological sensitivity). *Relational methodological sensitivity* is the capacity of a research design to detect when the target property, event, or process depends materially on relations, positions, configurations, bound-

aries, or cross-scale organization and to select methods capable of preserving those dependencies at the required level of warrant.

The requirement is compatible with methodological economy. Some questions genuinely permit a local or entity-centered design. The burden is to justify the boundary. Section 119 established that boundary and scale are epistemically consequential. Here that principle becomes practical: a design should be able to explain why omitted relations are provisionally treated as background rather than constitutive components of the target claim.

Bourdieu and Wacquant's insistence on thinking relationally again provides one relevant methodological lineage (Bourdieu and Wacquant 1992). Giddens's structuration theory offers another, emphasizing recursive relations among practices, rules, and resources (Giddens 1984). GRE uses these lineages as resources rather than as compulsory templates. Relational sensitivity can be realized through historical comparison, process tracing, network analysis, qualitative reconstruction, formal models, institutional analysis, or combinations of methods depending on the object.

Proposition 6.228 (Relational adequacy condition). *When the warranted form of a claim depends materially on relations or positions omitted by the principal method, methodological adequacy requires either incorporating a mode capable of reconstructing those relations or explicitly restricting the claim to the narrower object that the existing method can support.*

This condition gives methodological complementarity a specific function.

6.14.7 Methodological Complementarity

Complementarity arises when methods contribute different but jointly relevant access to a research problem. The concept is stronger than accumulation. Two methods are complementary when the contribution of one changes how the evidence or limitations of the other can be interpreted. Historical reconstruction can clarify why a variable changed meaning. Ethnographic observation can reveal a mechanism behind an aggregate pattern. Quantitative comparison can test how widely a locally reconstructed relation appears. Formalization can expose whether an interpretive explanation contains mutually inconsistent assumptions. Interpretive work can reveal that formally identical categories carry different meanings across contexts.

Definition 6.229 (Methodological complementarity). *Methodological complementarity is a relation among methods in which their distinct epistemic capacities jointly improve the reconstruction, discrimination, scope, or revisability of a claim while the differences among their evidential and representational bases remain explicit.*

Complementarity does not require convergence on one result. Agreement can strengthen a claim when methods carry sufficiently independent vulnerabilities, but disagreement can be equally informative. If archival evidence suggests one trajectory while administrative data suggest another, the discrepancy can reveal category change, missing records, selection effects, or a mistaken historical interpretation. Complementarity therefore includes the capacity to generate productive friction.

Longino's emphasis on transformative criticism within epistemic communities supports this orientation toward heterogeneity and critical interaction (Longino 1990). Gadamer's account of understanding through historically situated horizons provides a different lineage for thinking about how distinct standpoints can enter a relation

without presuming complete assimilation (Gadamer 2004). GRE does not merge these traditions; it uses their shared resistance to epistemic isolation as a methodological resource.

Proposition 6.230 (Complementarity without collapse). *Methods can contribute to one research claim without being reduced to one representational language, provided the design specifies what each method evidences, where translation occurs, and which disagreements remain unresolved.*

This proposition anticipates Sections 150 and 151. Mutual correction requires preserving enough methodological difference for tension to remain diagnostically useful.

6.14.8 Methodological Tension as Productive Resource

Methodological tension appears when different modes of inquiry support different descriptions, boundaries, mechanisms, scales, or confidence profiles. Research practice often treats such disagreement as a problem to be eliminated by selecting the supposedly superior method. Some disagreements do require adjudication. Others reveal that the object has been incompletely specified or that methods are accessing different manifestations of a relational process.

A historical account can emphasize contingency where a formal model emphasizes structural regularity. An ethnographic account can disclose heterogeneous meanings beneath a statistically stable category. A quantitative analysis can reveal prevalence patterns that challenge a compelling local narrative. A legal analysis can identify formally binding categories that diverge from lived practices. These tensions can generate new questions when their sources are reconstructed rather than averaged away.

Definition 6.231 (Productive methodological tension). *Productive methodological tension* is a documented disagreement or non-alignment among methods that generates epistemically useful pressure to reconsider the object, boundary, scale, category, mechanism, evidence-production process, or scope of a research claim.

Productivity is not automatic. Tension becomes useful only when the participating methods are sufficiently warranted for the disagreement to deserve explanation. A poorly executed analysis does not acquire value merely because it conflicts with stronger evidence. Likewise, unresolved disagreement should not be romanticized. Some tensions can be adjudicated through additional data, better measurement, clearer concepts, or more appropriate modeling.

Proposition 6.232 (Tension-preservation principle). *When a disagreement among adequately executed methods cannot yet be explained by identifiable error, preserving the disagreement with its provenance can be epistemically preferable to forcing premature convergence, because the unresolved tension may identify a missing relation, unstable category, scale difference, or historical discontinuity.*

This principle connects methodological pluralism to the preservation and re-epistemization commitments developed in Chapter 5. It also sets a limit on the aspiration to unify methods.

6.14.9 Limits of Methodological Unification

Methodological unification can be valuable. Shared standards can improve comparability, replication, cumulative evidence, and communication. Common data struc-

tures can support collaboration. Formal frameworks can reveal connections across cases. Standardized measures can make large-scale comparison possible. GRE therefore has no general commitment against methodological integration.

The problem arises when integration requires erasing distinctions that are constitutive of the research object or the evidence. A common metric can suppress heterogeneous value. A universal category can obscure historical transformation. A single causal representation can background interpretation and meaning. A standardized observational unit can fragment relations whose significance lies in configuration. A unified formal language can retain structural equivalence while losing the domain-specific semantics that made the represented relation intelligible.

Definition 6.233 (Methodological unification limit). A *methodological unification limit* is reached when further integration of methods would require suppressing epistemically relevant differences in object constitution, evidence production, representation, scale, temporality, meaning, or standards of warrant that remain material to the research claim.

The limit is claim-relative. The same methods can be unified for one purpose and remain irreducible for another. A shared coding scheme may be adequate for estimating prevalence while remaining insufficient for reconstructing the historical emergence of the coded categories. A formal state representation may support simulation while leaving interpretive questions about the meaning of transitions unresolved.

Proposition 6.234 (Pluralism with disciplined limits). *Methodological pluralism is strongest when it permits integration where relevant information and inferential commitments can be preserved, preserves irreducibility where integration would create material epistemic loss, and keeps both choices open to later revision as the object and research purpose change.*

Methodological pluralism therefore does not culminate in a catalogue of equally valid methods. It establishes a research discipline in which methods are selected in relation to questions and objects, remain historically and relationally sensitive, enter complementary or critical relations where useful, and resist premature unification when epistemically relevant remainder persists. The next section develops the principal inquiry modes more concretely. Formal, quantitative empirical, qualitative empirical, historical, genealogical, interpretive, hermeneutic, ethnographic, legal and institutional, and computational inquiry can then be examined as differentiated research practices whose capacities overlap without becoming interchangeable.

6.15 Formal, Empirical, Historical, and Interpretive Inquiry

Section 6.14 established methodological pluralism as a disciplined response to differentiated epistemic access, partial methodological irreducibility, and the possibility of mutual correction among methods. The present section gives that argument a more concrete research-practice form by distinguishing several inquiry modes that recur across Generative Relational Theory and Generative Relational Economics. Its objective is to specify what each mode principally makes accessible, the kinds of claims it can support, and the characteristic remainders that should remain visible when modes are combined. The discussion proceeds through formal, quantitative empirical, qualitative empirical, historical, genealogical, interpretive, hermeneutic, ethno-

graphic, legal and institutional, and computational inquiry before returning to their partial irreducibility. The method is comparative rather than hierarchical. Each mode is treated as an organized relation among research question, object, evidence, representation, and inferential practice. The resulting distinctions prepare the next section, where formal and quantitative models are examined more narrowly as epistemic instruments with several different functions.

Definition 6.235 (Inquiry mode). An *inquiry mode* is a relatively coherent organization of research objects, evidential access, representational practices, inferential operations, and standards of warrant through which a class of research questions becomes tractable.

The definition does not treat inquiry modes as closed disciplinary territories. A single project can move among several modes, and one method can serve different modes depending on its role. An interview, for example, can contribute to qualitative empirical description, interpretive reconstruction, ethnographic analysis, or historical inquiry. A simulation can function as formal exploration, computational experimentation, or comparison among theoretical mechanisms. What matters is the epistemic role that the research practice performs in relation to the claim.

6.15.1 Formal Inquiry

Formal inquiry examines the consequences of explicitly specified structures, relations, assumptions, or transformation rules. Its principal strength lies in making dependence visible. Once premises, state variables, relations, constraints, or rules are rendered sufficiently explicit, a formal representation can disclose implications that are difficult to inspect in ordinary prose. Formal inquiry can therefore clarify whether a proposed mechanism is internally coherent, whether two assumptions are jointly compatible, whether a result follows from a specified structure, or which conditions are necessary for a modeled transition.

This function should be distinguished from empirical confirmation. A mathematically valid implication can remain empirically inadequate when the representation omits relations that matter in the target domain. Conversely, empirical irregularity does not by itself show that a formal derivation is internally defective. Van Fraassen's account of scientific representation is useful here because it keeps the relation between model and world analytically distinct from the internal structure of the model itself (Fraassen 1980). GRE retains that separation while adding the requirement that representational choices remain historically and relationally inspectable.

Definition 6.236 (Formal inquiry). *Formal inquiry* is inquiry in which explicit symbolic, logical, mathematical, computational, or structural representations are used primarily to examine relations among assumptions, constraints, transformations, and consequences.

Formal inquiry can be highly generative because it may reveal unexplored cases, inconsistencies, invariants, or possible mechanisms. Its generativity does not convert formal consequence into ontological necessity. Within GRE, formalization remains an epistemic operation under ontological suspension. The next section will therefore treat formal models as instruments whose function must be specified relative to a research task.

6.15.2 Quantitative Empirical Inquiry

Quantitative empirical inquiry organizes observed or recorded variation through explicit measurement and numerical comparison. Its characteristic objects include distributions, frequencies, differences, associations, transitions, heterogeneous effects, temporal patterns, and estimated dependencies. It can make visible regularities or contrasts that remain difficult to establish from a small number of cases and can provide disciplined estimates of uncertainty when the measurement and inferential design are adequate.

The numerical form of a result does not remove the relational conditions of its production. Variables depend on classification; samples depend on access and inclusion; measurements depend on instruments and institutional procedures; missingness can be structured; and causal estimates depend on assumptions about comparison, assignment, temporal order, and alternative pathways. Contemporary causal-inference work makes these design dependencies explicit rather than treating numerical association as sufficient evidence of causation (Gangl 2010; Woodward 2003).

Definition 6.237 (Quantitative empirical inquiry). *Quantitative empirical inquiry* is inquiry that represents empirically recorded variation numerically in order to estimate, compare, or test distributions, relations, changes, or dependencies under an explicit measurement and inferential design.

GRE therefore treats quantitative evidence as powerful but situated. A coefficient, estimated effect, or network statistic can support a claim within a specified boundary, scale, temporal horizon, and data-generating process. Its evidential strength is increased by clarity about how the measured object relates to the relational object of interest and by sensitivity to historically changing categories or measurement regimes.

6.15.3 Qualitative Empirical Inquiry

Qualitative empirical inquiry reconstructs properties of social and relational reality that require contextual differentiation, situated description, process tracing, or close attention to categories that cannot yet be responsibly compressed into a fixed numerical representation. Its materials can include interviews, observations, documents, correspondence, fieldnotes, institutional records, material artifacts, and naturally occurring interaction. The defining feature is not the absence of numbers but the preservation of contextual and categorical structure during empirical reconstruction.

Qualitative inquiry can identify relations that standardized instruments fail to register, recover distinctions that would otherwise be collapsed into one variable, and disclose how actors interpret or reproduce institutional categories. Bourdieu's practice-oriented work illustrates how dispositions, fields, and practical relations can require empirical reconstruction at a level that is difficult to recover from formal categories alone (Bourdieu 1977). Longino's emphasis on critical interaction among differently situated perspectives further supports the epistemic value of preserving heterogeneous access rather than forcing premature representational uniformity (Longino 1990).

Definition 6.238 (Qualitative empirical inquiry). *Qualitative empirical inquiry* is inquiry that reconstructs empirically grounded relations, processes, categories, meanings, or differences while preserving contextual information judged material to the

research claim.

Its limits include local dependence, selective access, interpretive mediation, and difficulty establishing prevalence beyond the observed field. These limits call for explicit scope rather than a downgrade in epistemic status. Qualitative evidence can be decisive for a claim about process, category formation, mechanism, or situated relation even when it is insufficient for a population-level frequency claim.

6.15.4 Historical Inquiry

Historical inquiry reconstructs change through time. It is especially important when the identity, meaning, effect, or accessibility of a relation depends on sequence. Historical inquiry can establish how an institution emerged, when a category changed, which alternatives were available at a given moment, how a relation persisted through transformation, or why a later configuration cannot be inferred from a cross-sectional snapshot.

GRE's concern with generative relations makes temporal ordering more than contextual background. Path-dependent processes can make early events consequential through later reinforcement, while structural transformation can alter the very categories through which earlier evidence is interpreted (David 1985; Pierson 2000; Sewell 1992; Sewell 1996). Historical inquiry therefore contributes not only chronology but reconstruction of changing conditions of possibility.

Definition 6.239 (Historical inquiry). *Historical inquiry* is inquiry that reconstructs temporally ordered relations, events, categories, institutions, and generative conditions in order to establish how a research object formed, persisted, changed, or became intelligible through time.

Historical warrant depends on provenance, temporal specificity, category sensitivity, and disciplined handling of gaps in the record. Later knowledge can support re-epistemization of an earlier sequence, yet retrospective interpretation should remain distinct from retrospective determinism. A historical reconstruction can show that a later outcome became possible through a sequence without claiming that it was already necessary at the sequence's beginning.

6.15.5 Genealogical Inquiry

Genealogical inquiry shares historical materials with historical inquiry while placing particular emphasis on the formation of categories, practices, subject positions, standards, and regimes of intelligibility. Its central question is often less the continuous history of a stable object than the historical conditions through which something came to be constituted as an object, problem, identity, norm, or field of intervention.

This orientation is compatible with ontological suspension because genealogy can investigate the historical production of classifications without requiring that the classification exhaust the underlying reality. Hacking's work on historical ontology shows how categories and possibilities of description can emerge historically and then participate in the constitution of objects and persons (Hacking 2002). Foucault's analyses of power and subject formation likewise emphasize relations through which subjects and domains of knowledge are historically constituted (Foucault 1982).

Definition 6.240 (Genealogical inquiry). *Genealogical inquiry* reconstructs the histor-

ically contingent formation, stabilization, transformation, and effects of categories, norms, subject positions, problems, or regimes of intelligibility.

Genealogy should not be reduced to a search for a single hidden origin. Its value often lies in disclosing discontinuities, competing lineages, forgotten alternatives, and the relations through which a present category acquired authority. Within GRE, this makes genealogy especially useful for studying economic categories whose apparent naturalness may depend on institutional, legal, administrative, or epistemic histories.

6.15.6 Interpretive Inquiry

Interpretive inquiry addresses meanings, reasons, symbols, narratives, classifications, and practical understandings through which relations become intelligible to participants and observers. Economic and institutional action is rarely exhausted by externally observable behavior. The same transfer, contract, refusal, gift, debt, or administrative act can carry different meanings across relational and historical contexts, and those meanings can themselves alter subsequent action.

Interpretive inquiry therefore treats meaning as part of the evidential target rather than as noise surrounding an otherwise complete behavioral record. It can reconstruct how actors understand obligations, how institutions narrate their purposes, how categories acquire normative force, or how apparently similar practices differ because they inhabit different symbolic relations. Ricoeur's movement from text toward action provides one important account of how interpretation can extend beyond literary objects toward meaningful social action (Ricoeur 1991).

Definition 6.241 (Interpretive inquiry). *Interpretive inquiry* is inquiry directed toward the meanings, reasons, symbolic relations, narratives, and practical understandings through which an object, action, or relation becomes intelligible within a situated field.

Interpretation remains evidentially constrained. Participant accounts can conflict; meanings can be strategic or retrospective; and an interpretation that is coherent to the researcher can still be weakly supported by the field. Interpretive warrant therefore depends on textual, observational, historical, and relational evidence together with explicit treatment of alternative readings.

6.15.7 Hermeneutic Inquiry

Hermeneutic inquiry develops interpretation through the relation between part and whole, present and history, question and text, and interpreter and tradition. It is especially relevant when the meaning of a document, concept, institution, or practice cannot be fixed by isolated propositions. Legal texts, philosophical concepts, policy documents, archival materials, and institutional vocabularies often acquire meaning through larger interpretive horizons that change over time.

Gadamer's account of historically effected understanding emphasizes that interpretation proceeds from a situated horizon rather than from a view outside history (Gadamer 2004). Ricoeur similarly develops a hermeneutics in which interpretation is mediated by texts, symbols, and action rather than reducible to recovery of an author's private intention (Ricoeur 1991). For GRE, these insights support reflexive interpretation without requiring that all interpretations be equally warranted.

Definition 6.242 (Hermeneutic inquiry). *Hermeneutic inquiry* is interpretive inquiry that reconstructs meaning through historically situated relations among parts, wholes, contexts, traditions, questions, and interpreters.

Hermeneutic inquiry is therefore particularly valuable when concepts travel across periods or domains. It can disclose that a familiar term has shifted in meaning, that a legal category is intelligible only through a doctrinal history, or that a theoretical concept acquires different implications when inserted into a new problem field. Such reconstruction should preserve the distance between historical meaning and present analytical use.

6.15.8 Ethnographic Inquiry

Ethnographic inquiry studies relations through sustained engagement with situated practices. Its distinctive contribution lies in observing how categories, norms, skills, routines, infrastructures, and tacit forms of coordination are enacted in settings where formal descriptions may only partially capture what participants actually do. Ethnography can therefore reveal discrepancies between official procedure and practical conduct, between stated rule and negotiated practice, or between institutional category and lived relation.

The strength of ethnographic inquiry depends on relational presence rather than mere physical proximity. Access, trust, role, language, duration, and the researcher's changing position affect what can be observed and how observed conduct is interpreted. Hutchins' study of distributed cognition illustrates how close analysis of practice can disclose cognitive organization distributed across persons, artifacts, and procedures that would be difficult to reconstruct by isolating individual actors (Hutchins 1995). Bourdieu's account of practice likewise supports attention to practical regularities that actors may not formulate explicitly (Bourdieu 1977).

Definition 6.243 (Ethnographic inquiry). *Ethnographic inquiry* is sustained, situated empirical inquiry into practices and relations through observation, participation, interaction, and contextual interpretation within a field of activity.

Ethnographic evidence is powerful for reconstructing mechanism, practice, meaning, and relational organization, while usually requiring caution in population-level generalization. Its local density is a feature rather than a defect when the research claim concerns how a process is enacted. Wider inference requires additional justification or complementary evidence.

6.15.9 Legal and Institutional Inquiry

Legal and institutional inquiry reconstructs rule-governed orders, formal classifications, rights, obligations, procedures, organizational arrangements, enforcement relations, and the practical operation of institutions. It is indispensable when the research object is partly constituted through legal or institutional facts rather than merely influenced by them. Property, corporate personhood, contractual obligation, administrative eligibility, organizational authority, and many economic categories depend on rule systems whose content cannot be inferred from behavior alone.

Hart's analysis of law clarifies the importance of rule structures and institutional recognition for understanding legal orders (Hart 2012). North and Ostrom, from different institutional traditions, likewise emphasize that institutions organize incen-

tives, constraints, and patterned interaction while their operation depends on historically and contextually specific arrangements (North 1990; Ostrom 2005). GRE extends this institutional sensitivity by distinguishing formal rule, institutional manifestation, practical enactment, and downstream relational effects.

Definition 6.244 (Legal and institutional inquiry). *Legal and institutional inquiry* is inquiry directed toward the constitution, interpretation, operation, interaction, and transformation of formal or informally stabilized rules, categories, organizations, rights, obligations, procedures, and institutional relations.

Such inquiry can combine doctrinal interpretation, archival reconstruction, organizational analysis, interviews, administrative records, and comparative institutional evidence. A formally valid rule may be weakly implemented; an informal rule may be strongly stabilizing; and institutional effects can exceed the intentions of rule designers. The method therefore requires attention both to constitutive rules and to relational realization.

6.15.10 Computational Inquiry

Computational inquiry uses algorithmic procedures to represent, explore, reconstruct, or generate patterns that would be difficult to examine through unaided analytical reasoning. It includes simulation, agent-based modeling, network computation, large-scale data processing, optimization, machine learning, and computational experiments. Its distinctive contribution lies in executable representation: assumptions and transition rules can be iterated, complex interactions can be explored across many configurations, and consequences can be compared under controlled alterations of the computational system.

Agent-based computational economics exemplifies one use of computation to investigate how macro-level patterns can emerge from specified heterogeneous agents and interactions (Tesfatsion 2006; Epstein and Axtell 1996). Simulation studies also show that computational models can function as epistemic instruments whose results depend on model construction, implementation, parameterization, and interpretation rather than functioning as transparent deductions from theory (Winsberg 2010).

Definition 6.245 (Computational inquiry). *Computational inquiry* is inquiry in which executable algorithmic procedures are used to represent, process, simulate, compare, infer, or explore relations and transformations relevant to a research question.

Computational power can expand the tractable search space without dissolving epistemic uncertainty. Simulated agents remain representations; inferred patterns depend on data and objective functions; and high-dimensional results can conceal rather than eliminate assumptions. Computational inquiry is therefore strongest when implementation choices, data provenance, representational scope, and the relation between computational output and substantive claim remain inspectable.

6.15.11 Partial Irreducibility among Inquiry Modes

The preceding modes overlap extensively. Historical inquiry can be quantitative; ethnography can be interpretive and empirical; legal inquiry can be hermeneutic; computational inquiry can instantiate formal theory; qualitative evidence can support causal-process reconstruction; and genealogical work can draw on institutional

records. The purpose of distinguishing modes is therefore not to create disciplinary borders. It is to prevent overlap from being mistaken for equivalence.

Each mode foregrounds a different epistemic relation. Formal inquiry clarifies structural consequence. Quantitative empirical inquiry estimates patterned variation. Qualitative empirical inquiry preserves contextual difference and process. Historical inquiry reconstructs sequence and transformation. Genealogical inquiry reconstructs the formation of categories and regimes of intelligibility. Interpretive and hermeneutic inquiry reconstruct meaning. Ethnography reconstructs situated practice. Legal and institutional inquiry reconstructs rule-governed orders. Computational inquiry expands executable exploration and algorithmic inference. A project can move among these functions, yet information may be lost when one is translated wholly into another.

Proposition 6.246 (Differentiated inquiry principle). *When a research claim depends on properties that are differentially accessible through formal structure, empirical variation, historical sequence, situated practice, meaning, institutional constitution, or computational exploration, adequate inquiry should preserve the evidential contribution and characteristic remainder of each materially relevant mode rather than assuming complete interchangeability.*

Partial irreducibility does not protect a mode from criticism. Historical narratives can be contradicted by quantitative evidence; formal elegance can fail empirically; ethnographic interpretations can be challenged by documentary records; computational results can reveal sensitivities that undermine a verbal mechanism; and legal analysis can show that a category presumed by empirical work has been misidentified. The possibility of correction depends precisely on retaining enough difference for one mode to disclose what another has missed.

Proposition 6.247 (Mode-specific warrant). *The warrant supplied by an inquiry mode should be stated in terms of the property it renders accessible, the evidence or representation through which access is achieved, the inferential operation performed, and the boundary beyond which the resulting claim requires additional support.*

This formulation keeps methodological pluralism operational. Researchers need neither choose one privileged mode for the entire project nor combine every available method. They need to establish which inquiry relation is appropriate to the claim, where another mode can provide correction or complementary access, and where translation would suppress a material remainder. The next section narrows this discussion to formal and quantitative models. Rather than treating models as one homogeneous method, it distinguishes their roles in representation, reconstruction, explanation, comparison, prediction, counterfactual exploration, theory critique, theory generation, and practical decision support.

6.16 Epistemic Functions of Formal and Quantitative Models

This section specifies the epistemic functions that formal and quantitative models can perform within research praxis. Its role is to prevent the term *model* from naming a single undifferentiated activity and to clarify why representational adequacy, reconstruction, explanation, comparison, prediction, counterfactual exploration, and theory development require different forms of warrant. The discussion proceeds func-

tion by function and then reconnects model use to the distinction between research-dominant and application-dominant praxis developed earlier in this chapter. The method is analytical rather than taxonomic: the same model can serve several functions, yet the evidential burden appropriate to one function does not automatically transfer to another. This functional differentiation is particularly important for GRE because formalization is useful for relational structure, generative dynamics, and cross-scale comparison while remaining subject to ontological suspension, historical sensitivity, representational remainder, and methodological pluralism.

Definition 6.248 (Epistemic model). An *epistemic model* is a deliberately constructed representation whose variables, relations, parameters, rules, states, or other formal elements are used to make selected properties of a target object or process accessible for a specified research or practical purpose.

The definition treats model use as purposive and target-relative. Giere's account of scientific representation is useful here because it treats scientists as using models to represent selected aspects of reality for particular purposes rather than requiring model and target to stand in a relation of complete similarity (Giere 2004). Models therefore achieve epistemic usefulness partly through selection. The same selectivity that makes a model tractable also generates a remainder: relations, histories, meanings, scales, or contingencies outside the representation can remain materially relevant.

6.16.1 Models as Representations

Representation is the most basic model function considered here. A formal or quantitative model specifies a structured representational domain in which selected features of a target are rendered through variables, categories, state spaces, parameters, equations, distributions, graphs, algorithms, or rules. Such a model can clarify what is being claimed about a target because it requires some assumptions and relational commitments to become explicit. It can also conceal assumptions by embedding them in apparently technical choices whose substantive meaning receives insufficient attention.

The epistemic question is therefore not whether a model is literally identical to its target. It concerns which target properties the representation is intended to preserve, which transformations are licensed, which differences are treated as negligible, and what inferential work the representation is expected to support. Under ontological suspension, a formal relation in a model is not automatically an ontological relation in the world. A state variable can represent a historically formed category without implying that the category is a timeless natural kind. A network edge can represent an observed or inferred relation without exhausting the meaning or institutional structure of that relation.

Definition 6.249 (Model representation claim). A *model representation claim* specifies the target of a model, the properties intended to be represented, the representational correspondence being asserted, the purposes for which that correspondence is treated as adequate, and the material remainders left outside the representation.

This formulation makes representation inspectable. A model can be useful for one purpose and inadequate for another without contradiction. A simplified mobility model may represent aggregate flows adequately while remaining weak for reconstructing lived reasons for movement. A legal-economic model may preserve entitle-

ment structure while suppressing informal practice. A generative model may clarify how local interaction rules can produce aggregate patterns while remaining silent about the historical formation of the rules themselves.

6.16.2 Models as Instruments of Reconstruction

Models also function as instruments of reconstruction. Here the task is not merely to represent an already known object but to infer relational structure, latent states, parameters, trajectories, or mechanisms from incomplete manifestations and traces. Statistical estimation, network inference, latent-variable models, state-space reconstruction, inverse problems, and many computational procedures operate in this mode. The model mediates a movement from observed evidence toward an analytically specified relational object.

Reconstruction carries a stronger burden than descriptive representation because multiple underlying structures may be compatible with the same observed manifestations. The identification problem therefore matters. Manski's work on identification is especially relevant because it distinguishes what can be learned from available data under weak assumptions from what becomes identifiable only after additional assumptions are imposed (Manski 2008). Within GRE, this implies that a reconstructed relation should retain information about the assumptions that made the reconstruction possible.

Definition 6.250 (Model-based reconstruction). *Model-based reconstruction* is an inferential use of a model in which observed manifestations, traces, or measurements are used to estimate or delimit unobserved relational structures, states, parameters, or processes under explicitly stated assumptions.

A point estimate can therefore be less epistemically informative than a wider reconstruction set when the latter more accurately preserves underdetermination. Model complexity does not itself solve non-identifiability. Additional parameters can increase representational flexibility while leaving several relational explanations compatible with the evidence. Reconstruction is strongest when the relation between evidence, assumptions, inferred object, and residual alternatives remains explicit.

6.16.3 Models as Instruments of Explanation

Models can contribute to explanation by identifying structural dependencies, causal relations, generative mechanisms, invariances, or process organizations that make an observed pattern intelligible. This function differs from reconstruction. Reconstructing a stable association or latent configuration does not yet explain why it arises or how it would respond to relevant changes.

Woodward's interventionist account clarifies one important form of explanatory modeling: causal explanation can concern how changes in one variable would produce changes in another under suitable interventions and invariance conditions (Woodward 2003). For GRE, however, explanation can also require historical sequence, institutional constitution, interpretation, and distributed generative organization. A formal model may isolate one mechanism while other inquiry modes establish whether that mechanism exists, how it became operative, and what boundaries constrain its explanatory relevance.

Proposition 6.251 (Explanatory burden of models). *A model supports an explanatory claim only to the extent that the modeled dependencies, mechanisms, or generative structures are adequately linked to the target process and competing explanations are addressed at the level required by the claim.*

This principle separates internal derivability from external explanation. A conclusion can follow rigorously from model assumptions while the assumptions remain weakly connected to the target. Formal validity is an achievement inside the representational system; explanatory warrant additionally requires a justified world-link.

6.16.4 Models as Instruments of Comparison

Models provide comparison by placing different cases, periods, configurations, or scenarios within a common representational frame. Quantitative normalization, common indicators, standardized parameters, typologies, relational measures, and simulation environments can reveal contrasts that are difficult to see through unstructured description. Comparison is particularly useful when a research question concerns variation across institutional arrangements, relational topologies, historical trajectories, or intervention designs.

The common frame that enables comparison can also distort it. Commensuration may suppress qualitative differences, historically specific meanings, or non-equivalent categories. A comparison therefore needs an account of what is held common and what remains case-specific. Porter documents how quantitative and standardized forms of objectivity can acquire institutional authority precisely because they facilitate impersonal comparison and coordination (Porter 1995). The gain in comparability can be real while still carrying representational costs.

Definition 6.252 (Model-mediated comparison). *Model-mediated comparison* is the use of a common formal or quantitative representation to examine differences or similarities among targets while specifying the dimensions treated as comparable and the case-specific properties that remain outside or resist the common frame.

Comparison thus becomes an explicit analytical achievement rather than an assumed property of the cases. A model can make two objects comparable in one dimension while preserving their non-equivalence in others.

6.16.5 Models as Instruments of Prediction

Prediction concerns the use of a model to estimate future, unobserved, or held-out manifestations under specified conditions. Predictive performance can provide important information about whether a model captures stable regularities relevant to its forecasting task. It is especially valuable when claims must survive contact with data not used in model construction.

Predictive success nevertheless has a bounded epistemic meaning. A model can predict well through stable correlation while offering a weak account of mechanism. A structurally informative model can explain an important process while predicting poorly because the system is exposed to unmodeled shocks, measurement limitations, strategic adaptation, or genuine openness. Prediction and explanation can reinforce one another, but neither function subsumes the other.

Manski's distinction between identification, prediction, and decision is useful be-

cause it makes visible the assumptions needed to move from observed data toward statements about outcomes and practical choices (Manski 2008). GRE extends this caution to historically changing relational systems: predictive validity can decay when institutions, categories, behavior, technologies, or the relations being modeled change.

Proposition 6.253 (Predictive scope principle). *The epistemic significance of predictive performance is indexed to the population, boundary, scale, temporal horizon, data-generating conditions, and decision context under which the prediction is evaluated.*

Prediction should therefore carry a scope statement rather than appearing as a context-free property of the model.

6.16.6 Models as Instruments of Counterfactual Exploration

Models enable counterfactual exploration by examining how represented outcomes change when specified conditions, parameters, relations, rules, or interventions differ. This function can reveal dependency structure, test the robustness of explanations, explore unrealized alternatives, and support practical deliberation. Counterfactual modeling is especially useful when direct experimentation is impossible, unethical, historically unavailable, or institutionally infeasible.

A counterfactual result remains conditional on the model's representational and structural assumptions. Woodward's interventionist framework shows why causal counterfactuals require disciplined specification of interventions and invariances rather than arbitrary alteration of variables (Woodward 2003). Historical and institutional counterfactuals require an additional constraint: alternatives should remain compatible with what was materially, institutionally, and epistemically feasible in the relevant period.

Definition 6.254 (Model-based counterfactual exploration). *Model-based counterfactual exploration* is the disciplined alteration of specified model conditions in order to examine conditional changes in represented outcomes, while preserving explicit assumptions about feasibility, invariance, boundary, and the relation between the modeled alteration and the target process.

This definition separates counterfactual exploration from fantasy scenario generation. Models can widen the space of considered alternatives, but substantive feasibility remains a distinct empirical, historical, institutional, and normative question.

6.16.7 Models as Instruments of Theory Critique

Formalization can expose weaknesses in theory by requiring verbal claims to be made structurally explicit. Internal inconsistency, missing mechanisms, hidden closure assumptions, non-identification, sensitivity to parameter choices, unstable equilibria, or dependence on restrictive boundary conditions can become visible once a theory is represented formally. Quantitative models can also reveal that an apparently general theoretical claim survives only within a narrow empirical range.

Computer simulation provides a particularly useful example. Winsberg emphasizes that simulation is a scientific practice involving theory, modeling, approximation, implementation, and evidence rather than a transparent execution of prior theory (Winsberg 2010). When simulation behavior diverges from theoretical expectation, the discrepancy can direct attention toward assumptions, implementation

choices, omitted processes, or genuinely new dynamics.

Proposition 6.255 (Model-enabled theory critique). *A model functions as an instrument of theory critique when its explicit structure reveals consequences, incompatibilities, sensitivities, absences, or empirical failures that materially challenge the scope or organization of the theory from which the model was derived.*

Critique does not require immediate rejection. A failure can localize where revision is needed and can thereby become generative for theory development.

6.16.8 Models as Instruments of Theory Generation

Models can generate theoretical possibilities rather than merely implement pre-existing theory. Exploratory formalization may reveal a previously unnoticed dependency. Simulation can display aggregate patterns arising from local rules that were not anticipated verbally. Network or statistical models can disclose regularities that demand new concepts. A model can therefore function as a conjecture-producing environment.

Agent-based approaches make this generative function particularly visible. Epstein and Axtell construct artificial societies in which macro-patterns arise from repeated interactions among heterogeneous agents (Epstein and Axtell 1996). Tesfatsion similarly presents agent-based computational economics as a constructive approach in which decentralized interactions, learning, organizations, and institutions can be studied through computationally realized systems (Tesfatsion 2006). Such models do not establish that the represented mechanism operates in the empirical world merely because it can generate a pattern. They can, however, enlarge the space of plausible mechanisms and direct subsequent empirical, historical, or interpretive inquiry.

Definition 6.256 (Theory-generative model use). *Theory-generative model use* occurs when formal or quantitative exploration produces new candidate concepts, mechanisms, relations, hypotheses, or explanatory structures that were not fully specified before the modeling process.

The resulting theoretical proposal remains provisional until it acquires warrant beyond the generative model environment.

6.16.9 Models as Instruments of Theory Transformation

Theory generation becomes theory transformation when model-based inquiry reorganizes an existing theoretical system rather than adding a local hypothesis. Repeated sensitivity failures may alter the theory's account of stability. Model comparison can show that a familiar category aggregates several processes that need separation. A simulation may reveal that interactions treated as residual are structurally central. Empirical modeling may make a historical discontinuity visible that requires a new state space or identity criterion.

Theory transformation is therefore recursive. Theory guides model construction; model behavior reveals consequences and limits; empirical and historical inquiry evaluate those consequences; and the resulting findings can change the concepts from which later models are built. This recursion echoes the broader account of research-dominant praxis developed in Section 6.4: inquiry can transform the

epistemic-theoretical system through which subsequent inquiry proceeds.

Proposition 6.257 (Recursive model-theory transformation). *When model construction or model-based evidence reveals a persistent mismatch that is traceable to the conceptual organization of a theory, warranted revision can extend beyond parameter adjustment to the theory's categories, relational architecture, mechanisms, boundary conditions, or criteria of identity.*

This proposition guards against treating every failure as a tuning problem. Some failures concern the representational architecture itself.

6.16.10 Use of Models within Application-Dominant Praxis

Within application-dominant praxis, models can support forecasting, resource allocation, risk assessment, scenario exploration, monitoring, prioritization, and intervention design. Their practical relevance increases the need to separate epistemic output from decision authority. A model can estimate consequences under assumptions; it does not by itself determine which consequences should be valued, which risks are acceptable, whose losses count, or how uncertainty should be distributed.

The distinction becomes especially important when model outputs are operationalized through institutional procedures. Once a score, forecast, ranking, optimization rule, or simulation result changes access, incentives, expectations, or behavior, the model becomes part of the relational system under study. MacKenzie's analysis of financial models illustrates how models can become incorporated into market practices and contribute to reshaping the processes they represent (MacKenzie 2006). Model evaluation in application-dominant praxis can therefore require post-deployment monitoring of performative and reflexive effects.

Definition 6.258 (Application-oriented model use). *Application-oriented model use is the incorporation of model outputs into practical judgment, intervention design, allocation, monitoring, or institutional action under an explicit account of uncertainty, value conflict, reversibility, affected relations, and possible model-induced transformation of the target system.*

This definition preserves human and institutional responsibility. Practical closure can draw on models without delegating the entire decision problem to them.

6.16.11 Model Function and Praxis Orientation

The same formal object can perform different epistemic functions in different phases of praxis. A network model can first represent a relation structure, later reconstruct missing ties, then compare institutional configurations, and finally support an intervention scenario. A simulation can serve exploratory theory generation in research-dominant praxis and later become a decision-support instrument in application-dominant praxis. The epistemic requirements change with the function.

Definition 6.259 (Model function profile). *A model function profile records the target of a model, its current epistemic or practical function, the assumptions and evidence supporting that function, the form of validation or criticism appropriate to it, the relevant uncertainty, and the praxis orientation within which the model is being used.*

The function profile prevents warrant from migrating silently across uses. Good predictive performance does not automatically establish causal explanation. A use-

ful counterfactual tool does not automatically establish historical truth. An elegant formal representation does not automatically justify practical intervention. A model that is adequate for exploratory research may require substantially stronger validation, monitoring, and accountability before it becomes part of consequential application.

Proposition 6.260 (Non-substitution among model functions). *Evidence supporting one model function should not be treated as sufficient support for another function unless the inferential bridge between them is independently justified.*

This principle makes model use compatible with the methodological pluralism developed in Section 6.14. Models are powerful because they can perform several tasks, and epistemically disciplined because those tasks remain distinguishable.

6.16.12 Limits of Model-Centered Inquiry

Model-centered inquiry becomes inadequate when tractability is mistaken for relevance, formal precision for substantive warrant, predictive performance for explanation, or model availability for completeness of the research object. Some materially important properties are weakly represented by available variables; some relations acquire meaning through history, law, language, interpretation, or situated practice; some boundaries change during inquiry; and some forms of uncertainty arise from categories or possible futures that have not yet been adequately articulated.

The limitation is especially serious when model outputs acquire institutional authority. Representation can feed back into classification, behavior, resource allocation, and future data. In such cases the model can partly produce the conditions under which it later appears empirically successful. Reflexive monitoring therefore belongs to model criticism whenever outputs enter the relational system they describe.

Models also create opportunity costs. Building, calibrating, validating, maintaining, and interpreting a sophisticated model consumes intellectual and institutional resources. A project should therefore be able to explain why formal or quantitative modeling provides epistemic access that simpler comparison, historical reconstruction, field observation, qualitative evidence, or interpretive analysis cannot supply as effectively for the target claim.

Proposition 6.261 (Disciplined model-use principle). *Formal and quantitative models are epistemically strongest when their function, target, representational commitments, assumptions, evidence, validation standard, uncertainty, praxis orientation, and material remainder are explicit, and when claims exceeding those supports remain available to correction from other inquiry modes.*

The principle places models within research praxis rather than above it. Formal and quantitative instruments can sharpen representation, reconstruct hidden structure, explain dependencies, compare cases, predict outcomes, explore counterfactuals, criticize and generate theory, and support practical judgment. Their contribution remains strongest when their partiality is preserved. The next section develops the reciprocal side of methodological pluralism by examining how different methods can correct one another when their evidential and representational outputs diverge.

6.17 Mutual Correction among Methods

The methodological pluralism developed in Section 6.14 becomes epistemically consequential only when different modes of inquiry can do more than coexist. This section develops the corrective relation among methods. Its role is to specify how historical, formal, quantitative, qualitative, interpretive, and field-based inquiry can expose limits in one another without being reduced to a single methodological standard. The objective is therefore narrower than methodological integration: the section asks how one mode of inquiry can identify assumptions, omissions, category failures, scope conditions, or representational distortions in another. The discussion proceeds through eight recurrent forms of correction before formulating recursive methodological revision as a general research practice.

Mutual correction differs from simple agreement among methods. Convergence can increase confidence when independently generated evidence supports compatible claims, yet agreement can also arise because several methods share the same categories, data infrastructure, institutional blind spots, or background assumptions. Conversely, disagreement need not imply that one method has failed. It can indicate that the methods access different scales, historical periods, relational positions, or manifestations of the object. Longino's account of scientific objectivity emphasizes the epistemic importance of criticism directed toward background assumptions rather than the mere accumulation of observations (Longino 1990). GRE extends this insight methodologically: a method becomes especially valuable when it can reveal where another method's warrant ceases to travel.

Definition 6.262 (Methodological correction). *Methodological correction* is a warranted revision of a research claim, category, representation, scope condition, inferential bridge, or method choice generated when evidence or reasoning from one inquiry mode exposes a materially relevant limitation in another.

Correction therefore concerns the research configuration rather than victory of one method over another. A formal model may survive historical correction after its scope is narrowed. A quantitative regularity may remain useful after interpretation changes its meaning. An ethnographic category may become stronger after measurement reveals its distribution. The relevant question is what must be revised so that the combined research configuration better fits the object and the claim.

6.17.1 Formal Models Corrected by History

Formal models often obtain analytical power by stabilizing categories, rules, relations, parameters, and state spaces long enough to examine their consequences. Historical inquiry tests whether those stabilizations remain valid across the period to which the model is applied. The corrective function of history is therefore directed less toward the internal mathematics of a model than toward the historical persistence of its represented objects and assumptions.

A formal model may treat an institution as a stable rule set even though the legal meaning of the institution changed. It may represent agents as choosing from a fixed opportunity set even though political transformation altered which actions were conceivable or permitted. It may use one category across several decades while the practices classified under that category changed substantially. Hacking's historical ontology is relevant here because categories and objects of knowledge can acquire their

apparent stability through historically specific practices of classification and reasoning (Hacking 2002). A model that ignores such transformations can remain internally coherent while representing several historically different objects as though they were one.

Historical correction can take several forms. It can restrict the temporal scope of a model, split a variable or state into historically distinct forms, introduce regime change, alter the identity criterion of an entity, or show that a parameter assumed to be exogenous was itself produced by an earlier institutional sequence. Pierson's analysis of increasing returns and path dependence demonstrates why timing and sequence can materially condition political development (Pierson 2000). In such settings, a model that represents only contemporaneous covariation can miss the historically generated constraints that make the present configuration possible.

Proposition 6.263 (Historical correction of formal scope). *When historical evidence shows that a model's entities, rules, boundaries, or opportunity structures changed materially within the modeled period, the model's scope or structure should be revised before its results are generalized across that period.*

The proposition does not privilege historical narrative over formal analysis. Formalization can make historical claims more explicit by forcing assumptions about continuity, sequence, and identity into inspectable form. The corrective relation is reciprocal even when this subsection emphasizes one direction.

6.17.2 Quantitative Findings Corrected by Interpretation

Quantitative inquiry can establish distributions, associations, differences, temporal patterns, and estimated effects with a degree of explicitness that interpretive inquiry often does not seek. Yet numerical results remain dependent on what the variables mean, how categories were constructed, what practices generated the observations, and whether apparently identical measurements carry the same significance across groups or contexts. Interpretation corrects quantitative findings when it shows that a numerical relation has been assigned a meaning that the evidence does not support.

The problem is particularly visible when administrative or survey categories travel across relational contexts. A variable labeled "employment," "household," "participation," or "trust" can aggregate substantially different practices. A statistically stable association can then coexist with heterogeneity in what the measured category denotes. Porter's history of quantitative objectivity shows how standardized measurement gains institutional strength partly by suppressing local judgment and making comparison portable (Porter 1995). That portability is valuable, but it can also conceal the interpretive work through which heterogeneous situations become commensurable.

Interpretive correction can therefore identify category mismatch, contextual heterogeneity, shifts in respondent meaning, or institutional production of the measured variable. Ricoeur's treatment of explanation and understanding is useful because it resists treating these operations as mutually exclusive (Ricoeur 1991). A quantitative result can be explanatorily informative while still requiring interpretation of the actions, texts, rules, and meanings through which the measured pattern was generated.

Definition 6.264 (Interpretive correction of quantitative meaning). *Interpretive correction of quantitative meaning* occurs when contextual, linguistic, institutional, or practice-based evidence revises the substantive interpretation assigned to a quantita-

tive pattern without requiring that the numerical pattern itself be discarded.

The distinction is important. Correction can change the claim attached to a coefficient while leaving the coefficient unchanged. It can also reveal that separate estimates are needed because the original variable pooled non-equivalent relations. Interpretation therefore enters quantitative inquiry at the level of meaning and category adequacy, not only after statistical analysis is complete.

6.17.3 Qualitative Categories Corrected by Measurement

Qualitative inquiry often develops categories from close engagement with practices, narratives, institutions, and situated differences. Such categories can achieve high contextual adequacy while remaining uncertain in distribution, prevalence, comparative reach, or temporal stability. Measurement can correct qualitative categories when it reveals that a distinction treated as central is rare, that a supposedly marginal form is widespread, that several field-defined types overlap empirically, or that variation within a category is greater than the qualitative account initially suggested.

This corrective function should not be understood as quantitative validation of qualitative truth. Measurement works through operationalization, and operationalization can itself distort the category under examination. The relevant contribution is more specific: explicit measurement can test the extension, distribution, boundary, and repeatability of a qualitative distinction. It can also make counterexamples visible at a scale that local observation cannot easily access.

For example, a field study may identify a meaningful distinction between two organizational practices. A subsequent survey or administrative reconstruction may show that the distinction predicts only a small part of observed variation, or that a third pattern appears frequently outside the original sites. The qualitative category need not be abandoned. It may instead be revised into a conditional type, decomposed into several dimensions, or limited to a particular institutional context. Longino's emphasis on critical interaction is again relevant: objectivity is strengthened when assumptions and classifications are exposed to perspectives capable of challenging them (Longino 1990).

Proposition 6.265 (Measurement-based category correction). *When a qualitative category carries claims about prevalence, distribution, comparative scope, or empirical boundaries, appropriately constructed measurement can correct those claims by testing where the category travels, where it overlaps with alternatives, and where its internal variation becomes materially significant.*

Measurement therefore supplies one kind of resistance to overextension. The qualitative category, in turn, supplies the interpretive content needed to determine what is being measured. Mutual correction is strongest when both operations remain visible.

6.17.4 Historical Claims Corrected by Comparative Evidence

Historical inquiry reconstructs sequences, contingencies, institutional transformations, and context-specific mechanisms. Its strength can become a limitation when a mechanism inferred from one trajectory is treated as broadly general without comparison to alternative sequences. Comparative evidence corrects historical claims by showing whether an apparently distinctive process recurs elsewhere, whether

similar outcomes arise through different mechanisms, or whether comparable initial conditions generate divergent trajectories.

Comparison is especially useful for testing narratives of necessity. A single historical sequence can appear internally coherent because later events make earlier steps seem preparatory. Comparative cases can reveal branches that were feasible but unrealized, institutions that responded differently to similar pressures, or similar outcomes produced without the mechanism emphasized in the focal account. Sewell's analysis of events and structural transformation emphasizes that consequential historical events can reorganize schemas and resources rather than simply instantiate pre-existing structures (Sewell 1996). Comparative inquiry can test whether the inferred transformation depends on features specific to one event or reflects a broader relational pattern.

Comparative correction also works against false uniqueness. Researchers can overstate the singularity of an institutional form because the evidential archive is organized nationally or disciplinarily. Cross-case comparison may reveal homologous processes under different names, or it may show that surface similarity conceals distinct legal, political, or cultural relations.

Definition 6.266 (Comparative correction of historical inference). *Comparative correction of historical inference* is the revision of a historical claim after evidence from additional cases, trajectories, or periods alters the inferred necessity, uniqueness, portability, or mechanism of the focal sequence.

Comparison does not eliminate historical specificity. It identifies more precisely which parts of a historical explanation can travel and which depend on a particular sequence, boundary, or institutional configuration.

6.17.5 Models Corrected by Field Observation

Models can organize relations that are difficult to perceive directly, yet their tractability often depends on simplifying how actors interpret rules, how institutions are enacted, how informal practices modify formal structures, and how exceptional situations are handled. Field observation corrects models when situated practice reveals relations, distinctions, feedbacks, or constraints omitted from the model's representation.

The correction is particularly important for models built from administrative data or formally specified institutions. What appears in the data as a rule can be implemented selectively. What appears as a binary organizational boundary can be traversed through informal coordination. A resource recorded as available may be practically inaccessible to particular actors. Bourdieu and Wacquant's methodological relationalism emphasizes that positions and practices acquire meaning within fields of relations rather than in isolation (Bourdieu and Wacquant 1992). Field observation can therefore disclose how modeled positions are actually inhabited and negotiated.

A field-based discrepancy can have several implications. It may indicate measurement error, an omitted variable, an omitted relation, a misspecified behavioral rule, an unrepresented institutional layer, or a boundary problem. The appropriate response is not automatically to enrich the model. Sometimes the field observation shows that the model should be used only for a narrower target. In other cases it motivates a new state, relation type, or mechanism.

Proposition 6.267 (Field correction of modeled relations). *When field evidence reveals recurrent practices or relations that materially alter the mechanism or target represented by a model, the discrepancy should be treated as information about model scope or structure rather than absorbed as unexplained residual variation by default.*

Field observation thus supplies contact with forms of relational organization that standardized representations can weakly preserve. The model can subsequently test whether those observations matter beyond the local site.

6.17.6 Interpretation Corrected by Counterevidence

Interpretation is indispensable when research concerns meaning, intention, legal reasoning, symbolic practice, institutional language, or historically situated categories. Yet interpretive coherence can become self-reinforcing if evidence is selected primarily for compatibility with an established reading. Counterevidence corrects interpretation by requiring plausible readings to confront passages, actions, cases, or outcomes that the interpretation predicts poorly or cannot readily accommodate.

Counterevidence need not be decisive falsification. Interpretive claims often concern layered, contested, and context-dependent objects for which several readings retain partial support. The corrective requirement is that resistant evidence remains inside the interpretive field rather than being dismissed solely because it complicates the preferred account. Ricoeur's effort to articulate explanation together with understanding provides one model for maintaining interpretive openness while subjecting interpretation to structured constraints (Ricoeur 1991).

A resistant case can lead to several revisions. The interpretation may be narrowed to a subset of contexts; an additional actor perspective may be incorporated; the meaning of a category may be differentiated historically; or the original interpretation may be replaced. Counterevidence can also reveal that the apparent contradiction arises because the research object itself contains competing normative or symbolic orders.

Definition 6.268 (Interpretive counterevidence). *Interpretive counterevidence* is evidence that remains materially difficult to accommodate under a proposed interpretation and therefore creates a reason to revise the interpretation's scope, internal differentiation, contextual assumptions, or substantive content.

The concept protects interpretive inquiry from both extremes: it avoids treating interpretation as unconstrained, while also avoiding the assumption that a single discrepant observation mechanically decides among complex meanings.

6.17.7 Formal Elegance Corrected by Empirical Inadequacy

Formal elegance can make a model intellectually compelling because compression, symmetry, tractability, or structural economy can reveal relations that are difficult to see in ordinary prose. Section 6.12 nevertheless separated aesthetic judgment from epistemic warrant. Mutual correction makes that separation operational: empirical inadequacy can override the attraction of an elegant formal structure when the structure fails at the target for which empirical adequacy is required.

McAllister's historical analysis of aesthetic evaluation in science shows that standards of beauty and elegance can guide theory preference while changing across sci-

entific history (McAllister 1996). Such criteria can be generative because they orient attention toward coherent and fertile theoretical forms. Their epistemic role remains defeasible. An elegant model that persistently misrepresents observed relations, omits decisive historical conditions, or fails under relevant comparison should not be insulated by its formal appeal.

Empirical correction need not imply abandonment. A model can remain valuable as an exploratory structure, limiting case, comparative benchmark, or theory-generating instrument after losing status as an empirically adequate explanation. The model-function profile developed in Section 6.16 makes this repositioning explicit.

Proposition 6.269 (Aesthetic non-immunity of formal models). *Formal elegance can support attention, tractability, and theory generation, but it does not immunize a model against empirical, historical, interpretive, or relational evidence that materially undermines the function for which the model is being used.*

Correction therefore need not destroy an elegant model. It can reclassify its epistemic function and preserve what remains generative without overstating its warrant.

6.17.8 Empirical Regularity Corrected by Historical Discontinuity

Empirical regularity can be compelling because repeated association suggests stability. Historical discontinuity places a boundary around that inference. A relation estimated across one institutional regime, technological environment, legal order, or classificatory system may weaken or reverse after the underlying conditions change. Regularity therefore requires a continuity assumption that historical inquiry can test.

This issue is especially important in economic and institutional research because the production of data is itself historically organized. The same variable name can persist while the process generating it changes. Policy reforms can alter incentives and reporting. New technologies can change available actions. Political events can reorganize institutions. Sewell's account of structural transformation highlights how events can alter schemas and resources in ways that change the conditions of subsequent action (Sewell 1992; Sewell 1996). When those transformations occur, pooling observations across the discontinuity can manufacture apparent stability or conceal genuine change.

Historical correction asks whether the relation has the same identity on both sides of the break. If the answer is uncertain, researchers may need regime-specific estimates, interaction terms, segmented comparisons, revised categories, or a different model of continuity. The correction can also run in the other direction: a purported historical rupture may prove less consequential when empirical evidence shows continuity in behavior or outcomes.

Definition 6.270 (Historical discontinuity correction). *Historical discontinuity correction is the revision of an empirical regularity claim when historically evidenced changes in institutions, categories, technologies, relations, or opportunity structures undermine the assumption that observations before and after the change are generated by a sufficiently continuous process.*

The concept ties empirical scope to historical identity. A regularity can be robust within a regime and still fail as a transhistorical claim.

6.17.9 Recursive Methodological Revision

The preceding cases show that correction among methods is rarely a one-step procedure. Historical evidence may force a formal model to change; the revised model may suggest a new comparison; comparison may reveal a measurement problem; revised measurement may generate a quantitative anomaly; field observation may then reveal an omitted practice; and the resulting interpretation may require another round of model revision. Methodological pluralism therefore becomes recursive when correction alters the subsequent organization of inquiry itself.

Definition 6.271 (Recursive methodological revision). *Recursive methodological revision* is the repeated reorganization of methods, categories, representations, evidence, and inferential relations in response to corrections generated within and across inquiry modes over successive research cycles.

The object of revision can be local or architectural. A local revision changes an estimate, category, coding rule, model term, or interpretation. An architectural revision changes which methods are used, which method has priority for a particular claim, how evidence is translated across representations, or what the research object itself is taken to be. Dewey's account of inquiry as transformation of an indeterminate situation is useful here because inquiry proceeds through repeated reconstruction rather than a fixed sequence of neutral operations (Dewey 1910). GRE adds that such reconstruction occurs across heterogeneous methods whose corrective relations can themselves evolve.

Recursive revision also requires preservation. If prior categories, model versions, coding decisions, field notes, alternative interpretations, and rejected mechanisms disappear, later researchers cannot reconstruct why a methodological change occurred or whether the change improved warrant. Methodological revision should therefore leave an inspectable history when the stakes and resources justify it.

Proposition 6.272 (Mutual-correction principle). *In methodologically plural inquiry, disagreement among adequately executed methods should be examined for differences in object definition, representation, boundary, scale, historical period, evidential access, and inferential assumptions before it is reduced to error or averaged into consensus.*

Proposition 6.273 (Recursive correction principle). *When a methodological correction materially changes the research object, category system, evidential interpretation, or inferential bridge, the methods that depend on the revised element should themselves be reconsidered rather than treated as unchanged downstream procedures.*

These principles give methodological pluralism a dynamic form. Methods remain distinct enough to resist one another and connected enough to learn from the resistance. Mutual correction does not promise final methodological convergence. It creates a disciplined process through which the research configuration can become more adequate while preserving the remainders that one method cannot absorb into another. The next section examines this problem at the representational interface by analyzing how claims are translated across narrative, variable, relational, legal, qualitative, and formal forms.

6.18 Translation across Methodological Representations

The preceding sections established methodological plurality and mutual correction. Those commitments create a further problem: methods rarely remain epistemically isolated. A historical narrative may be coded into variables, field observations may be summarized as categories, social relations may be represented as edges, legal statuses may become analytical groupings, and formal results may later be expressed in interpretive prose. This section examines such movements as *translations across methodological representations*. Its role is to specify what can be preserved, transformed, omitted, or newly introduced when an object passes from one representational form into another. The discussion proceeds through recurrent translation interfaces and then develops criteria for information loss, non-equivalence, and reversibility. The objective is methodological discipline rather than representational purity: GRE can move among heterogeneous representations while keeping the epistemic consequences of those movements visible.

Definition 6.274 (Methodological representation translation). A *methodological representation translation* is a rule-governed transformation through which an object, relation, event, category, experience, or result expressed in one methodological representation is re-expressed in another representation for a specified research purpose.

Translation therefore includes a source representation, a target representation, a purpose, a set of transformation rules, and a remainder. The remainder matters because methodological representations select different properties of an object. Giere's purposive account of scientific representation is useful here: models represent selected aspects of targets for particular purposes rather than reproducing targets in their entirety (Giere 2004). Translation across representations consequently changes the selection through which the object becomes epistemically available.

6.18.1 Narrative–Variable Translation

Narrative representations preserve sequence, actor perspective, institutional context, contingency, ambiguity, and relations among events in forms that can remain open to reinterpretation. Quantitative inquiry often requires a different structure. Events and descriptions must be mapped into variables whose values can be compared across observations. The translation creates analytical portability, but it also requires decisions about what counts as an instance, which distinctions are retained, and which narrative features are treated as irrelevant to the target claim.

Consider a historical narrative describing repeated episodes of insecure employment. The narrative may distinguish contract status, bargaining relations, household responsibilities, employer practices, legal protections, expectations of continuity, and the person's interpretation of risk. Translating the narrative into a variable such as "employment insecurity" requires an operational rule. The rule might use contract duration, hours variability, probability of dismissal, or a composite index. Each choice makes a different part of the narrative analytically portable.

Porter's history of quantitative objectivity shows how standardized categories and measures gain strength through comparability and impersonal portability (Porter 1995). Desrosières likewise demonstrates that statistical reasoning depends on his-

torically constructed practices of classification, coding, equivalence, and aggregation (Desrosières 1998). A variable is therefore an epistemic achievement rather than a transparent extraction from narrative material.

Definition 6.275 (Narrative-to-variable translation). A *narrative-to-variable translation* is the transformation of contextually organized descriptions into a coding or measurement scheme that preserves selected properties in a form permitting systematic comparison across observations.

The strength of the translation depends on fit between the retained properties and the claim for which the variable is used. A variable can be well suited to estimating prevalence while remaining poorly suited to reconstructing sequence, meaning, or institutional mediation. The source narrative should remain recoverable where later reinterpretation could materially change the variable's meaning or boundary.

6.18.2 Relation–Edge Translation

Relational inquiry often translates a substantive relation into an edge within a network representation. The operation is powerful because edges make relational structure mathematically tractable. Degree, centrality, clustering, paths, communities, temporal ordering, and multilayer structure can then be examined explicitly. Network science provides a mature vocabulary for these structural properties (Newman 2003), while temporal and multilayer approaches show how timing and relation type can be incorporated rather than collapsed into one static graph (Holme and Saramäki 2012; Kivelä et al. 2014).

Yet a substantive relation and an edge are not interchangeable objects. A relation can include direction, intensity, obligation, meaning, legal status, temporal depth, multiplexity, contested interpretation, and third-party dependence. An edge representation retains only those properties encoded in its definition and attributes. Even a weighted, directed, temporal edge may omit features that remain important to the relation under investigation.

Definition 6.276 (Relational edge translation). A *relational edge translation* is the representation of a substantively specified relation through a graph or network element whose existence and attributes are determined by an explicit edge-definition rule.

The edge-definition rule is therefore part of the evidence. A coauthorship edge, for example, indicates a documented joint publication under a particular counting rule; it does not by itself establish intellectual influence, trust, friendship, equal contribution, or continuing collaboration. Likewise, a transaction edge can record exchange while leaving bargaining power and legal dependence outside the representation.

Higher-order interactions create an additional limit. Some relations involve groups whose interaction cannot be reconstructed adequately from pairwise links alone. Higher-order network research makes this distinction explicit by representing interactions among three or more units through structures beyond ordinary pairwise edges (Battiston et al. 2020). Translation from relation to edge is therefore strongest when the edge structure preserves the relational property relevant to the research claim and when omitted higher-order structure is explicitly considered.

6.18.3 Historical Category–State Variable Translation

Historical categories are situated within institutions, languages, classificatory practices, and trajectories of change. Formal or computational inquiry may translate such a category into a state variable that can assume specified values across time. This translation makes transitions, persistence, and comparative dynamics easier to analyze, but it requires an identity criterion that determines when historical variation counts as change within one state space and when the category itself has transformed.

A category such as “firm,” “household,” “worker,” or “citizen” can retain the same lexical label across periods while its legal constitution, institutional boundary, resource access, and practical meaning change substantially. Hacking’s historical ontology emphasizes that categories and objects of knowledge can emerge and change through historically specific styles of reasoning and classificatory practices (Hacking 2002). Treating a historical category as a stable state variable can therefore conceal transformations in the category that makes the variable possible.

Definition 6.277 (Historical state-variable translation). A *historical state-variable translation* is the representation of a historically situated category through a defined state space whose values permit comparison or dynamic analysis across specified periods.

Such a translation requires at least three explicit judgments: the historical identity criterion for the category, the coding rule that assigns observations to states, and the temporal interval over which the state space is treated as sufficiently stable. If any of these conditions changes materially, apparent state transitions may partly reflect category transformation rather than change within a stable category.

The distinction is especially important for long-run modelling. A model can represent a sequence of states with formal precision while silently treating historically non-equivalent categories as commensurable. Historical correction, developed in Section 6.17, then becomes a test of whether the state-variable translation remains warranted across the period under study.

6.18.4 Field Experience–Formal Structure Translation

Field experience contains observations, conversations, embodied routines, spatial arrangements, tacit expectations, anomalies, and practical sequences that often exceed immediate formal expression. Formalization can nevertheless disclose structure that is difficult to see within the density of experience. Recurrent dependencies can become graphs, sequences can become transition structures, constraints can become admissible-state conditions, and differentiated positions can become model parameters or relational roles.

The translation begins with abstraction. Some properties of field experience are selected because they appear recurrent or analytically consequential. Those properties are then assigned formal counterparts. The formal structure can clarify assumptions and expose implications that were only implicit in field description. It can also generate new questions that return the inquiry to the field.

Bourdieu and Wacquant’s reflexive methodology is relevant because the analytical construction of the object is itself part of social-scientific practice rather than a passive transcription of experience (Bourdieu and Wacquant 1992). Formalization intensifies this constructive moment by requiring explicit boundaries, relation types,

state definitions, or functional dependencies.

Proposition 6.278 (Field-to-formal traceability). *When field experience is translated into a formal structure, the analytical pathway from observed or interpreted field material to formal objects should remain sufficiently traceable to identify which empirical distinctions support the formalization and which experiential properties remain outside it.*

Traceability allows formal results to return to their evidential basis. Without it, the formal structure can acquire autonomy from the field and make later correction difficult. With it, formalization can function as a disciplined compression that remains open to revision when additional field evidence exposes omitted relations or alternative structures.

6.18.5 Legal Category–Analytical Object Translation

Legal categories are particularly consequential methodological representations because they are simultaneously classificatory and institutionally operative. Terms such as corporation, employee, property, beneficiary, contract, creditor, or household member can allocate rights, duties, liabilities, standing, and access to remedies. Research often translates these categories into analytical objects for comparison, measurement, modelling, or causal analysis.

The translation must distinguish legal definition from analytical purpose. Organizational law, for example, can constitute entities and separate asset pools in ways that have material economic consequences (Hansmann and Kraakman 2000). An analytical category labelled “firm” may nevertheless require a different boundary when the research target concerns productive coordination, ownership, control, consolidated reporting, or network dependence. Similarly, reporting frameworks can define an economic reporting entity whose boundary does not simply coincide with one legal entity (IFRS Foundation 2018).

Definition 6.279 (Legal-to-analytical translation). *A legal-to-analytical translation is the transformation of a legally constituted category, status, relation, or boundary into an analytical object specified for a research question while preserving the legal properties materially relevant to that question.*

The preservation clause matters. An analytical simplification that removes legal relations can become misleading when those relations are causally or institutionally active. At the same time, legal categories should not automatically determine the full analytical ontology. Research can distinguish legal ownership from effective control, formal employment from practical dependence, or juridical organization from economic coordination when the evidence supports those distinctions.

Legal categories thus enter methodological translation in a dual role: they are representations produced by institutions and relations that can help constitute the object being studied. Their analytical translation must preserve this performative dimension where it matters.

6.18.6 Qualitative Difference–Quantitative Measure Translation

Qualitative inquiry often encounters differences before their magnitude, prevalence, or distribution is known. Researchers may identify varieties of practice, contrasting

meanings, institutional types, experiences of constraint, or degrees of relational dependence through interviews, observation, documents, or interpretive comparison. Translating those differences into quantitative measures can make distribution and comparison explicit, but it requires a metric or ordering structure that the qualitative material does not automatically supply.

A distinction can be nominal, ordinal, interval-like, multidimensional, or resistant to meaningful compression into one scale. Measurement therefore begins by specifying what form of difference is being asserted. Standardization is useful when observations can be made sufficiently commensurable, yet the history of quantification shows that commensurability is constructed through choices about categories, units, coding, and acceptable loss of local detail (Porter 1995; Desrosières 1998).

Definition 6.280 (Qualitative measurement translation). A *qualitative measurement translation* is the assignment of numerical, ordinal, categorical, or vector-valued representations to qualitatively identified differences according to an explicit measurement rule and a specified comparative purpose.

The definition allows several forms of measurement without presuming that every qualitative distinction belongs in one metric space. Some differences are better represented by multiple dimensions or mutually exclusive types. Others may support ranking while resisting meaningful interval comparisons. Measurement quality therefore includes fidelity to the topology of the qualitative distinction, not merely reliability of numerical coding.

Quantification can then feed back into qualitative inquiry. Unexpected distributions, clustering, or overlap can reveal that the original distinction was too coarse, too context-specific, or internally heterogeneous. Translation can thus become a site of mutual correction rather than a one-way reduction of qualitative material to numbers.

6.18.7 Formal Result–Interpretive Claim Translation

Formal results acquire substantive meaning only through interpretation. A theorem establishes consequences within a formal system. A coefficient estimates a relation under a statistical specification. A simulation produces trajectories under programmed rules and parameter settings. A network metric summarizes a property of a defined graph. None of these results carries a complete interpretation of the empirical or historical world independently of the bridge connecting formal objects to substantive claims.

Ricoeur’s treatment of explanation and understanding is helpful because it shows that formal explanation and interpretation can be connected without reducing one to the other (Ricoeur 1991). Giere similarly emphasizes that models represent selected aspects of reality through purposive representational claims (Giere 2004). The move from result to interpretation therefore adds propositions about what the formal object corresponds to, which assumptions travel with the result, and how the result bears on the substantive research question.

Definition 6.281 (Formal-to-interpretive translation). A *formal-to-interpretive translation* is the inferential operation through which a result established within a formal, statistical, or computational representation is connected to a substantively meaningful claim about a specified research object.

This translation should preserve function. A predictive result translated into explanatory prose requires an additional explanatory bridge. A simulated possibility translated into a claim of historical occurrence requires historical evidence. A network centrality score translated into power requires a theory and evidence connecting the metric to relevant forms of control, access, dependence, or influence. The model-function distinctions developed in Section 6.16 therefore constrain interpretation after formal analysis.

Proposition 6.282 (Interpretive bridge requirement). *A substantive claim derived from a formal result requires an explicit interpretive bridge specifying how the formal objects, assumptions, and result correspond to the properties of the research object invoked by the claim.*

The bridge does not weaken formal inquiry. It identifies the point at which formal validity becomes substantive inference and therefore makes that inference open to correction.

6.18.8 Information Loss in Translation

Translation is usually selective. A narrative coded into variables may lose sequence and ambiguity. A relation represented as an edge may lose meaning or higher-order context. A legal category transformed into an analytical grouping may lose doctrinal distinctions. Field experience compressed into a formal structure may lose tacit, embodied, or situational detail. These losses are not automatically methodological defects; compression is often the condition that makes analysis possible. The epistemic problem arises when omitted information is material to the claim or when the loss becomes invisible.

Definition 6.283 (Translation remainder). *A translation remainder is information, structure, meaning, uncertainty, or contextual dependence present in the source representation that is not preserved in the target representation under the chosen translation rule.*

Definition 6.284 (Material translation loss). *A material translation loss occurs when a translation remainder could reasonably alter the interpretation, scope, comparison, mechanism, attribution, or practical use of the claim for which the target representation is employed.*

This distinction permits disciplined compression. Researchers need not preserve every detail from every representation. They should identify losses that matter for the intended inferential function. Longino's emphasis on critical scrutiny is relevant because what appears irrelevant from one methodological position may become consequential from another (Longino 1990). Mutual correction is partly a process of discovering previously invisible translation remainders.

A useful translation record can therefore state the source representation, target representation, translation rule, retained properties, known remainders, uncertain losses, and intended function. Such documentation becomes especially important when the target representation travels far from the context in which the translation was originally made.

6.18.9 Non-Equivalent Representations

Two methodological representations can concern the same research object without being equivalent. A historical narrative and a time series can overlap in temporal scope while preserving different properties. A legal category and a survey category can use similar labels while defining membership differently. A graph and an ethnographic account can describe the same organizational setting while representing distinct relational structures. Translating between them therefore requires comparison of preserved information rather than an assumption of identity.

Definition 6.285 (Representational non-equivalence). Two methodological representations are *non-equivalent* with respect to a research purpose when each preserves at least one property materially relevant to that purpose that cannot be recovered from the other representation under the available translation rules and auxiliary information.

Non-equivalence can be local rather than global. Two representations may be equivalent for estimating one quantity while diverging for historical explanation or normative interpretation. A legal and administrative classification may yield identical counts for one period while differing in the rights or exclusions attached to membership. A weighted network and a narrative may support the same claim about repeated interaction while differing on whether the interaction expresses cooperation, coercion, obligation, or strategic dependence.

The practical consequence is that methodological integration should not force all representations into one master format. Some research claims are better supported by keeping multiple representations in parallel and specifying the relations among them. Partial irreducibility, introduced in Section 6.14, thus reappears at the level of representation itself.

Proposition 6.286 (Parallel-representation principle). *When methodologically non-equivalent representations preserve different properties that are materially relevant to the same research claim, the inquiry should retain those representations in parallel or explicitly preserve their irreducible remainders rather than treating translation into one format as epistemically complete.*

Parallel representation can be more cumbersome, but the additional complexity is warranted when a single representation would erase distinctions central to the research object.

6.18.10 Reversibility and Irreversibility of Translation

Some methodological translations are approximately reversible. A dataset generated from a fully documented coding scheme may allow reconstruction of the coded categories and source identifiers. A formal transformation can sometimes be inverted when the mapping is one-to-one and all necessary parameters are retained. Other translations are substantially irreversible. Aggregation can erase individual variation; anonymization can deliberately remove linkage information; summary statistics cannot reconstruct the original observations; and a binary edge representation cannot recreate meanings, negotiations, or temporal sequences that were never encoded.

Definition 6.287 (Representational reversibility). A methodological translation is *reversible relative to a specified property set* when the source representation's relevant

properties can be reconstructed from the target representation and retained auxiliary information with an explicitly acceptable degree of uncertainty.

Definition 6.288 (Representational irreversibility). A methodological translation is *irreversible relative to a specified property set* when information necessary to reconstruct those properties has been discarded, merged, transformed beyond recoverability, or never encoded in the target representation and available auxiliary record.

Reversibility is therefore relative to what needs to be recovered. A transformation can be reversible for category membership and irreversible for narrative sequence. A legal record can preserve formal status while losing informal bargaining history. A quantitative dataset can permit reconstruction of measured responses while leaving the respondent's interpretive context unavailable.

The distinction has direct implications for research design. When translation is expected to be lossy and future reinterpretation is plausible, preservation of source material, provenance, coding rules, model versions, and translation metadata can protect later inquiry. Preservation remains subject to privacy, legal, ethical, security, and resource constraints. The aim is selective recoverability rather than indefinite retention of all material.

Proposition 6.289 (Translation traceability principle). *For methodologically consequential translations, research records should preserve enough provenance to identify the source and target representations, the transformation rule, materially relevant losses, and the degree to which later reconstruction remains possible, subject to applicable ethical and institutional constraints.*

Translation across methodological representations is thus a generative moment of research praxis. It enables comparison, formalization, measurement, modelling, and integration, while also producing new analytical objects and new possibilities for loss. Treating translation explicitly allows methodological plurality to remain connected without pretending that heterogeneous representations are interchangeable. The next section develops the recursive consequence of this insight by treating research as iterative reconstruction across observation, interpretation, formalization, empirical examination, and revision.

6.19 Iterative Reconstruction in Research

This section develops the recursive organization of research praxis after the methodological pluralism, mutual correction, and representational translation established in Sections 6.14–6.18. Its role is to explain how observation, interpretation, concept formation, formalization, empirical examination, and comparison can repeatedly reconstruct one another rather than form a single linear sequence. The objective is to specify the principal moments through which research objects, categories, models, theories, and methods are stabilized provisionally and then reopened when evidence, translation remainders, anomalies, or new relational configurations require revision. The discussion proceeds analytically through twelve moments of reconstruction and concludes by treating iteration across research cycles as a cumulative but non-identical process. The framework is methodological rather than ontological: it concerns how inquiry reorganizes its representations and inferential commitments while remaining answerable to evidence and to the relational realities under investigation.

Definition 6.290 (Iterative research reconstruction). *Iterative research reconstruction* is a research process in which observations, interpretations, concepts, formal representations, empirical examinations, comparisons, categories, theories, and methods are repeatedly revised in response to one another, with the provenance of consequential revisions kept sufficiently visible for later scrutiny.

Iteration therefore differs from repetition. Repetition may reproduce the same procedure under similar assumptions. Iterative reconstruction permits the object of inquiry, the questions asked of it, the representational system, and the standards of adequacy to change when warranted. Dewey's account of inquiry already treats problematic situations, conceptual operations, and experimental consequences as recursively connected rather than as isolated stages (Dewey 1910). Longino's emphasis on transformative criticism similarly makes scientific knowledge dependent on the possibility that claims and background assumptions can be altered through critical interaction (Longino 1990). GRE extends these insights by making relational change, methodological translation, and generative consequences explicit within the research cycle.

6.19.1 Observation

Observation is the first moment considered here because research reconstruction requires some relation through which features of the object become available to inquiry. Observation need not be temporally first in every project. Concepts, instruments, archives, or prior theories often precede a particular observation and condition what can be noticed. The analytical role of observation is therefore to supply or reorganize evidential contact rather than to provide an unmediated foundation.

Definition 6.291 (Reconstructive observation). *Reconstructive observation* is observation treated as revisable evidential access whose target, conditions, instruments, and interpretive relevance can be re-specified during inquiry.

An observation can change the research configuration in several ways. It can add a previously unavailable trace, challenge an existing category, disclose variation hidden by aggregation, reveal a relation that a model omitted, or weaken confidence in an earlier mechanism. Observations can also remain stable while their role changes. A record initially treated as background may become central after a new comparison; a recurrent field practice may acquire theoretical relevance only after a category is reformulated; an apparent anomaly may become expected once the relevant boundary or scale changes.

Observation should therefore preserve provenance. Researchers should be able to distinguish what was directly recorded, what was instrument-mediated, what was reconstructed from archival or administrative traces, and what entered the evidential record through later inference. Hacking's historical analyses of scientific objects and classifications illustrate how practices of observation and intervention can change the entities and regularities available to inquiry (Hacking 2002). For iterative reconstruction, such change is part of the evidential history rather than an inconvenience to be erased.

6.19.2 Interpretation

Interpretation organizes observations into provisional meanings, relations, and explanatory possibilities. It connects a trace to a context and determines which distinctions become analytically relevant. Interpretation is required even when data appear highly standardized because the meaning of variables, categories, absences, changes, and comparisons depends on assumptions concerning the research object and its relational setting.

Definition 6.292 (Reconstructive interpretation). *Reconstructive interpretation* is an interpretation whose assumptions, contextual relations, and evidential consequences remain open to revision when subsequent observation, comparison, formalization, or counterevidence changes the warranted reading of the material.

Interpretation can revise observation without denying the observation's occurrence. A recorded decline can remain numerically unchanged while being reinterpreted as category migration rather than behavioral change. A repeated interaction can remain documented while its meaning shifts from cooperation to dependency after additional institutional evidence. A silence in an archive can move from apparent absence of activity to evidence of a recording regime that excluded certain relations. In each case, the reconstruction changes what the observation supports.

Interpretive revision benefits from preserving competing readings when more than one remains materially plausible. This practice supports the revisability developed in Section 6.17: later methods may supply evidence that discriminates among interpretations that could not initially be resolved. Interpretive plurality is therefore productive when it is disciplined by evidence, provenance, and explicit inferential conditions rather than used to suspend evaluation indefinitely.

6.19.3 Concept Formation

Concept formation gives research a vocabulary for distinguishing objects, relations, mechanisms, trajectories, and evaluative dimensions. Concepts permit observations to become comparable and arguments to become cumulative. They also create selective boundaries around what counts as a case, a relation, a transformation, or an effect. Concept formation is consequently both enabling and risky.

Definition 6.293 (Reconstructive concept). A *reconstructive concept* is a research concept whose extension, internal distinctions, relational dependencies, and evidential indicators can be revised when the existing formulation no longer adequately organizes the phenomena for which it is used.

Conceptual revision may occur through differentiation, aggregation, redefinition, or relocation. A single category may divide when previously hidden heterogeneity becomes consequential. Several categories may be grouped when their differences prove irrelevant to the target claim. A concept may retain its name while changing its operational criteria, or it may move from being treated as an attribute of actors to being understood as a relation among them.

The history of science contains many cases in which changing concepts reorganized observation and explanation. Kuhn's account of scientific development emphasizes that changes in disciplinary matrices can alter the questions, classifications, and standards through which phenomena are rendered intelligible (Kuhn 1962). Iterative reconstruction does not require adopting a universal theory of paradigms. It draws

the more limited methodological lesson that concept formation participates in the production of the research object and therefore requires its own revision history.

6.19.4 Formalization

Formalization converts selected concepts and relations into explicit structures whose implications can be inspected more precisely. As developed in Sections 6.16 and 6.18, formalization can clarify assumptions, expose inconsistencies, support comparison, and generate new questions. It can also conceal translation loss when the relationship between the formal object and its source representation becomes opaque.

Definition 6.294 (Reconstructive formalization). *Reconstructive formalization* is a formal representation designed so that its assumptions, translation rules, target properties, and material remainders can be revised when empirical, historical, interpretive, or comparative inquiry reveals a mismatch between the formal structure and the research object.

Formalization can reconstruct earlier stages of inquiry by forcing implicit assumptions into explicit form. A model may reveal that a verbal explanation presupposes independence where field evidence suggests dependence, or that a proposed mechanism requires a temporal ordering unsupported by the record. Conversely, an apparently poor formal fit can identify the need to revise categories, boundaries, or scale rather than simply to add parameters.

This is why formalization should remain function-specific. A formal structure developed for comparison need not become an explanatory model, and an exploratory model need not be interpreted as a literal description of the underlying ontology. Reconstruction occurs when formal work returns to the concepts, evidence, and translations from which it was built and helps reorganize them.

6.19.5 Empirical Examination

Empirical examination tests how provisional concepts, interpretations, and formal structures relate to observed material. The term is used broadly here to include quantitative, qualitative, historical, ethnographic, legal-institutional, and computational evidence where the inquiry makes contact with records, practices, measurements, traces, or events capable of constraining a claim.

Definition 6.295 (Reconstructive empirical examination). *Reconstructive empirical examination* is the use of evidence to assess and potentially reorganize the concepts, representations, mechanisms, and scope conditions through which a research claim has been formulated.

Empirical examination therefore does more than confirm or reject a finished theory. It can show that the wrong object was measured, that the relevant relation operates at another scale, that the sampling frame excludes a crucial population, or that an apparent regularity is specific to a historical configuration. Popper's tradition of exposing theories to potential criticism remains an important precedent for maintaining empirical vulnerability (Popper 2002). Iterative reconstruction broadens the location of possible revision: criticism may alter the proposition under test, but it may also alter the categories, measurement architecture, boundary, comparison class, or method through which the proposition became testable.

Evidence can consequently be theory-relevant without being reducible to a binary test. The appropriate response to a mismatch depends on diagnosis. Some findings weaken a theory; others reveal a measurement failure; still others disclose a new object that the existing theory did not attempt to explain.

6.19.6 Comparison

Comparison makes differences and commonalities visible across cases, periods, scales, representations, models, or methodological results. Its reconstructive role is to challenge the assumption that categories and mechanisms travel unchanged. A claim that appears adequate within one case may require revision when a second case reveals a hidden boundary condition.

Definition 6.296 (Reconstructive comparison). *Reconstructive comparison* is comparison used to identify which properties of a research object, concept, mechanism, or representation remain stable across specified differences and which require revision of scope, category, or explanation.

Comparison can operate within a method or across methods. Historical comparison may test whether a category retains meaning across periods. Cross-institutional comparison may distinguish a local rule from a more general mechanism. Comparison between a model and field material may identify where formal structure preserves or loses relevant relations. Comparison among competing interpretations can locate the observations on which disagreement turns.

The value of comparison therefore depends on explicit comparability. Similar labels, measurements, or legal categories do not guarantee equivalent objects. Section 6.18 showed that translation across representations can create material remainders. Reconstructive comparison carries that lesson forward by requiring the basis of comparability itself to remain revisable.

6.19.7 Reinterpretation

Reinterpretation occurs when later evidence, concepts, comparisons, or models change the warranted meaning of earlier material. It is more than replacing one opinion with another. Reinterpretation should identify what changed in the evidential or conceptual configuration and why the revised reading better fits the available material.

Definition 6.297 (Reinterpretive update). A *reinterpretive update* is a documented change in the warranted interpretation of existing evidence produced by a change in relevant context, concepts, comparisons, auxiliary evidence, or representational relations.

The same historical document can support a different inference after previously inaccessible archives become available. The same interview passage can acquire different relevance after a category distinction is refined. A statistical association can be reinterpreted after qualitative inquiry shows that a variable combines relations with different meanings. Reinterpretation is therefore a normal consequence of cumulative inquiry rather than an embarrassment to be minimized.

A disciplined reinterpretation preserves the earlier reading and the reasons it once appeared plausible. This creates a visible epistemic history and prevents later knowl-

edge from being projected backward as if it had always been available. Such preservation also supports future re-epistemization: later researchers can reconstruct how evidence, concepts, and interpretations co-evolved rather than seeing only the latest stabilized result.

6.19.8 Model Revision

Model revision changes the structure, parameters, assumptions, target, or function of a model when the current representation becomes inadequate for its intended epistemic role. Revision can be local, such as recalibrating a parameter, or structural, such as changing the relations represented or abandoning an earlier state space.

Definition 6.298 (Model revision). *Model revision* is a documented change to a model's structure, assumptions, parameters, target, scope, or epistemic function undertaken because new evidence, comparison, theory, or methodological criticism changes the conditions under which the model is warranted.

Model revision should preserve the distinction among model functions developed in Section 6.16. A revision that improves prediction may leave explanatory inadequacy unresolved. A model that becomes less parsimonious may become more historically faithful. A formal representation abandoned for estimation may remain useful as a conceptual comparison device. Revision therefore concerns fit between model and function rather than movement toward a single ideal model.

Versioned model records are especially useful where models participate in application-dominant praxis. When model outputs inform classification, allocation, or intervention, later changes can alter both the representation and the system being represented. Preserving earlier versions helps distinguish a change in the world from a change in the model's assumptions or data architecture.

6.19.9 Category Revision

Categories organize observation, measurement, comparison, administration, and interpretation. Their revision can therefore have consequences across an entire research configuration. A category that once appeared useful may become too broad, historically obsolete, normatively problematic, or empirically heterogeneous.

Definition 6.299 (Category revision). *Category revision* is a change in the definition, boundaries, internal differentiation, membership rule, or analytical role of a research category undertaken because the existing category no longer adequately supports the claims for which it is used.

Category revision can require retrospective work. Earlier datasets may need re-coding; historical comparisons may need qualification; models may need rebuilding; and apparent trends may change when the classification system changes. Hacking's work on historical kinds and classification practices is relevant because categories can have histories and can participate in reorganizing the phenomena to which they are applied (Hacking 2002).

The reconstructive principle is therefore consequentiality. A category should not be revised merely because an alternative vocabulary is available. Revision becomes methodologically important when the existing category produces material misrepresentation, obscures a relevant relation, collapses heterogeneous cases, or impedes

comparison. Once revised, dependent analyses should be reassessed rather than allowed to inherit the earlier category silently.

6.19.10 Theory Revision

Theory revision reorganizes claims about relations, mechanisms, structures, trajectories, or generative processes when accumulated research changes what can be adequately explained. Theories provide continuity across individual studies, but that continuity is productive only when theories remain vulnerable to reconstruction.

Definition 6.300 (Theory revision). *Theory revision* is a change in a theory's propositions, mechanisms, scope conditions, conceptual architecture, or relations among explanatory elements undertaken in response to evidence, comparison, conceptual criticism, or methodological development.

Theory revision may narrow scope, differentiate mechanisms, add historical conditions, reorganize causal priority, or replace an explanatory architecture. It may also preserve a theory's central insight while revising the vocabulary through which that insight is expressed. Kuhn's account of conceptual change and Longino's account of critical interaction both show that theory development occurs within communities whose standards and background assumptions can themselves change (Kuhn 1962; Longino 1990).

For GRE, theory revision should leave a trace of the relations among versions. A revised theory need not present its predecessor as wholly mistaken. Earlier formulations may remain locally useful, may describe a narrower domain, or may contain distinctions that later synthesis risks losing. Iterative reconstruction therefore favors versioned theoretical development over retrospective narratives of seamless progress.

6.19.11 Method Revision

Method revision occurs when the procedures through which evidence is produced or analyzed become inadequate to the evolving research object. This can involve modifying sampling, measurement, field practice, archival strategy, computational procedure, comparison design, or the relation among several methods.

Definition 6.301 (Method revision). *Method revision* is a change in the procedures, instruments, evidential pathways, or methodological composition of an inquiry prompted by evidence that the existing research design insufficiently accesses, represents, or tests a materially relevant property of the research object.

Method revision follows from methodological pluralism rather than contradicting it. A method can be appropriate for one claim and inadequate for another. A new object may require additional access; a category revision may invalidate an earlier measurement; an unexpected historical discontinuity may require archival reconstruction alongside statistical analysis. Section 6.17 treated mutual correction among methods as a source of such redesign.

Method revision should also preserve comparability where possible. Changing an instrument or coding scheme can improve adequacy while disrupting longitudinal continuity. The research record should therefore state what changed, why it changed, which earlier observations remain comparable, and which require qualification. This

makes methodological improvement compatible with cumulative knowledge rather than allowing each redesign to erase the evidential history that motivated it.

6.19.12 Iteration across Research Cycles

The preceding moments become a research cycle when they are connected through revision. Observation can reshape interpretation; interpretation can reshape concepts; concepts can reshape formalization and measurement; empirical examination and comparison can reshape models, categories, theories, and methods; revised methods then produce new forms of observation. The sequence is not fixed, and several moments can operate simultaneously.

Definition 6.302 (Research reconstruction cycle). *A research reconstruction cycle is a temporally organized configuration in which at least one component of inquiry is revised in response to evidence or criticism and the consequences of that revision are propagated to other dependent components of the research configuration where materially relevant.*

Proposition 6.303 (Dependency-sensitive revision principle). *When a consequential revision changes a concept, category, model, evidential interpretation, or method on which other research claims materially depend, those dependent claims should be re-assessed rather than presumed to survive the revision unchanged.*

This principle turns iteration into reconstruction rather than incremental accumulation alone. A research programme can grow by adding evidence, but it can also deepen by revising the structures through which earlier evidence was understood. The result is cumulative without requiring identity across cycles. Later inquiry inherits its archives, concepts, methods, models, critiques, and unresolved alternatives from earlier work while potentially reorganizing their relations.

Proposition 6.304 (Cumulative reconstruction principle). *Research becomes cumulatively reconstructive when successive cycles preserve enough provenance to identify what was retained, revised, abandoned, or reinterpreted, while permitting new evidence and methods to alter the organization of the inherited epistemic structure.*

This form of cumulation differs from a simple stockpiling model of knowledge. What accumulates includes evidence and results, but also revision histories, failed representations, rejected categories, methodological corrections, and records of translation loss. Peirce's fallibilist account of inquiry and Dewey's recursive treatment of investigation both provide important precedents for knowledge that advances through corrigible reconstruction rather than final closure (Peirce 1877; Dewey 1910).

Iterative reconstruction also prepares the reflexive problem that follows. Research cycles do not occur outside the relational systems they study. Observation, classification, representation, measurement, and publication can themselves enter those systems and modify later evidence. The next section therefore examines reflexivity in research: the conditions under which inquiry becomes part of the causal and relational field that subsequent inquiry must reconstruct.

6.20 Reflexivity in Research

This section develops reflexivity as a practical requirement of research praxis after the iterative reconstruction established in Section 6.19. Its role is to examine circumstances in which inquiry enters the relational field that it studies and thereby modifies later observations, classifications, representations, measurements, institutional responses, or public understandings. The objective is to make those feedback pathways inspectable without converting reflexivity into a universal claim that every research act substantially transforms its object. The discussion proceeds through observational, classificatory, representational, measurement, and publication interventions before turning to research feedback, documentation, revision, and the limits of reflexive analysis. The argument is relational and methodological: reflexivity concerns identifiable pathways between research operations and subsequent states of the research field.

Definition 6.305 (Research reflexivity). *Research reflexivity* is the disciplined analysis of pathways through which research practices, representations, classifications, measurements, communications, or institutional arrangements can alter the evidential field, relational configuration, or practical behavior relevant to later inquiry.

Research reflexivity therefore extends the relational account of research developed in Sections 6.7–6.8. The researcher is situated within institutions, languages, infrastructures, and relations of access, but situatedness alone does not establish a material feedback effect. Reflexive analysis becomes especially important when a research operation changes what can subsequently be observed or when actors orient themselves to the categories, measures, or representations produced by inquiry. Bourdieu and Wacquant place reflexivity at the center of sociological practice by requiring inquiry to examine the social and intellectual conditions of its own production (Bourdieu and Wacquant 1992). GRE retains that requirement while giving particular attention to generative feedback: research can become one relation among those that help produce the subsequent state of the system.

6.20.1 Observational Intervention

Observation can alter the field from which later evidence is drawn. The effect may arise because participants become aware of observation, because instruments change the conditions under which activity occurs, because access arrangements reorganize interaction, or because repeated observation stabilizes a new routine. The relevant epistemic question concerns whether an observational relation contributes materially to a later state rather than whether observation is philosophically pure.

Definition 6.306 (Observational intervention). An *observational intervention* occurs when the establishment or maintenance of an observational relation contributes to a change in behavior, relations, material conditions, institutional routines, or evidential availability that is relevant to the target inquiry.

The definition is intentionally conditional. A satellite sensor can record an event with negligible influence on the event itself, while a researcher embedded in a small organization can alter communication simply through presence, questioning, or requests for documentation. Laboratory instruments may physically disturb the systems they measure, whereas archival observation may leave the historical event unchanged while still altering present preservation, classification, or interpretation. Re-

flexive inquiry therefore requires a claim about a pathway, magnitude, and target rather than an assumption that observation is invariably transformative.

Observational intervention also has temporal structure. An effect can be immediate, such as altered participant behavior during observation, or delayed, such as a new reporting routine created to satisfy a study and retained afterward. The resulting evidence may then partly reflect the observational arrangement that helped generate it. This does not automatically invalidate the evidence. It changes what the evidence is evidence of and requires the observational relation to enter the reconstruction.

Proposition 6.307 (Pathway requirement for observational reflexivity). *A claim that observation materially altered a research field should identify a plausible pathway connecting the observational arrangement to the relevant change, together with the temporal, relational, and institutional conditions under which the pathway operates.*

6.20.2 Classificatory Intervention

Classification is a particularly important reflexive interface because categories can organize both knowledge and conduct. A research category can begin as an analytical convenience and later become a label used by participants, institutions, regulators, funders, or automated systems. Once incorporated into practice, the category can influence eligibility, identity, resource allocation, comparison, or strategic behavior.

Hacking's historical work emphasizes that classifications and the people or practices classified can develop in relation to one another (Hacking 2002). For research praxis, the methodological lesson is that category use should be followed beyond the moment of coding. The question is whether a category remains an internal representational device or enters the relations through which the object subsequently develops.

Definition 6.308 (Classificatory intervention). *A classificatory intervention occurs when a research classification becomes consequential within the field by affecting recognition, treatment, self-description, institutional procedure, comparison, access, or resource distribution.*

Classificatory reflexivity requires attention to circulation. A category confined to a private analytic notebook has a different intervention profile from one published in an influential report, embedded in a survey instrument, adopted by an institution, or converted into an administrative eligibility rule. The category's performative capacity therefore depends on relations of authority, dissemination, uptake, and implementation.

The possibility of intervention does not imply that researchers should avoid classification. Inquiry requires distinctions. Reflexivity instead asks that consequential categories retain a visible genealogy: how they were constructed, what differences they compress, who can contest them, and what changes follow when they enter practice. Such documentation becomes especially important when category effects later appear in the data used to validate the classification itself.

6.20.3 Representational Intervention

Research representations can travel beyond the settings in which they were produced. Narratives, diagrams, models, maps, indices, causal accounts, and typologies can re-

shape expectations and reorganize relations when actors begin to orient themselves to them. Representation then has a dual role: it remains an epistemic object while also becoming a possible element of the system represented.

MacKenzie's analysis of financial models provides a clear case in which models can become incorporated into market practice and contribute to reshaping the processes they describe (MacKenzie 2006). GRE treats this as one form of a broader representational feedback problem. A representation can alter coordination, legitimacy, strategic imagination, institutional design, or the perceived space of feasible action even when it was initially produced for descriptive or explanatory purposes.

Definition 6.309 (Representational intervention). A *representational intervention* occurs when a research representation enters subsequent practice in a way that materially alters expectations, relations, institutional arrangements, decision rules, or the possibilities actors treat as available.

Representational intervention should remain separate from representational adequacy. An inaccurate representation can become highly consequential if institutions adopt it, while a highly accurate representation can remain practically inert if it does not circulate or lacks authority. Reflexive analysis therefore tracks at least two questions separately: how well the representation is warranted as knowledge and how strongly it participates in later relational generation.

This distinction also matters for correction. When a consequential representation is revised, the earlier representation may already have generated effects that persist. Correcting the text does not automatically reverse the institutional arrangements, investments, reputational consequences, or categories that developed under the earlier representation. Reflexive revision may consequently require tracing residual effects rather than assuming that epistemic correction restores the prior field.

6.20.4 Measurement Intervention

Measurement can intervene when measured actors or institutions orient conduct toward the measure itself. Rankings, performance indicators, benchmarks, targets, audit scores, and evaluation metrics can become practical objects around which strategies are reorganized. Espeland and Sauder show how public rankings can generate reactivity through mechanisms including commensuration and self-fulfilling processes (Espeland and Sauder 2007). The measured system can therefore change in response to the representation used to assess it.

Definition 6.310 (Measurement intervention). A *measurement intervention* occurs when the production, disclosure, or institutional use of a measure contributes to changes in the behavior, organization, or relational environment of the measured system.

Measurement intervention can occur through several pathways. Actors may optimize directly for a metric, redirect resources toward visible dimensions, change documentation practices, reorganize categories to improve measured performance, or withdraw activity from domains that are weakly represented by the metric. The resulting improvement in the measure can then have several interpretations. It may indicate genuine improvement in the underlying target, adaptation to the measurement regime, or some combination of both.

Reflexive measurement therefore requires a distinction between target change

and measure-oriented adaptation. Longitudinal analysis becomes especially difficult when the measure itself changes the practices that generate later observations. A time series may remain numerically comparable while the relation between indicator and target shifts because actors have learned to respond strategically or institutionally to the indicator.

Proposition 6.311 (Measurement-reactivity condition). *When a measure becomes consequential for actors or institutions, later observations of that measure should be interpreted with attention to the possibility that the measurement regime has altered the process generating the measured values.*

6.20.5 Publication Intervention

Publication extends research reflexivity beyond data collection and analysis. A finding can enter public discourse, institutional decision processes, professional practice, litigation, policy design, investment, advocacy, education, or organizational self-understanding. Publication is therefore part of the causal history of some research objects rather than merely the final communication of knowledge about them.

Definition 6.312 (Publication intervention). *A publication intervention occurs when dissemination of a research claim, category, representation, or finding contributes materially to subsequent relations, decisions, expectations, institutional arrangements, or evidential conditions within the relevant field.*

The intervention profile of publication depends on audience, authority, accessibility, timing, framing, and institutional uptake. A technical article with limited circulation may produce little immediate field effect while later becoming foundational to a regulatory framework. A widely publicized preliminary finding can have large immediate consequences despite substantial uncertainty. Reflexive publication therefore concerns both anticipated and emergent pathways of circulation.

Publication can also alter the future evidence base. Once participants know a hypothesis or classification, their subsequent behavior may reflect knowledge of the research. Institutions may begin recording variables that previously went undocumented, or they may change categories in response to critique. Archives, administrative records, and later datasets can consequently contain traces of earlier research dissemination. Historical reconstruction should preserve this possibility when research claims become part of the field's own history.

Publication reflexivity does not require suppressing consequential findings. It requires attention to foreseeable harms, uncertainty communication, provenance, and the difference between communicating a warranted claim and projecting a level of certainty or practical authority beyond the evidence. Where publication is likely to alter the field substantially, dissemination strategy itself becomes part of research praxis.

6.20.6 Research Feedback

The preceding intervention forms can combine into feedback structures. Observation generates a classification; the classification is formalized into a measure; the measure is published; institutions reorganize behavior around the measure; and the reorganized behavior becomes the next round of evidence. Research then participates in a

recursive process in which its products condition the phenomena from which later research draws.

Definition 6.313 (Research feedback loop). *A research feedback loop is a recurrent pathway in which a research operation or output alters the relational field and the altered field subsequently contributes new evidence, categories, behaviors, or institutional conditions to later inquiry.*

Research feedback can amplify, dampen, redirect, or stabilize patterns. A public measure may intensify competition; a new category may stabilize recognition of a previously weakly legible relation; a corrective representation may weaken a harmful institutional routine; repeated evaluation may normalize a practice that initially existed only provisionally. The direction and desirability of feedback are therefore empirical and normative questions rather than consequences of reflexivity alone.

Feedback also complicates causal attribution. If an observed regularity strengthened after a theory, measure, or classification was institutionalized, later evidence cannot simply be treated as independent confirmation of the original claim. The research product may be one contributor to the regularity. This is closely related to the institutionally generated confirmation problem developed in Section 6.6: theories and representations can help produce the conditions under which they later appear descriptively successful.

Proposition 6.314 (Reflexive evidential dependence). *When prior research outputs materially contribute to the production of later evidence, evaluation of the later evidence should include the research-mediated pathway rather than treating the observations as independent of the earlier inquiry.*

6.20.7 Reflexive Documentation

Reflexivity becomes methodologically useful when possible research effects can be reconstructed rather than merely acknowledged. Reflexive documentation extends ordinary provenance by recording how research activity may have entered the field. It is especially important when the same project, institution, or research community returns repeatedly to a site or when research products are likely to circulate among participants.

Definition 6.315 (Reflexive documentation). *Reflexive documentation is the preservation of information needed to reconstruct materially relevant pathways through which research presence, categories, instruments, measurements, representations, publications, or institutional arrangements may have altered the research field or later evidential conditions.*

Useful documentation can include changes in access arrangements, participant awareness of research aims, dissemination events, category adoption, metric uptake, institutional responses, changes in recording practices, and observable shifts following publication. The relevant record depends on the target inquiry; exhaustive self-documentation is neither possible nor desirable. The objective is to preserve evidence for plausible pathways that could materially affect later inference.

Reflexive documentation should also preserve uncertainty. Researchers often cannot know at the moment of fieldwork whether a conversation, category, report, or measurement will become consequential. Recording plausible intervention pathways without prematurely declaring their effects supports later re-epistemization.

This follows the provenance-preserving logic developed in Section 6.19: future inquiry should be able to distinguish a stable empirical pattern from one partly generated by changing research relations.

Documentation itself remains ethically constrained. Recording participant reactions, institutional adaptations, or confidential communications can create privacy, security, and power risks. Reflexive completeness therefore cannot be pursued without regard to consent, confidentiality, data minimization, and the potential consequences of preserving sensitive material.

6.20.8 Reflexive Revision

Reflexive information matters when it can change the research configuration. If inquiry has altered the field, later interpretation may need to revise the object definition, temporal boundary, causal model, comparison strategy, measurement assumptions, or practical conclusions. Reflexivity thereby becomes a source of methodological reconstruction rather than an appended statement of positionality.

Definition 6.316 (Reflexive revision). *Reflexive revision* is a research revision undertaken because evidence indicates that inquiry itself has materially altered the relational field, evidential conditions, or interpretation relevant to the target claim.

Reflexive revision can take several forms. Researchers may distinguish pre-exposure and post-exposure periods, model research dissemination as part of a causal pathway, revise a category after observing classification effects, separate target improvement from metric adaptation, or change an intervention when publication creates unanticipated harms. In longitudinal work, a research project may also become part of the historical sequence it later seeks to explain.

Longino's account of critical interaction supports a wider view of objectivity in which assumptions and standards remain open to transformation through criticism (Longino 1990). Reflexive revision adds a further requirement: criticism can concern the research relation itself. If the conditions of observation have changed partly because of inquiry, the revised account should incorporate that change rather than preserve a fictional separation between research process and research object.

Proposition 6.317 (Reflexive revision principle). *When a materially supported research-feedback pathway changes the evidential field or target relation, dependent claims, models, categories, and practical recommendations should be reassessed to the extent that their warrant relied on the earlier configuration.*

Reflexive revision is compatible with strong claims. A finding can remain well warranted after research effects are incorporated. The objective is calibration: identify what changed, which claims depend on the change, and which conclusions remain robust across the reconstructed field.

6.20.9 Limits of Reflexivity

Reflexivity has practical and epistemic limits. Research cannot reconstruct every consequence of its own existence, and infinite regress would make inquiry impossible. A researcher examining the effect of a measure can also affect responses to that measure; documenting that effect can itself become another intervention. Methodological reflexivity therefore requires a stopping rule.

Definition 6.318 (Reflexive relevance threshold). A *reflexive relevance threshold* is the point at which a plausible research-mediated pathway becomes sufficiently material to the target claim, evidential interpretation, ethical responsibility, or practical consequence that explicit reflexive analysis is warranted.

The threshold is target-relative. Reflexive analysis should become more demanding when research outputs are authoritative, publicly visible, institutionally consequential, repeated over time, closely coupled to participant behavior, or used directly in allocation and governance. It can remain lighter when plausible research-mediated effects are weak relative to the target process and would not materially change interpretation.

Several constraints follow. First, reflexivity should not attribute every change to researcher presence. That would replace methodological naivety with researcher-centered overreach. Second, reflexive claims themselves require evidence; plausible influence should remain distinct from demonstrated influence. Third, some research effects will remain unknowable because data are unavailable, feedback is distributed, or future consequences have not yet emerged. Such uncertainty should be recorded rather than filled with speculative narratives.

Proposition 6.319 (Proportional reflexivity). *The depth of reflexive analysis should be proportionate to the plausibility, materiality, and consequence of research-mediated pathways for the claim or practical decision under investigation.*

Reflexivity therefore functions as a disciplined enlargement of research praxis. It asks inquiry to include itself among the relations that may matter when evidence supports doing so, while preserving the possibility that some observations remain only weakly affected by the act of study. This balance keeps research answerable both to its own generative consequences and to relational realities that exceed the researcher. The historical transformation of research methods introduces a further source of reconstruction: methods themselves change through time, altering what later inquiry can observe, compare, and warrant.

6.21 Historical Evolution of Methods

This section extends the reflexive account of research developed in Section 6.20 by treating methods themselves as historically evolving components of research praxis. Its role is to examine how methods become possible, authoritative, limited, displaced, renewed, or reinterpreted under changing material, institutional, technological, conceptual, and evidential conditions. The objective is to preserve methodological learning across time without treating current practice as the natural endpoint of a linear history. The discussion proceeds from methods as historical formations through their material, institutional, technological, and conceptual conditions, then considers changing standards of evidence, methodological obsolescence, emergence of new methods, and re-evaluation of earlier methods. The approach is reconstructive: a method is examined together with the relations and infrastructures that make its use, validation, and circulation possible.

Definition 6.320 (Historical formation of a method). The *historical formation of a method* is the temporally situated configuration of concepts, instruments, materials, skills, institutions, standards, and research problems through which a procedure becomes available and intelligible as a method of inquiry.

This definition gives the history of methods an epistemic role. A method cannot be understood only through an abstract description of its procedure, because the same formal procedure can have different research functions under different evidential infrastructures, technologies, categories, and institutional expectations. Kuhn's account of scientific practice emphasizes that accepted problems, exemplars, standards, and forms of puzzle solving are historically organized within research traditions (Kuhn 1962). Hacking similarly draws attention to historically developing styles of reasoning, classifications, and objects of inquiry (Hacking 2002). GRE uses these insights without assuming that every methodological change is a paradigm replacement. Method histories can involve gradual adaptation, recombination, extension, institutional diffusion, technical refinement, rediscovery, or selective abandonment.

A historical account also modifies how methodological pluralism is understood. The pluralism developed in Sections 6.14–6.18 concerns partially irreducible modes of access in a present research configuration. Historical analysis adds that the available repertoire itself changes. What appears to be a stable menu of methods at one time may be the temporary result of earlier investments, exclusions, technical possibilities, conceptual innovations, and institutional settlements. Method selection therefore takes place within an inherited but revisable methodological field.

6.21.1 Methods as Historical Formations

A method is learned, taught, standardized, criticized, modified, and transmitted. These processes give it a history that is partly distinct from the history of the phenomena it is used to investigate. A statistical procedure, archival practice, interpretive tradition, laboratory technique, legal method, ethnographic practice, or computational routine can persist across changes in its objects and can also be transformed when new objects strain its inherited assumptions.

Definition 6.321 (Methodological lineage). A *methodological lineage* is a historically reconstructible sequence through which a method, family of methods, or methodological principle is transmitted, modified, recombined, contested, or repurposed across research settings.

Lineage does not imply continuity of identity in every respect. A procedure can retain its name while its instrumentation, data structure, interpretation, or evidential role changes substantially. Conversely, a new label can describe a recombination of older operations. Historical reconstruction should therefore attend to the components that persist and those that transform rather than infer methodological identity from terminology alone.

Methods can also acquire authority historically. Repetition, successful application, professional training, journal conventions, regulatory recognition, software implementation, and institutional investment can stabilize a procedure as an expected way of producing evidence. Such stabilization can be epistemically productive because it supports comparability, training, replication, and shared criticism. It can also make alternative forms of evidence harder to recognize when the dominant method defines what counts as an admissible research object or credible result.

The historical formation of methods therefore enters present evaluation. A current method may be technically sophisticated while carrying categories or assumptions inherited from earlier contexts. A historically older method may remain useful because the relation it captures persists, or because it preserves a form of access that newer

infrastructures neglect. Historical status alone supplies neither authority nor disqualification.

6.21.2 Material Conditions of Method

Methods depend on material conditions. Archives require preservation media and storage; fieldwork requires mobility, time, safety, and access; laboratory techniques require equipment and consumables; surveys require communication infrastructures and sampling frames; computational inquiry requires hardware, data storage, energy, and software environments. These conditions affect which methods can be practiced, at what scale, by whom, and with what continuity.

Definition 6.322 (Material condition of method). A *material condition of method* is a resource, infrastructure, embodied capability, spatial arrangement, or physical support whose availability materially affects whether a methodological operation can be performed, repeated, extended, or preserved.

Material conditions can shape methodological possibility without determining research conclusions. The existence of high-resolution sensors can make previously inaccessible variation observable, yet interpretation still requires conceptual and evidential work. The absence of stable archives can narrow historical reconstruction, yet alternative traces may remain available through oral testimony, material culture, institutional records, or later copies. The relevant point is that methodological feasibility is relationally produced through material arrangements.

Material asymmetry can also generate epistemic asymmetry. Research communities with durable infrastructures can accumulate longitudinal datasets, standardized instruments, and reusable computational pipelines, while communities with fewer resources may rely on intermittent observation or locally maintained records. Apparent differences in methodological preference can therefore partly reflect differences in feasible access. This extends the analysis of the researcher's material position in Section 6.8: method repertoires are themselves conditioned by the material environments in which inquiry occurs.

Material dependence also matters for preservation. A method may remain conceptually intelligible while becoming difficult to reproduce because instruments, calibration standards, software versions, materials, or tacit craft knowledge have disappeared. Historical method reconstruction can consequently require attention to laboratories, field sites, libraries, data formats, and embodied skills in addition to published descriptions.

6.21.3 Institutional Conditions of Method

Institutions organize methodological development through training, funding, publication, credentialing, ethics review, professional standards, and access to research sites. These arrangements help coordinate inquiry, but they also distribute methodological visibility and legitimacy unevenly. A method can become dominant partly because it fits available infrastructures and evaluation systems, while a potentially valuable alternative remains marginal because it is expensive, slow, difficult to standardize, or poorly aligned with established publication formats.

Definition 6.323 (Institutional condition of method). An *institutional condition of method* is an organizational rule, incentive, access arrangement, training structure,

evaluation practice, or authority relation that materially shapes the development, use, circulation, or recognition of a method.

Porter's historical analysis of quantification shows how standardized numerical procedures can acquire authority in settings where impersonal and publicly defensible forms of judgment are institutionally valuable (Porter 1995). This does not reduce quantitative method to bureaucracy. It illustrates how methodological forms can answer institutional demands as well as epistemic questions. A similar analysis can be applied to other methods: intensive fieldwork may depend on institutions willing to support long-duration presence; archival work depends on regimes of preservation and access; collaborative research depends on structures that recognize distributed contribution.

Institutionalization can generate both capacity and path dependence. Once curricula, journals, software, review standards, funding categories, and career structures accumulate around a method, later researchers inherit a substantial methodological infrastructure. This can lower the cost of high-quality work within the established approach while raising the cost of experimentation outside it. Institutional conditions should therefore enter explanations of methodological persistence alongside demonstrated empirical success.

Proposition 6.324 (Institutional stabilization of method). *When training, evaluation, infrastructure, and access are organized repeatedly around a method, the resulting institutional support can stabilize its use beyond the evidential force of any single application and can shape which alternative methods remain practically available.*

The proposition does not imply that institutionalized methods are epistemically weak. It requires a distinction between evidential warrant and institutional reproduction. A method can be strongly warranted and institutionally stabilized at the same time; historical reconstruction should identify both relations where they matter.

6.21.4 Technological Conditions of Method

Technological change can alter the scale, granularity, speed, and kinds of evidence accessible to inquiry. Recording devices extend memory; imaging technologies expose previously inaccessible structures; digital archives change search and retrieval; networked communication changes collaboration; computational systems permit simulation, large-scale estimation, automated classification, and new forms of pattern detection. Technological conditions can therefore transform methods rather than merely accelerate established procedures.

Definition 6.325 (Technological extension of method). *A technological extension of method occurs when a technological system materially expands, reorganizes, or changes the operations through which a method observes, records, compares, reconstructs, models, or communicates its object.*

Extension can generate new evidence while introducing new mediation. A digital corpus makes large-scale textual comparison feasible but depends on digitization, metadata, search architecture, and preprocessing. Machine learning can reveal patterns across high-dimensional data while adding model dependence, opacity, training-data constraints, and classification assumptions. Remote sensing can widen spatial access while narrowing other forms of contextual contact. Technological expansion therefore changes both capability and the structure of methodological remainder.

Technologies also create new forms of methodological dependency. Proprietary platforms, inaccessible source code, discontinued software, changing file formats, or vendor-controlled data can reduce reproducibility even when computation appears highly standardized. Conversely, open tools and documented formats can support cumulative research across institutions. The epistemic consequences depend on provenance, accessibility, maintainability, and the relation between technological representation and the target object.

Historical comparison of methods should therefore avoid treating technological sophistication as a scalar measure of methodological superiority. New technologies can strengthen some kinds of access while weakening others. Their significance is target-relative and should be assessed through the claim–method relations developed in Section 6.14.

6.21.5 Conceptual Conditions of Method

Methods also depend on conceptual conditions. An instrument records only through a prior account of what counts as a signal; a variable requires decisions about categories and measurement; archival research depends on concepts that identify relevant traces; qualitative coding depends on distinctions that organize interpretation; formal models depend on specified entities, relations, states, and transformation rules. Changes in concepts can therefore make new methods possible or render established methods inadequate.

Hacking’s historical work is useful here because it treats classifications and styles of reasoning as historically consequential components of what can be investigated and said (Hacking 2002). GRE adds a relational emphasis: concepts help configure the interface between research object and methodological operation. When a concept changes, the same technique can begin to address a different object.

Definition 6.326 (Conceptual condition of method). *A conceptual condition of method* is a category, distinction, object specification, relational assumption, or inferential concept required for a methodological operation to identify, organize, or interpret its evidential target.

Conceptual dependence is especially visible when new objects emerge. A phenomenon may have been observable in fragments before a concept allowed those traces to be assembled into a coherent research problem. Conversely, an inherited concept can compress distinctions that later become important, making an established method systematically insensitive to variation within its categories.

This produces a recursive relation between concept and method. Concepts orient methodological access, while methodological encounters can generate pressure for conceptual revision. The iterative reconstruction developed in Section 6.19 therefore has a historical counterpart: over longer periods, methods and concepts can co-evolve as each reorganizes the possibilities of the other.

6.21.6 Changing Standards of Evidence

Historical change also affects what research communities treat as adequate evidence. Standards can shift regarding sample size, documentation, replication, transparency, statistical inference, qualitative saturation, archival provenance, measurement validity, causal identification, interpretive adequacy, or computational reproducibility.

Such changes can strengthen inquiry, but they can also redistribute attention toward what existing standards can recognize and away from difficult-to-formalize or weakly institutionalized evidence.

Longino's account of science emphasizes the role of criticism and social interaction in transforming background assumptions and standards of inquiry (Longino 1990). From a GRE perspective, standards of evidence are themselves part of research praxis. They regulate which claims travel, which doubts become institutionally visible, and which forms of evidence receive durable recognition.

Definition 6.327 (Evidential standard regime). An *evidential standard regime* is a historically situated configuration of criteria through which a research community assesses the admissibility, adequacy, transparency, reproducibility, interpretability, and inferential force of evidence.

A change in standards can alter the apparent status of existing research without changing the historical evidence that researchers originally possessed. Earlier work may later appear under-documented, statistically underpowered, insufficiently reflexive, or weakly reproducible by contemporary criteria. Such retrospective assessment can be warranted, yet it should distinguish two questions: whether the earlier conclusion remains supportable now, and whether the earlier researchers followed the strongest standards realistically available within their context.

Proposition 6.328 (Historical indexing of evidential evaluation). *Evaluation of an earlier method should distinguish its adequacy relative to the evidential standards and feasible alternatives of its historical context from the adequacy of its resulting claims under later standards and later evidence.*

This distinction enables critical re-evaluation without either presentism or inherited deference. Later standards can reveal limitations while historical reconstruction preserves the conditions under which earlier methods were intelligible and useful.

6.21.7 Methodological Obsolescence

Methods can become obsolete, but obsolescence is rarely a single condition. A method may lose comparative advantage because a new technique provides greater accuracy, lower cost, wider coverage, better safety, or stronger reproducibility. It may also become inadequate because the research object has changed, the conceptual categories on which it depends have been revised, or its material and technological infrastructure is no longer sustainable.

Definition 6.329 (Methodological obsolescence). *Methodological obsolescence* is a historically situated decline in the adequacy, feasibility, or comparative epistemic value of a method for a specified research function under changed evidential, conceptual, material, institutional, technological, or ethical conditions.

Obsolescence is therefore function-relative. A method can become inadequate for measurement while remaining valuable for historical comparison; unsuitable for causal attribution while remaining useful for exploration; inefficient for large-scale analysis while retaining distinctive sensitivity to local meaning. This follows the model-function distinction developed in Section 6.16: replacement should be assessed against the function a method is expected to perform.

Methods can also become institutionally obsolete before they become epistemically useless, or remain institutionally dominant after better alternatives appear. Histori-

cal analysis should therefore ask what exactly has changed: warrant, feasibility, cost, legitimacy, ethics, infrastructure, or disciplinary convention.

Methodological obsolescence creates preservation questions. If an older method generated long time series, archival conventions, or category systems, abrupt abandonment can break comparability. Transition strategies may need overlapping measurements, calibration studies, translation records, or parallel representations so that methodological improvement does not erase the historical relation between earlier and later evidence.

6.21.8 Emergence of New Methods

New methods can emerge when inherited methods encounter persistent limits, when new research objects become salient, when technological capacities expand, when conceptual innovations reorganize the object, or when institutional and social conditions make previously marginal forms of inquiry possible. Methodological novelty is therefore often relationally distributed rather than attributable to a single isolated invention.

Definition 6.330 (Methodological emergence). *Methodological emergence* is the formation of a sufficiently distinct research procedure or methodological configuration through the recombination, extension, or transformation of concepts, instruments, evidence practices, skills, infrastructures, and research problems.

This formulation allows degrees of novelty. A new method can involve a genuinely new instrument, a new combination of established techniques, a new inferential role for an existing representation, or a transfer across disciplinary settings. The important question is what new form of epistemic access or correction becomes possible.

Kuhn's analysis of scientific change is relevant because transformations in problems and standards can reorganize research practice (Kuhn 1962). Yet methodological emergence need not require a comprehensive disciplinary rupture. Many changes are cumulative or hybrid: historical inquiry incorporates computational search; qualitative research adopts digital recording and collaborative coding; formal models are linked to field experiments; archival practice integrates machine-assisted transcription while retaining human interpretation.

Proposition 6.331 (Generative conditions of methodological emergence). *A new method becomes epistemically significant when changes in concepts, instruments, evidence, skills, or institutions jointly enable a form of access, comparison, correction, reconstruction, or inference that was previously unavailable or materially weaker for the target problem.*

Methodological emergence should therefore be evaluated through capabilities and remainders rather than novelty claims alone. New methods inherit assumptions, create new dependencies, and can make some phenomena less visible even as they illuminate others.

6.21.9 Re-Evaluation of Earlier Methods

Historical evolution makes earlier methods available for re-evaluation. Later evidence, concepts, technologies, and standards can reveal weaknesses that were previously difficult to see. They can also reveal neglected strengths. A method abandoned

because it appeared inefficient under one research regime may later become valuable when a new problem makes its distinctive form of access relevant again.

Definition 6.332 (Historical methodological re-evaluation). *Historical methodological re-evaluation* is the reassessment of an earlier method through a reconstructed account of its original conditions together with later evidence, concepts, technologies, standards, and research questions.

Re-evaluation differs from simple ranking. The objective is to identify what the method could reveal, what it systematically missed, which assumptions supported its use, what alternatives were feasible, how later changes altered its comparative value, and whether some of its capacities remain recoverable. Porter's history of quantification, for example, shows that methods and ideals of objectivity can be understood partly through the institutional problems they were developed to address (Porter 1995). Such reconstruction helps explain both their historical power and their limits.

Re-evaluation can support methodological repair. Older data can be reinterpreted under revised categories; an earlier instrument can be recalibrated against new standards; historical qualitative material can be revisited with questions not available at the time of collection; discarded techniques can be combined with new technologies. The preservation of source material, procedural descriptions, code, instruments, and contextual records therefore increases the future possibility of re-epistemization.

Proposition 6.333 (Methodological re-epistemization). *When later evidence, concepts, or standards materially alter the interpretation of an earlier method, research should distinguish revision of the method's historical evaluation from revision of the claims originally produced through it, while preserving the provenance needed to reconstruct both.*

The historical evolution of methods therefore expands the recursive account of research praxis. Inquiry changes not only theories, categories, and representations but also the means through which later researchers can encounter and reconstruct reality. Present methods should consequently be treated as historically achieved and revisable capacities rather than as final forms of access. This conclusion leads directly to a parallel problem: the standards by which research itself is evaluated also evolve historically, changing what counts as relevance, rigor, significance, and value.

6.22 Historical Evolution of Evaluation

This section extends the historical account of methods in Section 6.21 to the standards through which research is judged. Its role is to show that evaluation is itself a historically situated practice embedded in institutions, disciplinary traditions, infrastructures, productive conditions, and changing conceptions of what research is for. The objective is to distinguish the evolution of criteria of relevance, rigor, significance, and value from the changing metrics used to operationalize them, and then to examine how altered productive conditions can require renewed evaluation of both current and earlier research. The discussion proceeds through evaluation as historical practice, transformations in major evaluative criteria, revision of metrics, evaluation under changing productive conditions, re-epistemization of earlier work, and finally the evaluation of evaluation itself. The method is reconstructive and reflexive: evaluation is treated as part of research praxis whose own standards, effects, and

limitations remain open to inquiry.

Definition 6.334 (Historical evaluation regime). A *historical evaluation regime* is a historically situated configuration of criteria, procedures, representations, institutions, and judgment practices through which research questions, methods, evidence, outputs, and contributions are assessed.

Evaluation regimes can support cumulative inquiry by stabilizing expectations, concentrating attention, enabling criticism, and coordinating scarce research resources. They can also privilege forms of contribution that are comparatively easy to recognize, count, compare, or institutionalize. Porter shows historically how ideals of impersonal quantitative objectivity became connected to institutional conditions of trust and standardized judgment (Porter 1995). Longino, from a different direction, emphasizes that standards of evidential relevance and criticism depend partly on background assumptions and organized critical interaction (Longino 1990). GRE therefore treats evaluation neither as external administration added after research nor as a timeless expression of epistemic quality. It is one of the relational practices through which research systems select, stabilize, revise, and sometimes distort what they recognize as valuable inquiry.

6.22.1 Evaluation as Historical Practice

Research evaluation occurs within historically specific communities and institutions. Peer judgment, examination, replication, citation, editorial selection, funding review, institutional audit, professional recognition, public accountability, and later historical reassessment can all function as evaluative practices. Their relative weight changes over time, as do the objects being evaluated. A research system may emphasize the soundness of an argument, the credibility of witnesses, experimental reproducibility, statistical identification, archival provenance, formal elegance, social usefulness, novelty, publication placement, public impact, data openness, or some combination of these.

Definition 6.335 (Research evaluation practice). A *research evaluation practice* is an organized activity through which a research community, institution, or relevant public assigns provisional judgments concerning the adequacy, relevance, significance, value, credibility, priority, or consequences of research.

Such practices acquire authority relationally. An evaluative criterion becomes consequential when journals, funders, universities, professional communities, governments, infrastructures, or researchers orient decisions toward it. The history of science described by Kuhn shows that standards of legitimate problems, methods, and solutions can shift with broader transformations of research practice (Kuhn 1962). This does not imply that evaluative change is arbitrary. Changes may respond to accumulated counterevidence, new instruments, failures of earlier standards, altered social responsibilities, or new forms of research production. Historical reconstruction is therefore required to distinguish mere fashion from changes that improve the fit between evaluative practice and the epistemic or practical functions it is meant to support.

Evaluation also has a generative dimension. Criteria influence which questions receive time, which results become durable, which methods receive institutional investment, which researchers gain access to resources, and which forms of evidence become legible. An evaluation regime can consequently alter the future composition

of the research field. This point connects evaluation with the reflexive pathways developed in Section 6.20: when researchers adapt behavior to evaluation, the evaluation regime becomes part of the process generating the later research record.

Proposition 6.336 (Generative effect of evaluation). *When evaluative criteria materially affect access to attention, publication, resources, recognition, infrastructure, or career continuity, the evaluation regime can contribute to generating the subsequent distribution of research topics, methods, outputs, and capacities.*

6.22.2 Changing Criteria of Relevance

Relevance concerns the relation between research and a problem, audience, body of knowledge, practical condition, or future possibility. What counts as relevant can change when historical problems change, when previously marginal relations become visible, when new evidence becomes available, or when institutions reorganize their priorities. Relevance is therefore indexed to an evaluative horizon rather than being an intrinsic property of a research object.

Definition 6.337 (Evaluative relevance). *Evaluative relevance* is the judged relation between a research contribution and a specified epistemic, theoretical, historical, practical, institutional, or public problem under a stated evaluative horizon.

A problem can gain relevance because historical conditions make its consequences newly visible. A previously local phenomenon can become relevant at another scale when infrastructures connect it to broader systems. Conversely, an issue that once organized a field may become less central when its underlying conditions change or when another contradiction becomes principal. This is consistent with the phase-sensitive analysis of praxis developed in Sections 6.3–6.6: evaluative relevance can change when the practical and epistemic configuration changes.

Historical variability also creates a danger of retrospective dismissal. Earlier research can appear irrelevant from a later horizon even when it addressed urgent questions in its original context. The reverse can also occur: archival work, descriptive data, apparently minor anomalies, or speculative formal results can acquire substantial later relevance after new questions emerge. The concept of deferred significance developed in Section 6.10 therefore applies equally to evaluation. Relevance judgments should remain temporally indexed and sufficiently documented to permit later reassessment.

Proposition 6.338 (Historical indexing of relevance). *A judgment of research relevance should identify the problem, audience, scale, and temporal horizon relative to which relevance is attributed, especially when the judgment is used to allocate durable research opportunities or resources.*

6.22.3 Changing Criteria of Rigor

Rigor concerns disciplined adequacy of inquiry, but the practices through which rigor is recognized can change historically. Different periods and disciplines may emphasize formal proof, experimental control, statistical inference, transparent documentation, archival criticism, conceptual precision, interpretive accountability, replication, triangulation, computational reproducibility, or reflexive disclosure. Methodological pluralism therefore requires rigor to be assessed partly in relation to the epistemic

function and object of a method rather than through one universal procedural template.

Definition 6.339 (Historically situated rigor). *Historically situated rigor* is the disciplined adequacy of a research practice relative to its target claim, method, evidence, available alternatives, and the strongest justified standards materially feasible in its historical setting.

This formulation has two consequences. First, historical situatedness does not immunize earlier research from later criticism. New evidence can reveal uncontrolled assumptions, weak measurement, inaccessible provenance, or inferential gaps. Second, later standards should not be projected backward without reconstructing what could realistically have been known or done. The distinction parallels the historical methodological evaluation developed in Section 6.21.

Rigor also changes when methods change. Computational research can increase the importance of code provenance, data lineage, model specification, robustness checks, and software environments. Large administrative datasets can expand statistical power while creating new concerns about category construction, missingness, selection, and institutional data-generating processes. Einav and Levin document the growing economic-research significance of large administrative and private-sector data and the opportunities created by more granular observation (Einav and Levin 2014). Such changes can raise some dimensions of rigor while creating new ones that earlier evaluative regimes did not need to emphasize.

Proposition 6.340 (Function-relative rigor). *Rigor should be evaluated against the epistemic function a method or representation is expected to perform, together with the inferential and provenance requirements generated by that function.*

6.22.4 Changing Criteria of Significance

Significance concerns why a research contribution matters within a larger epistemic or practical configuration. Section 6.12 distinguished significance from salience, difficulty, elegance, and immediate attention. Historical evolution adds a further dimension: the criteria through which significance is recognized can themselves change.

Research may be judged significant because it resolves a long-standing problem, opens a new domain, changes a concept, exposes a hidden relation, produces a reusable method, reorganizes a theory, preserves evidence, changes practical possibilities, or enables later work whose form could not have been specified in advance. These dimensions are not reducible to one another. Their importance can also become visible at different times.

Definition 6.341 (Research significance profile). A *research significance profile* is a multidimensional and temporally indexed account of the epistemic, theoretical, methodological, historical, practical, infrastructural, or generative ways in which a research contribution matters.

The profile formulation avoids compressing significance into a single rank. A work can be theoretically modest while infrastructurally important because it preserves a dataset or establishes a measurement standard. Another can have limited immediate application while generating a conceptual distinction that later reorganizes several research programs. A third can be historically significant because it records a disappearing practice even if its contemporary citation rate remains low.

Evaluation systems can obscure this plurality when they equate significance with readily observable indicators. Espeland and Stevens analyze commensuration as the transformation of qualitative differences into a common metric, a process that can enable comparison while altering what is visible in the objects compared (Espeland and Stevens 1998). The methodological lesson is that any metric of significance should state which dimension it represents and which forms of significance remain outside its scope.

6.22.5 Changing Criteria of Value

Research value extends beyond significance because evaluation may include normative judgments about which forms of inquiry deserve support, protection, continuation, dissemination, or practical uptake. Such judgments can involve epistemic value, public value, educational value, cultural value, institutional value, ethical responsibility, long-horizon generativity, or contribution to capabilities and infrastructures. Their relative weighting is historically variable.

Dewey's theory of valuation treats valuing as connected to practical conditions, desires, consequences, and inquiry rather than as a detached assignment of fixed worth (Dewey 1939). GRE adopts a compatible practical orientation while preserving the distinctions developed earlier in this chapter: value judgments remain separable from evidential warrant, aesthetic attraction, and immediate utility. A research contribution can be well supported yet normatively troubling; socially valuable yet epistemically weak; aesthetically compelling yet empirically unsupported; or valuable because it preserves future inquiry rather than because it produces immediate results.

Definition 6.342 (Research value configuration). A *research value configuration* is the historically situated arrangement of epistemic, normative, practical, institutional, cultural, educational, infrastructural, and generative considerations through which research worth is provisionally assessed.

The configuration concept makes evaluative plurality explicit. It also prevents one value dimension from silently substituting for another. The non-substitution principle developed for research judgment in Section 6.12 therefore extends to evaluation regimes. A high level of public visibility cannot establish epistemic adequacy. Strong formal rigor cannot by itself settle ethical acceptability. Immediate utility cannot exhaust long-horizon research value.

Historical evolution can alter the value configuration. Periods of crisis may increase emphasis on rapid applicability; periods of infrastructural expansion may reward standardization and data accumulation; intellectual transitions may increase the value of conceptual reconstruction; changing social relations may reveal the importance of voices or objects previously excluded from evaluation. These changes should become visible in evaluation rather than being disguised as timeless criteria.

6.22.6 Historical Revision of Metrics

Metrics translate selected dimensions of evaluation into standardized representations. Publication counts, citation measures, journal classifications, rankings, performance indicators, replication rates, grant success, data-sharing indicators, and other measures can support coordination across large research systems. Their use-

fulness depends on the relation between what is measured and what the evaluator intends to know.

Definition 6.343 (Evaluation metric). An *evaluation metric* is a standardized quantitative or categorical representation used to approximate one or more dimensions of research performance, contribution, quality, significance, value, or institutional functioning.

Metrics inherit the translation problems analyzed in Section 6.18. They select properties, impose comparability rules, and leave remainders. Desrosières' historical analysis of statistical reasoning emphasizes that categories and comparability are constructed through institutional and classificatory practices (Desrosières 1998). Porter similarly shows why quantified judgment can acquire authority under institutional conditions that value impersonal standards (Porter 1995). Metrics can therefore be historically intelligible and practically useful while remaining partial representations.

Historical revision becomes necessary when the relation between a metric and its intended evaluative target changes. A citation measure can be affected by field size, publication practices, database coverage, collaboration structure, or strategic citation. A ranking can become a target of institutional strategy and thereby change the behavior it was initially intended to measure. Espeland and Sauder show how public rankings can generate organizational reactivity through commensuration and self-fulfilling processes (Espeland and Sauder 2007). Such feedback does not render measurement useless, but it changes the evidential meaning of the metric.

Proposition 6.344 (Metric revision requirement). *When changes in research practice, strategic behavior, data infrastructure, or institutional conditions materially alter the relation between an evaluation metric and its intended target, the metric should be recalibrated, supplemented, reinterpreted, or retired with its historical comparability explicitly documented.*

Revision should also preserve historical continuity where possible. Abrupt replacement can make longitudinal interpretation difficult. Overlapping measurement periods, transparent transformation rules, archived definitions, and parallel representations can help distinguish genuine change in research practice from change induced by the measurement system itself.

6.22.7 Evaluation under New Productive Conditions

Evaluation becomes especially important when the productive conditions of research change. New instruments, large-scale data, automation, computational infrastructures, collaborative platforms, and machine-assisted analysis can alter the cost, speed, volume, and distribution of research production. Under such conditions, evaluative criteria inherited from a scarcer-output environment may lose discriminating power or encourage behavior poorly matched to the new research ecology.

Definition 6.345 (Research productive condition). A *research productive condition* is a material, technological, institutional, organizational, or cognitive arrangement that materially affects the rate, scale, cost, accessibility, or form through which research objects, analyses, representations, and outputs can be produced.

The concept is broader than technology. Changes in collaboration, funding concentration, data access, publication infrastructure, or institutional labor can also trans-

form productive conditions. When some forms of production become easier, evaluation may need to shift attention from mere output volume toward provenance, originality of problem formation, evidential quality, interpretive adequacy, reproducibility, long-horizon generativity, and the capacity to distinguish meaningful contribution from technically inexpensive repetition.

Machine-mediated research adds a further complication. Computational systems can increase analytical reach while introducing opacity concerning data transformations, model behavior, or inferential pathways. Burrell's analysis of machine-learning opacity distinguishes several sources of opacity, including secrecy, technical-literacy barriers, and characteristics of complex models (Burrell 2016). Evaluation under such conditions should therefore assess inspectability and provenance in addition to performance.

New productive conditions can also change the scarcity structure of research. When generating candidate hypotheses, simulations, formal transformations, summaries, or textual outputs becomes less costly, the scarce resource can shift toward judgment: selecting worthwhile questions, identifying meaningful anomalies, verifying evidence, interpreting results, preserving historical context, and deciding which outputs deserve sustained attention. This connects evaluation directly to the encounter–salience–judgment–orientation sequence developed in Sections 6.10–6.13.

Proposition 6.346 (Productive-condition adjustment). *When research productive conditions materially change the relative scarcity of generation, verification, interpretation, judgment, preservation, or attention, evaluation criteria should be reconsidered so that institutional rewards remain aligned with the research functions that have become comparatively consequential.*

6.22.8 Re-Epistemization of Earlier Research

Changing evaluative regimes alter how earlier research is understood. A study judged rigorous in its own period can later appear methodologically limited; a neglected archive can become central after a new historical question emerges; a formally elegant model can lose explanatory status after new evidence; a low-status descriptive project can acquire major value because it preserved otherwise unavailable observations. Re-evaluation can therefore change the epistemic position of earlier research without changing the historical fact that it was produced under another evaluative regime.

Definition 6.347 (Evaluative re-epistemization). *Evaluative re-epistemization* is the historically informed reassessment of an earlier research contribution under later evidence, concepts, methods, evaluative criteria, and productive conditions while retaining the provenance necessary to reconstruct its original epistemic setting.

Re-epistemization should distinguish several layers. One concerns historical adequacy: whether the work met strong standards available in its own period. Another concerns present warrant: whether its claims remain supportable under later evidence. A third concerns present significance or value: whether later problems make the work newly useful, newly limited, or newly consequential. These judgments can diverge.

Kuhn's account of changing disciplinary problems and standards helps explain why earlier achievements can be reclassified under later research regimes (Kuhn 1962). Hacking's historical work similarly demonstrates the importance of recon-

structuring the historical conditions under which categories and styles of reasoning acquire their force (Hacking 2002). GRE adds a preservation requirement: re-epistemization is possible only to the extent that future researchers can recover the evidence, assumptions, methods, categories, alternative interpretations, and contextual conditions necessary for reassessment.

Proposition 6.348 (Layered re-evaluation of earlier research). *Historical reassessment of earlier research should distinguish its adequacy within the original evaluation regime, the present warrant of its claims, and its present significance or value under later research conditions.*

This distinction prepares the preservation problem of the next section. If research systems expect future evaluative revision, then the ability to reconstruct earlier inquiry becomes part of present research responsibility.

6.22.9 Evaluation of Evaluation

An evaluation regime should itself become an object of research. Criteria and metrics can stabilize quality, facilitate coordination, support accountability, and concentrate scarce resources. They can also generate blind spots, strategic adaptation, category compression, unequal burdens, or premature closure. Reflexive research praxis therefore requires periodic assessment of whether the system of evaluation remains adequate to the research ecology it helps govern.

Definition 6.349 (Meta-evaluation of research). *Meta-evaluation of research* is the systematic assessment of an evaluation regime's criteria, procedures, metrics, institutional effects, exclusions, feedback pathways, and fitness for the epistemic and practical functions it is intended to support.

Meta-evaluation should examine at least five dimensions. The first is *validity*: whether the evaluative criterion or metric tracks the property it claims to assess. The second is *coverage*: which forms of contribution remain weakly represented. The third is *behavioral effect*: how actors adapt to the evaluative system. The fourth is *historical fit*: whether the regime still corresponds to current methods, productive conditions, and research objects. The fifth is *revisability*: whether anomalies, alternative judgments, and excluded forms of evidence can trigger correction.

Longino's emphasis on effective critical interaction is relevant here because objectivity depends partly on conditions under which assumptions and standards can be challenged (Longino 1990). An evaluation system that rewards formal compliance while making its own criteria difficult to contest can weaken the critical processes that evaluation is meant to support. Conversely, unlimited criterion instability can undermine comparability and long-horizon coordination. The problem is therefore one of disciplined revisability.

Proposition 6.350 (Reflexive evaluation principle). *A research evaluation regime should be periodically reassessed in relation to the validity of its indicators, the plurality of contributions it recognizes, the behavior it generates, the historical conditions under which it operates, and the pathways through which its own standards can be revised.*

The historical evolution of evaluation completes the argument initiated in Section 6.21. Methods and standards develop together, and both can alter the research field they regulate. Research praxis therefore requires more than methodological

revision; it requires the capacity to revise the judgments through which research is selected, rewarded, preserved, and transmitted. Such revision is only possible when the evidential and contextual materials needed for later reassessment survive. The next section turns to that infrastructural problem by examining evidence preservation for future re-epistemization.

6.23 Evidence Preservation for Future Re-Epistemization

Section 6.22 established that methods, evaluative criteria, and research productive conditions evolve historically. This section develops the infrastructural implication of that claim. Its role is to specify what present research praxis should preserve if later researchers are to reassess earlier evidence, interpretations, models, categories, and conclusions under new questions and new epistemic conditions. The objective is neither indefinite retention of every research trace nor reconstruction of an imagined unmediated past. It is to preserve enough of the evidential and contextual architecture of inquiry that consequential claims can later be re-examined without being reduced to their published conclusions. The discussion proceeds through primary records, provenance, alternative interpretations, negative results, model assumptions, historical and methodological context, future reanalysis, and the costs and selectivity of preservation. The method is reconstructive and resource-sensitive: preservation is treated as a present design decision whose value depends partly on the future forms of re-epistemization it keeps possible.

Definition 6.351 (Re-epistemization infrastructure). A *re-epistemization infrastructure* is a preserved configuration of records, provenance, assumptions, contextual information, interpretive alternatives, methodological documentation, and access conditions that enables later inquiry to reassess the epistemic standing of earlier research.

Preservation therefore concerns more than durability of files. A dataset without its variables' historical meanings can survive physically while becoming difficult to interpret. A model without its assumptions can remain executable while losing explanatory transparency. A published conclusion can remain widely accessible while the negative results, rejected interpretations, or primary materials required to contest it disappear. The relevant object of preservation is thus relational: records must remain connected to enough of the conditions through which they acquired evidential meaning.

6.23.1 Preservation of Primary Records

Future reassessment often depends on materials closer to the original encounter than the final research representation. Fieldnotes, interview recordings or transcripts, archival images, survey instruments, laboratory records, administrative extracts, codebooks, legal documents, observational logs, sensor outputs, images, specimen descriptions, computational inputs, and contemporaneous annotations can all function as primary research records. Their value lies partly in the fact that later questions may require distinctions that the original analysis did not encode.

Definition 6.352 (Primary research record). A *primary research record* is a research trace produced, collected, copied, or preserved sufficiently close to an encounter, ob-

servation, source, measurement, or research operation that later inquiry can inspect it without relying exclusively on the final analytical representation derived from it.

Primary does not mean epistemically unmediated. A transcript depends on transcription conventions; a sensor output depends on an instrument; an archival document was produced for historically situated purposes; an administrative dataset reflects prior classification. Preservation should therefore retain both the record and, where materially relevant, information about the mediation through which it became available. This principle follows the representation discipline developed in Sections 6.15–6.18: the closer record does not eliminate interpretation, but it can leave later inquiry more room to reconstruct it.

Preserving source-level records can also protect against premature analytical closure. A project that stores only derived variables may make later recoding impossible. A project that keeps only selected quotations may prevent future interpretation of omitted context. A simulation archive containing only final plots can prevent examination of initialization choices or intermediate behavior. Primary-record preservation therefore expands future analytical option value.

That option value remains constrained by ethics, law, confidentiality, security, consent, physical feasibility, and the interests of people or communities represented in the record. Some records require restricted access, transformation, delayed release, controlled environments, or eventual deletion. Preservation is therefore not equivalent to unrestricted openness. Its epistemic purpose is to maintain legitimate future reconstructability where that purpose can be reconciled with other obligations.

Proposition 6.353 (Source-level preservation principle). *When later reanalysis could materially depend on distinctions omitted by a current analytical representation, research praxis should preserve the closest ethically and legally retainable source-level records together with documentation sufficient to interpret their mediation.*

6.23.2 Provenance

Records become progressively less useful for re-epistemization when their origin and transformation history are unknown. Provenance identifies how an evidential object came to have its present form. For a dataset, this can include collection procedures, inclusion rules, transformations, merges, missingness decisions, coding changes, versions, and responsible actors. For an archival corpus, provenance can include source repositories, selection paths, digitization procedures, cataloguing conventions, and known gaps. For a model, provenance can include data versions, software environments, parameter choices, calibration stages, and changes across iterations.

Definition 6.354 (Research provenance). *Research provenance* is the documented history of the origin, custody, selection, transformation, versioning, and use of a research record, representation, model, or evidential object insofar as that history is materially relevant to its interpretation or warrant.

The value of provenance is relational rather than ceremonial. It enables a later researcher to distinguish a property of the studied object from a property introduced by collection, cleaning, translation, aggregation, or institutional processing. Gebru and colleagues' proposal for datasheets for datasets makes a closely related case for documenting motivation, composition, collection processes, recommended uses, and related dataset history (Gebru et al. 2021). The same logic extends beyond datasets: evidence becomes more re-interpretable when its production history

remains inspectable.

Versioning is particularly important under iterative reconstruction. Section 6.19 treated research as a sequence in which categories, models, interpretations, and methods can be revised. If each revision overwrites the preceding state, future researchers may know that a conclusion changed without being able to determine why. Preserving consequential versions, transformation rules, and reasons for change makes revision itself a research object.

Proposition 6.355 (Provenance-dependent reconstruction). *When an evidential claim materially depends on selection, transformation, aggregation, translation, or versioning, future reassessment requires preservation of enough provenance to distinguish source-level properties from properties introduced by the research process.*

Provenance also disciplines machine-mediated research. Computational systems can execute long transformation chains quickly, making the distance between source and final representation difficult to reconstruct retrospectively. Preserving machine-readable logs, human decisions, data versions, code or executable specifications where feasible, and interpretable descriptions of consequential transformations can reduce that opacity. The objective remains functional rather than exhaustive: document the transformations that future evaluators would need to inspect in order to understand how the evidential object was produced.

6.23.3 Preservation of Alternative Interpretations

A final publication usually presents a comparatively stabilized interpretation. Research praxis, however, often passes through competing explanations, category choices, causal stories, historical readings, and model specifications. Some alternatives are rejected because evidence strongly weighs against them; others remain underdetermined; still others disappear because of space, disciplinary convention, or later shifts in research orientation. Future re-epistemization becomes weaker when only the winning interpretation survives.

Definition 6.356 (Alternative-interpretation record). *An alternative-interpretation record is a preserved account of a materially plausible interpretation, explanation, categorization, or model considered during inquiry, together with its evidential basis, unresolved questions, and the reasons for its provisional retention or rejection.*

Longino's account of scientific objectivity emphasizes the role of critical interaction and the capacity for background assumptions to be challenged (Longino 1990). Preservation extends that critical possibility through time. A later conceptual framework may render a previously weak interpretation newly intelligible; newly available evidence may discriminate among alternatives that were once observationally equivalent; a historical category discarded as peripheral can become central when the research question changes.

Preservation of alternatives does not require equal epistemic weighting. A well-refuted explanation should remain identified as refuted under the evidence then available. A speculative hypothesis should remain marked as speculative. The objective is traceable disagreement rather than flattened pluralism. The preserved record should allow later researchers to reconstruct both the alternative and the grounds on which earlier inquiry assessed it.

This practice also protects against retrospective inevitability. Once one interpre-

tation becomes dominant, the history of inquiry can appear more linear than it was. Preserving serious alternatives reveals which evidential and conceptual forks were available at the time and thereby supports historically responsible re-evaluation.

6.23.4 Preservation of Negative Results

Research preservation should include informative failures. A null association, unsuccessful replication, falsified prediction, failed intervention, unstable measurement, model breakdown, unproductive archival route, or method that repeatedly fails under specified conditions can constrain future inquiry even when it does not yield a positive finding. The epistemic value lies in narrowing plausible claims, exposing boundary conditions, identifying fragile assumptions, and reducing unnecessary repetition of already explored paths.

Definition 6.357 (Negative research result). A *negative research result* is a sufficiently documented research outcome in which an expected, hypothesized, targeted, or methodologically sought relation, effect, pattern, replication, performance, or practical result is absent, unstable, unsupported, or fails under specified conditions.

Negative is therefore a relation to an expectation or target, not a synonym for worthless research. Popper's emphasis on severe testing and the epistemic importance of failed predictions provides one classical precedent for treating counterevidence as substantive rather than disposable (Popper 2002). GRE broadens the point beyond falsification. A negative result can be informative even when it does not decisively reject a theory: it can expose a scale limit, temporal dependency, contextual condition, translation problem, or method-object mismatch.

Preservation quality matters. A statement that "the analysis did not work" offers little future value unless later researchers can determine what was attempted, on which records, under which assumptions, with which stopping rules, and with what observed failure. Negative results therefore inherit the provenance and methodological-context requirements developed throughout this section.

Preserving negative results also supports more accurate historical reconstruction of a research field. If only successful pathways remain visible, later observers can overestimate the reliability, inevitability, or efficiency of the route through which knowledge developed. An archive of well-documented failure preserves the contingency of inquiry without implying that every abandoned path deserves renewed investigation.

6.23.5 Preservation of Model Assumptions

Formal and quantitative models condense assumptions about entities, relations, parameters, boundaries, temporal structure, observation processes, and permissible transformations. Section 6.16 treated models as epistemic instruments whose functions can vary across representation, explanation, prediction, counterfactual exploration, theory development, and application. Future reanalysis requires more than the model's equations or code. It requires enough documentation to recover the assumptions that gave those formal objects their intended interpretation.

Definition 6.358 (Model assumption record). A *model assumption record* is a preserved specification of the substantive, formal, statistical, computational, boundary,

scale, temporal, and evidential assumptions on which a model's construction, calibration, interpretation, or use materially depends.

Giere emphasizes that scientific models represent selected aspects of the world from a perspective rather than reproducing reality without remainder (Giere 2006). Winsberg similarly shows that computer simulation depends on layered modelling practices, approximations, assumptions, and judgments that mediate relations among theory, computation, experiment, and evidence (Winsberg 2010). Preservation should therefore include assumptions that may be invisible in the final output: excluded mechanisms, fixed parameters, initialization rules, omitted populations, measurement models, convergence criteria, prior distributions where relevant, software dependencies, and intended domains of applicability.

Assumption preservation also enables later function reassignment. A model originally built for prediction can later be examined for explanatory structure, or a model once used for counterfactual exploration can be re-evaluated under new empirical evidence. Such reuse is defensible only when later users can distinguish the model's original function and evidential support from the function they now ask it to perform.

Proposition 6.359 (Assumption-preservation requirement). *When a model's conclusions depend materially on assumptions that are not recoverable from its outputs alone, preservation should retain those assumptions and their relation to the model's intended epistemic or practical function.*

6.23.6 Preservation of Historical Context

Evidence is produced within historical conditions. Categories, institutions, languages, technologies, legal arrangements, social meanings, disciplinary standards, and practical possibilities can change after a research record is created. Future researchers can therefore misread a well-preserved record if they interpret its terms through later meanings or assume that present-day alternatives were historically available.

Definition 6.360 (Historical research context record). *A historical research context record is preserved information concerning the contemporaneous categories, institutions, material conditions, technologies, linguistic conventions, evaluative standards, and feasible alternatives needed to interpret a research object or evidential claim in its historical setting.*

Hacking's historical ontology emphasizes that categories and objects of inquiry can acquire their forms through historically situated practices of classification and reasoning (Hacking 2002). Kuhn similarly demonstrates that scientific problems, standards, and intelligibility can shift across historical research configurations (Kuhn 1962). Preservation for re-epistemization should therefore retain enough historical context to prevent a later category from being projected uncritically backward.

Historical context includes absences and constraints as well as visible institutions. What data could not be collected? Which populations were administratively invisible? Which concepts did not yet exist in the relevant disciplinary vocabulary? Which technical capacities were unavailable? Which legal or political restrictions structured access? Which alternative interpretations were imaginable at the time? These conditions can materially affect the meaning of both evidence and omission.

Context preservation is necessarily selective. An archive cannot preserve an entire historical world. The practical criterion is dependency: preserve contextual in-

formation whose later loss would materially alter interpretation of the target records, methods, categories, or claims.

6.23.7 Preservation of Methodological Context

Historical context describes the wider environment of inquiry; methodological context describes how researchers organized access to that environment. Future reanalysis requires knowledge of why a method was selected, how the sample or corpus was formed, which instruments and protocols were used, what transformations were applied, which exclusions occurred, and what alternatives were unavailable or rejected.

Definition 6.361 (Methodological context record). A *methodological context record* is preserved information concerning the selection, execution, limitations, alternatives, and consequential decisions of the methods through which research evidence was produced and interpreted.

This requirement complements the historical evolution of methods analyzed in Section 6.21. A method can be appropriate relative to the available tools and research question of one period while appearing limited under later capabilities. Re-evaluation becomes more disciplined when future researchers can identify whether an apparent limitation arose from the underlying object, the available instrument, institutional access, resource scarcity, or the researcher's methodological choice.

Methodological context should also preserve transformations between representations. Section 6.18 showed that translation from narrative to variable, field experience to formal structure, or qualitative distinction to quantitative measure can lose information. A later researcher needs access to the translation rules and, where feasible, the source representations in order to determine whether a finding depends on the chosen methodological representation.

Documentation can be structured without becoming exhaustive. Gebru and colleagues' dataset documentation framework illustrates how standardized prompts can preserve motivation, composition, collection process, and recommended uses in an inspectable form (Gebru et al. 2021). Analogous documentation can be adapted to interviews, archives, fieldwork, simulations, legal corpora, comparative cases, and mixed-method designs.

6.23.8 Future Reanalysis

Preservation becomes epistemically significant when it expands the possibility of later reanalysis. Future researchers may possess new questions, new concepts, new theoretical frameworks, improved instruments, expanded comparative cases, different ethical concerns, new computational capabilities, or access to evidence unavailable to the original inquiry. Reanalysis can therefore do more than verify whether an earlier calculation was executed correctly. It can reconstruct the research object itself.

Definition 6.362 (Future reanalysis). *Future reanalysis* is a later inquiry that re-examines preserved research records, representations, assumptions, or contexts under materially changed questions, evidence, methods, categories, theories, evaluative criteria, or historical conditions.

Future reanalysis is distinct from exact reproduction. Reproduction can be valu-

able when the objective is to determine whether a reported computational or analytical procedure can be repeated from the same materials. Reanalysis can intentionally ask a different question or employ a different representation. It may revisit an archive under a new historical interpretation, recode an older dataset using revised categories, compare a model with newly observed regimes, or re-evaluate a legal classification after institutional change.

This possibility gives preservation generative value. Preserved records do not merely retain past knowledge; they can become resources from which new relations, questions, interpretations, and methods emerge. The original research team cannot fully anticipate these later uses. Preservation therefore supports generativity under uncertainty by maintaining a bounded option for future reconstruction.

Proposition 6.363 (Reanalysis option principle). *The epistemic value of preservation includes the option it creates for future inquiry to reconstruct earlier evidence under questions, concepts, methods, or historical conditions that were unavailable or weakly developed at the time of original research.*

The option is neither unlimited nor automatically desirable. Consent, licensing, community interests, confidentiality, security, legal restrictions, and potential misuse can constrain later access. Preservation architecture should therefore distinguish retention from access: a record can be preserved under controlled conditions even when open reuse would be inappropriate.

6.23.9 Cost of Preservation

Preservation consumes resources. Storage is only one component. Records must be organized, documented, migrated across formats, protected against corruption, governed through access rules, reviewed for legal and ethical compliance, and made interpretable to future users. Sensitive records can require security infrastructures and continuing stewardship. Physical archives can require climate control and conservation. Computational environments can depend on obsolete software or hardware. Documentation itself demands researcher time and institutional attention.

Definition 6.364 (Preservation cost profile). *A preservation cost profile is the temporally extended configuration of financial, material, computational, organizational, documentary, legal, ethical, security, and attention costs required to retain a research object in a condition suitable for its intended future use.*

The inclusion of attention is important. Simon's analysis of information-rich environments emphasizes that abundance of information can create scarcity of attention (Simon 1971). A preservation system that retains enormous volumes without adequate indexing, provenance, or prioritization can shift scarcity from storage toward discoverability and interpretation. Preservation quality can therefore decline even as retained volume increases.

Costs can also be transferred. A research group can deposit poorly documented material and thereby shift future curation burdens to repositories or later researchers. Conversely, excessive documentation requirements can impose disproportionate burdens on small projects or communities with limited resources. A responsible preservation design should therefore consider who bears the costs of storage, curation, access, interpretation, and risk over time.

Preservation cost also has an opportunity dimension. Resources devoted to indef-

inite retention of low-value or reproducible materials may reduce the capacity to preserve unique archives, vulnerable records, minority-language materials, or historically transient observations. Cost recognition is thus necessary for preservation justice as well as institutional sustainability.

6.23.10 Selective Preservation under Resource Constraints

Because preservation has costs and risks, research praxis requires selective preservation. The objective is to maintain future re-epistemic capacity under finite resources rather than to retain every possible trace. Selection should be explicit because unexamined selection already occurs through storage limits, institutional neglect, proprietary control, format decay, researcher departure, and differential visibility.

Definition 6.365 (Re-epistemic preservation priority). A *re-epistemic preservation priority* is a provisional judgment about the relative importance of retaining a research record or contextual element based on its uniqueness, irrecoverability, dependency relations, future reconstructive value, ethical significance, generative potential, preservation cost, and associated risks.

Several considerations can guide that judgment. *Uniqueness* concerns whether comparable evidence could later be regenerated. *Irrecoverability* concerns whether loss would be permanent, as with disappearing oral histories, transient ecological observations, or records from closed institutions. *Dependency* concerns whether many later claims rely on the item. *Reconstructive value* concerns whether future researchers could reinterpret earlier conclusions if the item survived. *Generative potential* concerns whether the material can support questions beyond the original study. *Ethical and legal risk* concerns whether retention itself can produce harm, breach duties, or create unacceptable exposure. *Cost* concerns the continuing resources required to preserve the material meaningfully rather than nominally.

Proposition 6.366 (Selective preservation principle). *Under finite resources, preservation priority should increase when a research record is difficult to regenerate, carries substantial dependencies for later claims, preserves otherwise vulnerable historical or relational information, or materially expands future possibilities for reanalysis, while the priority should be balanced against continuing ethical, legal, security, and stewardship burdens.*

Selection should preserve relationships among records where those relationships carry evidential meaning. Retaining a final dataset while deleting its codebook can destroy interpretability; retaining a model while deleting its data version can weaken validation; preserving a quotation while losing the surrounding interview can remove contextual meaning. Preservation decisions should therefore sometimes target a minimal reconstructive bundle rather than isolated files.

Definition 6.367 (Minimal reconstructive bundle). A *minimal reconstructive bundle* is the smallest ethically and practically retainable set of records, provenance, assumptions, contextual information, and methodological documentation sufficient to support the intended range of future reassessment of a consequential research claim.

The bundle is target-relative. Research intended only for short-horizon operational monitoring can require a different preservation horizon from a unique historical archive. A computational result based on public regenerable data can justify preserving code, versions, and transformation rules more strongly than duplicating every source file indefinitely. A confidential qualitative study can require controlled

retention of contextual metadata while limiting access to source records. Selectivity becomes defensible when these choices are explicit, reasoned, and revisable.

Evidence preservation thus closes the loop opened by historical revision of methods and evaluation. If knowledge, categories, methods, and standards can change, research systems require enough memory to make later correction possible. Yet memory itself is selective, costly, and relationally governed. Preservation should therefore be designed as part of research praxis: sufficiently rich to sustain future re-epistemization, sufficiently documented to preserve interpretability, and sufficiently bounded to respect the ethical and material conditions under which evidence can responsibly endure. The following section turns from preservation of what can be retained to the complementary problem of conducting research when the available evidential field remains incomplete.

6.24 Research under Incomplete Evidence

Section 6.23 treated preservation as infrastructure for later re-epistemization. The present section turns to the complementary condition in which inquiry must proceed before the evidential field is complete. Its role is to specify how research-dominant praxis can remain rigorous when observation is partial, records are missing, evidence conflicts, and time or resources prevent indefinite investigation. The objective is to replace an implicit ideal of evidential completeness with a disciplined account of provisional inference, research decision, and research action under bounded evidential conditions. The discussion proceeds from incomplete observation and missing records through evidential conflict and provisional inference, then examines decisions and actions internal to research, temporal and resource constraints, explicit limits of conclusion, and the point at which practical closure begins to move inquiry toward application-dominant praxis. The method is reconstructive and constraint-sensitive: incomplete evidence is treated as a structured property of a research configuration whose location, consequences, and residual uncertainties should remain inspectable.

Definition 6.368 (Evidential incompleteness). *Evidential incompleteness* is a condition in which the evidence available to a research claim leaves one or more materially relevant observations, records, relations, temporal intervals, populations, mechanisms, comparisons, or alternative explanations insufficiently resolved relative to the intended scope of that claim.

Evidential incompleteness is therefore claim-relative. A dataset can be sufficient for one bounded descriptive question while remaining inadequate for a historical, relational, or generative claim requiring additional temporal or contextual information. The relevant task is not to classify an entire project as complete or incomplete. It is to identify where the evidential architecture leaves consequential dependence on absence, assumption, extrapolation, or unresolved conflict.

This framing also prevents incomplete evidence from being converted too quickly into a single undifferentiated uncertainty value. Missing observations, inaccessible records, disagreement among sources, uncertain measurement, and unresolved causal alternatives create different inferential problems and require different responses. Manski's work on identification under weak assumptions illustrates the importance of distinguishing what is supported by available data from what be-

comes identified only after stronger assumptions are introduced (Manski 2008). GRE extends that discipline across heterogeneous evidential forms: the location and type of incompleteness should remain visible wherever they materially affect the conclusion.

6.24.1 Incomplete Observation

Incomplete observation arises when the target process, relation, or field is only partially accessible through the observation regime used in inquiry. Chapter 5 developed partial observation epistemologically; here the problem becomes practical. Researchers must decide whether to continue observing, alter the observation regime, narrow the claim, combine methods, or proceed provisionally with a documented remainder.

Definition 6.369 (Incomplete observation profile). An *incomplete observation profile* is a structured description of which relevant dimensions of a research target are observed, weakly observed, indirectly observed, temporally unobserved, inaccessible, or presently unknown under a specified observation regime.

The profile should distinguish several conditions. A relation can be visible only through one participant's position. A historical process can contain intervals for which surviving traces are sparse. A network can be observed through recorded transactions while informal dependencies remain weakly visible. A policy can be measured through immediate outcomes while delayed effects remain outside the study horizon. These forms of partiality differ because their inferential consequences differ.

Incomplete observation can sometimes be reduced by additional data collection, but extension of observation also has costs and can alter the object. Longer field presence can reveal temporal variation while changing researcher-participant relations. Additional measurement can increase coverage while producing measurement reactivity. Expanded administrative linkage can reveal cross-domain relations while increasing privacy and governance burdens. The practical response therefore requires judgment about whether increased observation materially improves the target inference relative to the costs and transformations it introduces.

Proposition 6.370 (Observation-completion proportionality). *The effort devoted to reducing incomplete observation should be proportionate to the expected effect of the missing observation on the target claim, the feasibility and consequences of obtaining additional evidence, and the availability of defensible scope restriction or alternative evidential access.*

This proposition keeps observation open without turning completeness into an unlimited research obligation. Some inquiries can advance through carefully bounded claims even when portions of the object remain unobserved.

6.24.2 Missing Records

Missing records create a different problem because the absent evidence may have once existed, may have been selectively preserved, may never have been produced, or may remain inaccessible. Each pathway has a different epistemic meaning. An archival silence generated by institutional exclusion differs from random file loss;

a missing administrative category differs from an inaccessible confidential record; absence of documentation differs from evidence that an event did not occur.

Definition 6.371 (Missing-record condition). A *missing-record condition* is a research state in which a record materially relevant to a claim is unavailable and the pathway producing that unavailability is itself partly known, inferable, contested, or unknown.

The pathway matters because missingness can be relationally generated. Institutions decide what is recorded, which categories are administratively legible, which archives survive, who receives documentary recognition, and what is destroyed, privatized, or classified. Section 6.23 showed why preservation infrastructures matter; the present problem is what to do when those infrastructures have already failed or were never equally available.

A disciplined treatment therefore separates the empirical absence of a record from the substantive absence of the relation or event that the record might have represented. Where the record-production process is known, researchers can sometimes infer what kinds of cases are more likely to disappear. Where the pathway is uncertain, conclusions should remain correspondingly narrower. Historical and qualitative evidence can sometimes reconstruct missing institutional records indirectly, while quantitative designs can sometimes bound rather than point-identify quantities affected by incomplete data (Manski 2008). These responses remain claim-specific.

Proposition 6.372 (Missing-record interpretation principle). A *missing record should influence substantive inference through an explicit account of the record-production and loss process whenever that process is materially relevant and sufficiently reconstructable; where it remains unresolved, the conclusion should preserve the resulting inferential remainder.*

This principle also links evidential incompleteness to epistemic justice. Weakly recorded relations can become weakly represented in later research, especially when institutional visibility is itself unequally distributed. The following section develops that power dimension directly.

6.24.3 Conflicting Evidence

Incomplete evidence need not mean too little evidence. A research field can contain abundant evidence that points in different directions. Statistical patterns can diverge from interview accounts; administrative classifications can conflict with lived practice; historical sources can disagree about sequence or responsibility; different models can fit overlapping evidence while implying different mechanisms. Conflict is therefore a distinct evidential condition rather than merely a temporary inconvenience before convergence.

Definition 6.373 (Evidential conflict). *Evidential conflict* is a condition in which two or more materially relevant evidence sources, representations, methods, or interpretations support conclusions that cannot be jointly accepted without qualification, reconstruction, scope differentiation, or revision of background assumptions.

Longino's contextual empiricism is relevant here because evidential relevance depends partly on background assumptions that can themselves become objects of criticism (Longino 1990). Apparent disagreement can arise because methods operationalize different constructs, observe different scales, sample different populations, or rely on different historical boundaries. Section 6.17 therefore treated disagreement as a

trigger for methodological diagnosis rather than immediate averaging.

Research under conflicting evidence should preserve the conflict long enough to determine its source where feasible. One result may be adjudication: one source is less reliable for the target claim. Another may be differentiation: each source is adequate for a different property or scale. A third may be reconstruction: the conflict reveals that the original category combined phenomena requiring separation. A fourth may be durable underdetermination: available evidence does not support a defensible resolution.

Proposition 6.374 (Conflict-preservation principle). *When materially relevant evidence conflicts, research praxis should preserve the disagreement until the basis for adjudication, differentiation, reconstruction, or continued underdetermination has been made explicit enough for the target claim.*

Conflict preservation does not assign equal weight to every source. Evidence can differ substantially in provenance, measurement quality, inferential distance, historical fit, and vulnerability to bias. The requirement is that the route by which one source is privileged, combined, or bounded relative to another remain inspectable.

6.24.4 Provisional Inference

Research rarely waits for a final evidential state before inference begins. Concepts are formed from partial encounters, sampling decisions are revised from early observations, model families are compared before all mechanisms are known, and historical interpretations develop while archival gaps remain. Provisional inference is therefore a normal component of research praxis rather than an exceptional concession.

Definition 6.375 (Provisional inference). *A provisional inference is an inference accepted for a specified research purpose and scope while its dependence on incomplete evidence, contestable assumptions, unresolved alternatives, or future revision remains explicitly recorded.*

The central discipline is to separate what the evidence supports from what is contributed by assumptions. Manski's analysis of identification is again useful: weak assumptions can support bounded conclusions even when point identification is unavailable (Manski 2008). A parallel principle applies outside quantitative identification. A historical study can state a range of plausible sequences; an ethnography can restrict its inference to the observed relational field; a legal analysis can distinguish doctrinal interpretation from empirical implementation; a computational model can report results conditional on specified assumptions rather than presenting them as direct observations.

Provisionality should be operational rather than ceremonial. Phrases such as "more research is needed" provide little discipline unless the unresolved component is specified. A stronger account identifies which observation is absent, which assumption carries the inference, which alternative remains live, and what new evidence would materially change the conclusion.

Proposition 6.376 (Structured provisionality). *A provisional inference should identify, to the extent material for the claim, its evidential basis, consequential assumptions, unresolved alternatives, scope of use, and plausible revision triggers.*

Provisional inference therefore supports research continuity without simulating closure. It allows inquiry to accumulate, compare, formalize, and publish while pre-

serving a pathway for later correction.

6.24.5 Decision within Research

Incomplete evidence also enters decisions internal to research. Researchers decide which case to examine next, when to stop collecting data, which archive to prioritize, whether to merge categories, which model to estimate, which anomaly deserves follow-up, whether an interpretation is mature enough for publication, and whether a result should remain provisional. These decisions shape the evidential field that later appears to support the conclusion.

Definition 6.377 (Research decision under incomplete evidence). *A research decision under incomplete evidence is a choice among feasible inquiry paths made before the relevant evidential state is fully resolved, where the choice affects subsequent observation, representation, analysis, preservation, or communication.*

Such decisions are distinct from the external practical decisions emphasized in application-dominant praxis. Their immediate object is the conduct of inquiry. Yet they can still carry consequential path dependence. Choosing one archive can reduce time available for another. Fixing a codebook can stabilize later measurement. Publishing one classification can make it more likely to be reused. Selecting one model family can orient future data collection toward variables that model can represent.

Research decisions should therefore be treated as epistemically consequential actions within praxis. Dewey's account of inquiry emphasizes the movement from problematic situations through observation and inference toward provisional resolution (Dewey 1910). In GRE, the decision problem includes the relational and historical effects of choosing a particular path through that movement.

Proposition 6.378 (Research-decision traceability). *When a research decision made under incomplete evidence materially shapes later evidence or interpretation, the decision, its principal alternatives, and the considerations supporting it should remain sufficiently traceable for later reconstruction.*

Traceability does not require an exhaustive diary of every minor choice. It applies most strongly where the decision changes the object, sample, category system, model class, evidential access, stopping rule, or preservation architecture in ways that materially condition the conclusion.

6.24.6 Action within Research

Research decisions become research actions when they are implemented and thereby alter the inquiry configuration. Recruiting participants, opening a new field site, changing an instrument, recoding an archive, running a simulation, releasing a dataset, preregistering an analysis, publishing a classification, or constructing a new measurement infrastructure are actions internal to research praxis. Some act primarily on the research system; others can also act on the studied relational field.

Definition 6.379 (Research action under incomplete evidence). *A research action under incomplete evidence is an implemented change to the design, evidential access, representation, infrastructure, communication, or relational configuration of inquiry undertaken while relevant uncertainty remains unresolved.*

The distinction between decision and action matters because implementation can

create new evidence and new path dependence. An additional interview can reveal an unanticipated category. A changed survey instrument can improve measurement while reducing comparability with earlier waves. Publication can generate uptake that makes a representation performative. Section 6.20 showed that these pathways can become reflexive when research activity alters later evidence.

Action within research can therefore function as disciplined exploration. A pilot study, alternative coding exercise, replication, model perturbation, or targeted archival search can be chosen partly because it is informative under uncertainty. Yet research action also has ethical and practical consequences. Additional observation can burden participants; expanded linkage can increase privacy risk; preservation can create stewardship obligations. The value of information supplied by an action should therefore be assessed together with its relational costs.

Proposition 6.380 (Informative research action). *A research action undertaken under incomplete evidence is epistemically preferable, other considerations being comparable, when it is expected to discriminate among materially different interpretations, reduce consequential uncertainty, or reveal the limits of a current representation while preserving acceptable ethical and relational conditions.*

This proposition does not convert all research into experimental intervention. Informative action can include observation, comparison, documentation, preservation, or representational revision. Its defining feature is that the action is selected partly for what it can teach about the unresolved research configuration.

6.24.7 Research under Time Constraints

Inquiry operates within time. Field access closes, archives impose schedules, grants end, policy windows shift, participants leave, ecological states change, computational resources are allocated for finite periods, and publication or coordination requires provisional stopping points. Time constraints can therefore create pressure for epistemic closure before evidence has reached the level that researchers would prefer under an indefinite horizon.

Definition 6.381 (Time-bounded research closure). *Time-bounded research closure* is a provisional stopping point adopted because a specified research phase must conclude within a finite temporal horizon even though materially relevant evidential uncertainty remains.

Time-bounded closure can be responsible when the residual uncertainty is made explicit and the claim is scaled accordingly. It becomes more problematic when deadline pressure is converted into rhetorical certainty. The distinction is between ending a research phase and declaring the underlying epistemic problem settled.

Time scarcity also changes prioritization. Researchers may need to choose evidence with high discriminating value, preserve records for later work, narrow the claim, or defer secondary questions. These choices resemble attention allocation under information abundance discussed by Simon (Simon 1971). The relevant scarce resource is not only clock time but the capacity to process and compare evidence before a decision point.

Proposition 6.382 (Temporal closure discipline). *When research closes because of a time constraint, the resulting claim should distinguish evidential support achieved from questions deferred by the temporal boundary and should preserve, where feasible, the*

provenance needed for later continuation.

This discipline turns deadline-induced incompleteness into an explicit property of the research design rather than a hidden weakness of the conclusion.

6.24.8 Research under Resource Constraints

Research is also materially bounded. Financial support, personnel, expertise, computing, laboratory access, language capacity, archival permissions, travel, security, and institutional infrastructure can all limit what evidence is feasible to obtain. Section 6.8 treated these conditions as part of researcher position; here they enter the design and interpretation of incomplete evidence.

Definition 6.383 (Resource-bounded research design). A *resource-bounded research design* is a design whose evidential reach and methodological configuration are materially shaped by finite financial, technical, infrastructural, linguistic, organizational, or human capacities.

Resource constraints need not invalidate a study, but they can change which claims are defensible. A small comparative study can be strong for mechanism reconstruction while weak for prevalence. A project without proprietary data can remain rigorous while observing a different portion of the relational field. A low-resource archive project can preserve unique evidence even if its digitization or metadata remain partial. The relevant question is whether the claim is aligned with the access and limitations of the design.

Resource constraints can also create systematic epistemic asymmetry. Well-funded institutions can purchase data, instruments, field access, computing, and preservation capacity unavailable to others. If these differences become invisible, methodological privilege can be misread as purely epistemic superiority. The following section examines these power relations directly.

Proposition 6.384 (Constraint-claim alignment). A *resource-bounded inquiry remains epistemically defensible when the scope and strength of its claims are aligned with the evidence its resource configuration can support and when materially consequential access limitations are disclosed rather than converted into implicit universality.*

This principle also protects methodological diversity. Research quality should not be equated with maximal expenditure where lower-resource methods provide appropriate access to the target question.

6.24.9 Explicit Limits of Conclusion

Incomplete evidence becomes most consequential at the point where findings are communicated. A research conclusion can remain useful while carrying explicit limits on population, scale, time, mechanism, representation, or inferential strength. The purpose of such limits is neither ritual modesty nor wholesale weakening of the claim. It is to specify the boundary within which the conclusion is warranted.

Definition 6.385 (Explicit inferential limit). An *explicit inferential limit* is a stated boundary on the interpretation, transport, strength, temporal horizon, scale, population, mechanism, or practical use of a research conclusion arising from the evidential and methodological conditions under which it was produced.

Limits should be informative enough to guide later use. “The sample is limited”

is weaker than stating which relations or populations are weakly observed. “Causality cannot be established” is weaker than specifying whether temporal order, mechanism, counterfactual dependence, or alternative explanations remain unresolved. “Results may not generalize” is weaker than naming the boundary or scale across which transport has not been established.

Explicit limits also protect cumulative inquiry. Later researchers can decide whether new evidence addresses the missing dimension, whether a result can be combined with another study, or whether apparent contradiction reflects different scopes. Popper’s emphasis on exposing theories to criticism offers one historical precedent for keeping claims open to correction (Popper 2002); GRE extends this requirement to the specific relational and representational dependencies of the conclusion.

Proposition 6.386 (Limit-bearing conclusion). *A conclusion reached under incomplete evidence should carry the materially relevant limits that condition its warrant, especially where omission of those limits would invite transport, generalization, causal interpretation, or practical use beyond what the research design supports.*

The strength of a conclusion therefore depends partly on the precision of its boundary. A narrower but well-supported claim can contribute more reliably to cumulative research than a rhetorically expansive claim whose evidential dependencies remain hidden.

6.24.10 Application-Dominant Praxis under Incomplete Evidence

Research under incomplete evidence creates a boundary problem because some research decisions have consequences beyond the organization of inquiry. A pilot intervention can alter a community relation; release of a classification can affect eligibility or reputation; a forecasting system can guide institutional allocation; a published risk estimate can influence behavior; an experimental protocol can create lasting infrastructures. At such points, the principal contradiction can begin to shift from how to know under incomplete evidence toward how to act responsibly while knowledge remains incomplete.

Definition 6.387 (Praxis-orientation transition under incomplete evidence). *A praxis-orientation transition under incomplete evidence occurs when the dominant burden of a research configuration shifts from producing or revising warranted knowledge toward selecting, implementing, or governing consequences in a practical-relational world while consequential uncertainty remains.*

The transition is phase-dependent rather than institutional. A university research team can enter application-dominant praxis when it deploys a consequential classification or intervention. A public agency can remain in research-dominant praxis while reconstructing evidence before action. Hybrid configurations can carry both burdens simultaneously. Section 6.2 established this mode distinction; the present section identifies incomplete evidence as one of the conditions through which movement between modes becomes visible.

Three features are especially diagnostic. First, the relevant closure point becomes practical rather than primarily epistemic: an action, allocation, intervention, restriction, or deployment must be selected. Second, the consequences increasingly fall on

relations beyond the research system. Third, uncertainty itself becomes part of the responsibility structure because waiting, acting, or choosing among reversible and irreversible options can each generate effects.

Proposition 6.388 (Transition under consequential closure). *When a choice made under incomplete evidence primarily determines consequential action in the practical-relational world rather than the next organization of inquiry, the praxis configuration should be evaluated increasingly through the responsibilities of application-dominant praxis, even if research activities continue within the same institutional setting.*

This transition does not imply that research-dominant inquiry ceases. Evidence collection, model revision, interpretation, and re-epistemization can continue after action begins. The change concerns which contradiction becomes principal in the active phase. Research under incomplete evidence therefore reveals both the limits and the generative capacity of research praxis: inquiry can advance through bounded provisionality, preserve unresolved alternatives, and organize further learning, yet some choices eventually acquire a practical burden that cannot be resolved by additional epistemic refinement alone. The following section returns to the research field itself and examines how the power to name, classify, measure, make visible, and allocate evidential authority shapes whose relations can become objects of knowledge.

6.25 Researcher Power and Epistemic Justice

The preceding section examined research under incomplete evidence and showed that limitations of access, time, resources, and records can shape what inquiry is able to support. The present section develops a closely related problem: those limitations are rarely distributed evenly. Research praxis includes capacities to name, classify, measure, make visible, preserve, circulate, and authorize representations of persons, relations, institutions, and processes. These capacities can enlarge collective knowledge, yet they can also reorganize the epistemic field by determining which distinctions travel, whose evidence receives uptake, and which relations remain weakly legible. The role of this section is therefore to locate power within the ordinary operations of inquiry. Its objective is to specify how epistemic justice constrains research relations without replacing evidential warrant with automatic deference. The discussion proceeds from naming and classification through measurement, visibility, exclusion, evidential resources, representational authority, contestability, justice in research relations, and reflexive limitation. The method is relational and pathway-sensitive: power is attributed where identifiable research practices materially condition access, representation, uptake, or the future organization of inquiry.

Fricker's analysis of testimonial and hermeneutical injustice offers a philosophical precedent for examining unequal credibility and unequal participation in shared interpretive resources (Fricker 2007). Longino's account of socially organized criticism likewise emphasizes the epistemic importance of conditions under which criticism can enter inquiry and receive serious uptake (Longino 1990). GRE extends these concerns into a broader research-praxis architecture. Power can enter before an explicit credibility judgment is made: a relation may never be recorded, a category may be unavailable, a measurement infrastructure may be inaccessible, or a representation may circulate without a practicable route of contestation.

Definition 6.389 (Research epistemic power). *Research epistemic power is the rela-*

tionally distributed capacity to shape the conditions under which research objects are named, classified, measured, made visible, excluded, evidenced, represented, contested, preserved, or carried into subsequent inquiry and practice.

Definition 6.389 treats power as a property of research relations rather than a possession located only in individual researchers. Universities, funders, archives, statistical systems, journals, platforms, instruments, professional vocabularies, and data infrastructures can all participate in the organization of epistemic power. The relevant question is therefore which pathways materially shape the evidential and representational field, and with what consequences for the actors and relations under study.

6.25.1 Power to Name

Naming is one of the earliest operations through which an encountered phenomenon becomes portable within research. A name can stabilize attention, permit comparison, organize retrieval, support communication across institutions, and create a handle for cumulative inquiry. It can also foreground one interpretation while backgrounding others. The epistemic power of naming therefore lies partly in its capacity to establish which distinctions become repeatable in later research.

Names differ in their degree of stabilization. A provisional field term may remain close to participant language. A technical term may be embedded in a disciplinary lineage. An administrative label may carry eligibility rules or reporting consequences. A computational label may become a feature used repeatedly in automated classification. These forms should not be treated as equivalent merely because each assigns a linguistic sign. Bourdieu's account of language and symbolic power is relevant here because linguistic forms can acquire differential authority through social and institutional conditions (Bourdieu 1991).

Definition 6.390 (Naming power in research). *Naming power in research* is the capacity to introduce, stabilize, circulate, or privilege a term through which a research object, relation, difference, or process becomes available for subsequent description, comparison, classification, or action.

A justice-sensitive use of naming makes the naming relation inspectable. Researchers should distinguish, where materially relevant, participant terms, inherited disciplinary terms, institutional terms, and newly introduced analytical vocabulary. The point is not to preserve every vocabulary indefinitely. It is to prevent a newly stabilized name from erasing the provenance of the distinctions from which it was constructed.

Proposition 6.391 (Provenance of consequential naming). *When a research name materially shapes later classification, measurement, attribution, or institutional uptake, its provenance and intended scope should remain sufficiently visible for later users to distinguish the introduced term from the phenomenon or relation it is used to represent.*

6.25.2 Power to Classify

Classification converts a field of differences into a structured set of categories, states, types, or partitions. This operation can make previously diffuse relations empirically tractable. It can also create boundaries whose consequences exceed the immediate

research task. A classification may decide which cases are comparable, which observations enter a dataset, which histories count as instances of the same phenomenon, and which residual cases become coded as noise or exception.

The power of classification is especially visible when categories travel across settings. A category devised for one study can enter administrative practice, policy reporting, machine-learning datasets, or later scholarship. Once institutionalized, the category can influence what future systems observe. The classificatory effect can therefore become recursive: the research representation helps organize the world from which subsequent data are drawn. This possibility connects classification to the reflexive pathways developed in Section 6.20.

Definition 6.392 (Classificatory power in research). *Classificatory power in research* is the capacity to establish or stabilize distinctions that determine how cases, persons, relations, events, or observations are grouped, compared, included, excluded, or made available for subsequent inference.

Classification can be necessary without being ontologically final. Inquiry under ontological suspension in Section 6.9 already established that operational categories need not settle ultimate ontology. Justice adds a further requirement: where categories are consequential for represented actors or for the visibility of relations, researchers should examine whose distinctions are retained, whose are translated, and which alternatives become difficult to express within the adopted scheme.

Claim 6.393 (Contestable classification). *Consequential research classifications gain epistemic robustness when their criteria, residual cases, translation choices, and materially relevant alternatives remain open to informed contestation rather than being treated as self-interpreting features of the data.*

6.25.3 Power to Measure

Measurement adds another layer of epistemic power because it selects properties, establishes scales, and makes heterogeneous cases commensurable. Porter documents the institutional importance of quantitative objectivity and standardized procedures in modern public and scientific life (Porter 1995). Espeland and Stevens show that commensuration can have cognitive and political consequences because translating different entities into a common metric changes what becomes comparable and what distinctions recede (Espeland and Stevens 1998).

A measure can expand access to patterned evidence while remaining selective. The choice of construct, unit, denominator, coding rule, threshold, time window, or aggregation level can materially alter what becomes visible. Measurement power therefore concerns both the capacity to quantify and the authority to define the measurable form of the target.

Definition 6.394 (Measurement power in research). *Measurement power in research* is the capacity to define and operationalize properties through scales, indicators, coding rules, thresholds, or metrics that structure how observations become comparable and evidentially consequential.

Measurement power becomes justice-relevant where actors have unequal capacity to influence operationalization or to contest the resulting measure. A standardized index can travel farther than situated testimony because it fits existing institutional infrastructures. That portability can be useful, yet it may grant the metric greater

authority than the construct validity or contextual fit warrants.

Proposition 6.395 (Measurement-authority discipline). *The authority granted to a research measure should remain proportionate to the evidential support for its construct, scope, and transport conditions, especially where the measure can redistribute visibility, credibility, eligibility, or institutional attention.*

This proposition preserves a distinction developed repeatedly in the chapter: methodological portability and epistemic warrant are related but different. A measure can be easy to circulate while remaining weakly suited to a particular relational context.

6.25.4 Power to Make Visible

Research can make previously weakly represented relations visible. Documentation can reveal hidden labor, dispersed harms, informal coordination, historical exclusion, ecological contribution, or institutional dependence. Visibility can therefore expand the evidential field and support recognition, criticism, and later inquiry. Yet visibility also redistributes informational power. Making a relation visible to researchers, institutions, or publics can expose participants to surveillance, reputational risk, strategic disadvantage, or new forms of intervention.

Definition 6.396 (Research visibility power). *Research visibility power* is the capacity to alter whether and how an actor, relation, practice, effect, or trace becomes observable, recordable, comparable, circulable, or institutionally legible through research activity.

Visibility is therefore relationally indexed. A dataset can make a pattern visible to researchers while remaining inaccessible to the people represented within it. Publication can make a community visible to a wider public while reducing that community's control over contextual interpretation. Conversely, deliberate limits on visibility can protect confidentiality, bargaining position, cultural knowledge, or safety.

Proposition 6.397 (Purpose-sensitive visibility). *Research visibility should be assessed relative to epistemic purpose, consent and governance conditions, relational position, and foreseeable consequences for those made visible, rather than treated as an unqualified increase in epistemic justice.*

The proposition prevents a simple equation of transparency with justice. Visibility can support epistemic participation while also enabling new asymmetries of observation and control.

6.25.5 Power to Exclude

Every research configuration excludes something. Boundaries delimit populations; sampling frames omit cases; archives preserve some records and lose others; classification schemes generate residual categories; instruments detect only particular signals; publication compresses more material than it can retain. Exclusion is therefore partly unavoidable. The justice problem concerns patterned exclusion that materially narrows whose relations, evidence, interpretations, or consequences can enter inquiry and whose absence then becomes mistaken for insignificance.

Definition 6.398 (Epistemic exclusion in research praxis). *Epistemic exclusion in research praxis* is a relational condition in which actors, evidence, interpretations, cat-

egories, or relevant relations are systematically constrained from entering, influencing, contesting, or being preserved within a research process in ways that materially affect the resulting knowledge.

Fricker's account of hermeneutical injustice is especially relevant when unequal participation in interpretive resources makes some experiences harder to render intelligible within available categories (Fricker 2007). In research praxis, analogous exclusion can occur through inaccessible technical vocabularies, proprietary datasets, language barriers, credential requirements, institutional gatekeeping, or category systems that offer no adequate location for a relation participants regard as consequential.

Justice-sensitive inquiry should distinguish principled exclusion from unexamined exclusion. Ethical safeguards can properly restrict some data. A narrowly defined research question can properly exclude irrelevant cases. The issue is whether exclusion tracks the stated object and responsibilities of inquiry, or whether it silently reproduces asymmetries that distort the evidential field.

Claim 6.399 (Exclusion audit). *Where exclusion materially affects the interpretation or transport of a research claim, the research record should identify the principal exclusion pathway and distinguish design-based exclusion, access-based exclusion, ethical restriction, missingness, and category-generated invisibility where these differences matter.*

6.25.6 Unequal Evidential Resources

Epistemic participation depends partly on resources. Institutions with extensive funding, legal support, computing, archival access, measurement infrastructure, professional networks, and publication capacity can produce evidence in forms that travel widely. Communities or researchers with fewer resources may possess deep situated knowledge while lacking comparable means to standardize, preserve, analyze, or circulate it. Section 6.24 treated resource constraints as a research-design problem; the present subsection considers their distributive epistemic effects.

Definition 6.400 (Evidential resource asymmetry). *Evidential resource asymmetry is a structured difference in the capacity of actors or institutions to generate, access, preserve, verify, analyze, circulate, or contest evidence relevant to a research claim.*

Such asymmetry does not imply that low-resource evidence is automatically stronger or that high-resource evidence is suspect. It changes the conditions under which evidential authority is produced. A large administrative dataset may support broad comparison while remaining weak on informal relations. A small community archive may preserve unique histories while offering limited population coverage. Epistemic justice requires differentiated evaluation of these strengths rather than equating evidential capacity with institutional wealth.

Proposition 6.401 (Resource-aware evidential evaluation). *When evidential resources are distributed unevenly, research evaluation should distinguish the quality and relevance of the evidence from the institutional capacity that made its production, preservation, or circulation possible, while remaining explicit about limits created by unequal access.*

This principle also applies within research teams. Technical staff, data stewards, community partners, translators, field coordinators, and archivists can contribute

epistemically significant capacities that disappear when evidential production is represented solely through the final analytic author.

6.25.7 Representational Authority

Research does more than collect evidence; it produces accounts that can travel beyond the original encounter. Representational authority concerns whose account becomes durable and portable enough to stand for a relation in later scholarship, policy, education, administration, or public discussion. This authority may be distributed differently from firsthand access. A researcher can possess publication authority while a participant possesses situated experiential access. An institution can possess administrative records while a community retains local historical knowledge. A technical team can control the model while affected actors observe consequences the model does not represent.

Definition 6.402 (Representational authority in research). *Representational authority in research* is the capacity of an actor, institution, method, or artifact to establish a representation that receives durable epistemic uptake concerning a research object, relation, population, or process.

Representational authority should be calibrated to the property represented. Situated actors can have strong authority concerning experienced meaning or local practice without thereby settling prevalence or hidden mechanism. Researchers can have comparative authority derived from cross-case evidence while remaining weakly positioned to interpret tacit meanings. Statistical systems can detect patterns while carrying thin accounts of lived significance. Justice therefore supports differentiated authority rather than a single hierarchy of speakers.

Longino's emphasis on critical interaction supports the need for recognized avenues through which claims can be challenged and background assumptions exposed (Longino 1990). Within GRE, representational authority becomes more defensible when provenance, inferential scope, alternative interpretations, and routes of contestation remain visible.

Proposition 6.403 (Differentiated representational authority). *Representational authority should be indexed to the form of access and inferential reach supporting the representation, while consequential representations should preserve feasible routes through which differently positioned actors can challenge material errors, omissions, or category failures.*

6.25.8 Contestability

Contestability is the practical capacity to question, inspect, challenge, revise, or contextualize a research representation or decision. It is stronger than the abstract possibility of disagreement. A representation may be publicly available yet difficult to contest because its data are inaccessible, its categories undocumented, its technical procedures opaque, or no institution is responsible for receiving challenges.

Definition 6.404 (Epistemic contestability in research). *Epistemic contestability in research* is the capacity of relevant actors to identify a consequential research claim or representation, understand enough of its evidential and inferential basis to formulate a challenge, submit materially relevant counterevidence or interpretation, and obtain a reasoned pathway of review where revision is warranted.

Contestability does not require every disagreement to alter the conclusion. It requires a relation between challenge and review. The threshold can vary with consequence. A low-stakes exploratory model can require modest documentation. A classification that affects public allocation, reputation, access, or durable institutional records can warrant substantially stronger routes of explanation and correction.

Proposition 6.405 (Consequence-sensitive contestability). *The practical strength of contestability should increase with the consequence, persistence, opacity, and representational authority of the research output, while review procedures remain proportionate to feasible evidential and institutional conditions.*

Contestability also supports cumulative research. Challenges can reveal missing categories, inaccessible evidence, mistranslation, historical discontinuity, or boundary errors that would otherwise persist through repeated reuse. In this sense, contestability is not only procedural protection; it is a mechanism of methodological correction.

6.25.9 Justice in Research Relations

The preceding subsections identify several sites at which research relations can become epistemically asymmetric. Justice in research relations concerns how these capacities are organized together. It includes opportunities to contribute relevant evidence and interpretation, protections against harmful visibility, calibrated credibility, recognition of differentiated access, contestability of consequential representations, and preservation of provenance sufficient for later reassessment.

Definition 6.406 (Epistemic justice in research relations). *Epistemic justice in research relations* is the just organization of opportunities, protections, resources, authority, and contestability through which differently positioned actors can contribute to, be represented within, and challenge research concerning relations and processes in which they are materially implicated.

Definition 6.406 does not assign equal evidential weight to every contribution. Epistemic justice and evidential adequacy remain distinct. A participant's testimony can deserve serious uptake while remaining limited concerning population prevalence. An institutional dataset can be methodologically strong for some questions while reproducing category exclusions relevant to others. A community interpretation can reveal meaning inaccessible to an external researcher while remaining open to counterevidence. Justice governs the conditions under which these differences are recognized and assessed rather than flattening them into equivalence.

Proposition 6.407 (Justice-sensitive research relation). *A justice-sensitive research relation seeks to align epistemic authority with relevant access and evidential support, preserve meaningful opportunities for contestation, avoid unnecessary exposure or exclusion, and disclose material asymmetries in the resources through which evidence and representation are produced.*

This proposition remains narrower than a complete ethics of research. Consent, benefit sharing, compensation, ownership, liability, and broader distributive justice can require additional principles. The present concern is specifically the epistemic organization of the research relation.

6.25.10 Reflexive Limitation of Research Power

Research power becomes especially consequential when it disappears from the researcher's own account of inquiry. A classification can appear as if it were discovered rather than introduced; a metric can appear as a transparent property rather than an operational construction; publication can appear as mere communication even when it alters reputation or institutional behavior. Reflexive limitation begins by making these research-mediated pathways explicit.

Definition 6.408 (Reflexive limitation of research power). *Reflexive limitation of research power* is the deliberate identification, documentation, contestation, and where appropriate restraint of research capacities that materially shape naming, classification, measurement, visibility, exclusion, evidential access, or representational authority beyond what the epistemic and practical purpose of the inquiry warrants.

Limitation can take several forms: narrower classification scope, participatory category review, controlled disclosure, preservation of alternative vocabularies, explicit uncertainty, restricted data linkage, independent review, documentation of metric construction, or revision pathways after publication. The appropriate mechanism depends on the pathway of power. Reflexivity therefore should remain specific enough to guide design rather than functioning as a general declaration that researchers possess power.

Foucault's analysis of power relations is relevant insofar as power operates through structured possibilities for action rather than only through direct command (Foucault 1982). Research classifications, infrastructures, and representations can similarly structure later possibilities without determining them completely. This makes reflexive limitation compatible with research ambition: the aim is to preserve the capacity to know while reducing unjustified conversion of epistemic tools into unexamined authority.

Proposition 6.409 (Reflexive restraint principle). *Where a research operation generates epistemic or practical power beyond what is necessary for the warranted purpose of inquiry, the design should consider proportionate limits, countervailing review, or contestability mechanisms, with the chosen response indexed to the operation's consequence, reversibility, and persistence.*

Reflexive limitation also has a generative dimension. A research field that preserves contestability, differentiated authority, and multiple routes of evidential contribution can support future correction and new inquiry more effectively than one that secures short-term coherence by suppressing alternatives. Epistemic justice therefore belongs inside research praxis rather than appearing only as an external ethical constraint. It shapes which evidence can emerge, which representations remain revisable, and whose capacities to participate in future re-epistemization are preserved.

The next section broadens the analysis from epistemic justice to the aesthetic and normative conditions that operate across both research-dominant and application-dominant praxis. Having examined how research power organizes visibility and authority, the inquiry can now ask how aesthetic and normative judgment orient selection, evaluation, and action across the wider field of praxis.

6.26 Aesthetic and Normative Conditions across Praxis

The preceding section located epistemic power within the ordinary operations of research and showed that naming, classification, measurement, visibility, exclusion, and representation can reorganize the conditions of knowledge production. The present section broadens the analysis from epistemic justice within research to the aesthetic and normative conditions that operate across both research-dominant and application-dominant praxis. Its role is to clarify how judgments concerning elegance, coherence, significance, fairness, responsibility, urgency, and value orient what questions are pursued and what actions are taken. The objective is to preserve the analytical distinction among aesthetic, epistemic, and normative judgment while showing that practical orientation often depends on their interaction. The discussion proceeds from aesthetic and normative judgment in research and application to the selection of questions and actions, plural values, conflict among judgment forms, the historical formation of practical taste, and the revisability of practical judgment. The method is relational and historically situated: judgments are treated as configurations formed through persons, institutions, traditions, material conditions, representations, and anticipated consequences rather than as isolated mental acts or timeless criteria.

Section 6.12 developed judgment within research and distinguished aesthetic, epistemic, and normative dimensions. The present section extends that architecture across the wider field of praxis. Kant's account of aesthetic judgment remains useful as a classical reference for the distinctive structure of judgments of taste, while Dewey's account of aesthetic experience and valuation places judgment within temporally organized interaction and consequence (Kant 1987; Dewey 1934; Dewey 1939). GRE draws on these lineages without treating them as a complete theory of practical judgment. Its narrower concern is how aesthetic and normative conditions participate in the orientation of research and application under relational complexity, heterogeneous values, and incomplete knowledge.

Definition 6.410 (Practical judgment configuration). A *practical judgment configuration* is the historically situated combination of aesthetic, epistemic, normative, institutional, and contextual judgments through which a praxis evaluates questions, representations, actions, consequences, and possible future trajectories.

Definition 6.410 avoids reducing practical orientation to a single scalar criterion. A research project can appear theoretically elegant yet normatively problematic; an intervention can be ethically urgent yet weakly supported by available evidence; a policy can satisfy one conception of fairness while degrading another valued capability. Praxis therefore requires differentiated judgment together with explicit treatment of conflict among judgment forms.

6.26.1 Aesthetic Judgment in Research

Aesthetic judgment in research can orient attention before a full epistemic assessment is available. Researchers may be drawn toward a conjecture because it exhibits economy, a model because it reveals a striking symmetry, a historical pattern because it has an unexpected structural coherence, or a question because it appears capable of reorganizing several otherwise disconnected problems. Such judgments can be generative because they influence which possibilities receive sustained inquiry.

Section 6.12 already established that aesthetic attractiveness does not establish truth. The additional point here concerns praxis orientation. Aesthetic judgment can affect resource allocation, collaboration, model choice, problem formation, and the persistence with which an unresolved question is pursued. McAllister's historical analysis of aesthetic preferences in science is relevant because it shows that standards of scientific beauty themselves can change with theoretical development (McAllister 1996).

Definition 6.411 (Aesthetic orientation in research). An *aesthetic orientation in research* is the influence of judgments concerning form, elegance, coherence, simplicity, surprise, depth, or generative appeal on the selection, continuation, representation, or development of research activity.

Aesthetic orientation can be productive when it helps preserve possibilities whose value is not yet captured by established evaluation criteria. It can also become restrictive when a historically dominant style of elegance excludes phenomena that are irregular, heterogeneous, context-dependent, or resistant to concise representation. The epistemic task is therefore to retain aesthetic judgment as a source of orientation while preserving routes through which evidence can correct aesthetic preference.

Proposition 6.412 (Aesthetic orientation discipline). *When aesthetic judgment materially influences research selection or persistence, its orienting role should remain distinguishable from the epistemic warrant later offered for the resulting claim, model, or explanation.*

6.26.2 Aesthetic Judgment in Application

Application-dominant praxis also contains aesthetic conditions. Built environments, interfaces, institutions, legal forms, public spaces, technologies, and organizational procedures are experienced through qualities such as clarity, proportion, continuity, legibility, harmony, friction, rhythm, and fit. These qualities can affect whether an intervention is usable, inhabitable, trusted, memorable, or capable of sustaining participation.

Aesthetic judgment in application should therefore be distinguished from decorative preference. A design can alter how relations are encountered and enacted. The spatial organization of a public service can communicate dignity or surveillance; an interface can make some actions intuitive and others difficult; an institutional procedure can feel coherent or alienating; a legal or administrative form can either support intelligibility or intensify symbolic distance. Dewey's account of aesthetic experience is relevant here because it locates aesthetic quality within organized experience rather than in ornament detached from practice (Dewey 1934).

Definition 6.413 (Aesthetic condition of application). An *aesthetic condition of application* is a formally, sensorially, spatially, symbolically, or experientially organized feature of an intervention that materially affects how actors encounter, interpret, participate in, or reproduce the practical relation generated through that intervention.

Aesthetic quality can support accessibility, participation, and continuity while remaining normatively ambiguous. A highly coherent system can also intensify control; an elegant interface can conceal asymmetry; a compelling symbolic form can stabilize exclusion. Application therefore requires aesthetic evaluation to remain connected to normative and relational analysis.

Caution 6.414 (Aesthetic success in application). Aesthetic coherence or attractiveness can improve practical uptake while remaining compatible with harmful distribution, weak epistemic justification, or unjust relations. Aesthetic success should therefore remain analytically distinct from practical and normative success.

6.26.3 Normative Judgment in Research

Normative judgment enters research through the selection of problems, treatment of participants, distribution of burdens, use of categories, management of uncertainty, preservation of records, communication of findings, and anticipation of downstream use. These judgments can shape the evidential field itself. A decision to restrict data access can reduce one form of evidential availability while protecting participants from exposure; a decision to include a marginalized category can improve visibility while creating new risks of identification.

The epistemic-justice analysis of Section 6.25 shows that normative research judgment is especially important when research capacities are asymmetrically distributed. Fricker's analysis of epistemic injustice and Longino's account of critical interaction provide relevant precedents for treating participation, credibility, and criticism as epistemically consequential (Fricker 2007; Longino 1990).

Definition 6.415 (Normative condition of research). *A normative condition of research* is a value-laden constraint, commitment, or evaluative relation that materially shapes what inquiry may pursue, how it may proceed, whose interests and vulnerabilities must be considered, and how its products may be represented, preserved, circulated, or used.

Normative research judgment should remain explicit enough to distinguish ethical or political reasons from evidential ones. A project can be rejected because its likely harm exceeds its epistemic value even when the proposed method is technically rigorous. Conversely, an ethically important question can remain empirically unresolved. Keeping these judgments distinct supports more transparent justification.

Proposition 6.416 (Normative-epistemic separation in research). *Where normative considerations materially constrain research design or interpretation, the constraint should be stated without converting the normative reason into evidence for the substantive claim or the substantive evidence into a complete normative justification.*

6.26.4 Normative Judgment in Application

Application-dominant praxis makes normative judgment unavoidable because practical closure distributes benefits, burdens, risks, opportunities, recognition, and future capacities. Section 6.5 showed that action often occurs before uncertainty can be eliminated. Normative judgment therefore enters the decision architecture alongside epistemic confidence, urgency, reversibility, systemic spillover, and the distribution of consequences.

Dewey's theory of valuation is useful because it treats ends and values as objects of inquiry within problematic situations rather than as wholly external inputs (Dewey 1939). Sen's work on ethics and economics likewise illustrates the limitations of reducing practical evaluation to a narrow informational basis (Sen 1987). GRE extends this concern by asking how heterogeneous values arise, interact, conflict, and become institutionally represented within practical relations.

Definition 6.417 (Normative judgment in application). A *normative judgment in application* is a provisional evaluation of the permissibility, priority, fairness, responsibility, desirability, or acceptability of a practical option relative to the values, rights, vulnerabilities, relations, and anticipated consequences materially implicated in the decision.

Such judgment remains provisional because application can transform the very value configuration within which it was evaluated. An intervention can generate new capabilities, dependencies, harms, constituencies, expectations, or forms of recognition. Normative evaluation should therefore continue after implementation rather than being exhausted at the moment of decision.

Proposition 6.418 (Normative revision after application). *When application materially changes the relations, affected parties, consequence structure, or available possibilities that grounded the original normative judgment, that judgment should become eligible for reassessment even when the intervention achieved its initial operational objective.*

6.26.5 Selection of Questions

Research questions are selected through more than epistemic tractability. They can be oriented by curiosity, beauty, historical importance, institutional demand, injustice, practical urgency, theoretical anomaly, available methods, career incentives, or perceived future generativity. Section 6.13 treated orientation as the bridge between judgment and sustained inquiry. The present subsection emphasizes that question selection is therefore already an aesthetic and normative act as well as an epistemic one.

Definition 6.419 (Question-selection judgment). A *question-selection judgment* is the provisional evaluation through which a possible research question receives, retains, or loses priority relative to its epistemic promise, aesthetic appeal, normative importance, feasibility, opportunity cost, and anticipated contribution to future inquiry or practice.

Question selection becomes especially consequential under abundance. When many technically difficult or formally interesting questions can be generated, difficulty alone provides weak guidance regarding worth. A research community must still judge which questions deserve scarce attention, validation effort, preservation, and long-horizon commitment.

The generative-relational perspective adds a further consideration: some questions generate new fields of inquiry by creating concepts, methods, archives, datasets, or collaborations that expand future question space. Their value may therefore exceed the immediate answer obtained.

Proposition 6.420 (Generative question selection). *Question selection may legitimately consider the capacity of a research problem to generate new evidential access, concepts, methods, relations, or future questions, provided this generative promise remains distinct from established epistemic significance or normative priority.*

6.26.6 Selection of Actions

Application requires selection among actions, including the option to delay, pilot, monitor, restrict, reverse, or decline intervention. Action selection combines evidence with judgments about consequence, urgency, value conflict, reversibility, institutional capacity, and uncertainty. The same evidence can therefore support different actions under different normative configurations without making the underlying facts arbitrary.

Definition 6.421 (Action-selection judgment). An *action-selection judgment* is the practical evaluation through which one intervention, sequence, delay, pilot, restraint, or non-intervention is provisionally preferred over alternatives given the available evidence, value configuration, uncertainty, urgency, reversibility, and distribution of plausible consequences.

Aesthetic judgment can also enter action selection. A coherent intervention architecture may be easier to communicate, maintain, or inhabit. Yet practical elegance should remain subordinate to evidential and normative scrutiny where the two conflict. Likewise, a morally attractive goal does not determine the mechanism by which it should be pursued.

Proposition 6.422 (Action-selection non-substitution). *Within application-dominant praxis, aesthetic attractiveness, epistemic support, normative desirability, operational feasibility, and reversibility can each contribute to action selection, while strength on one dimension should not be treated as sufficient evidence of adequacy on the others.*

6.26.7 Plural Values

Practical judgment often involves values that differ in kind. Accuracy, dignity, autonomy, care, efficiency, resilience, equality, liberty, ecological continuity, transparency, privacy, stability, participation, and generativity cannot always be reduced without remainder to one shared scale. Sen's critique of informationally narrow evaluation provides one important economic precedent for preserving plurality in practical reasoning (Sen 1987).

GRE treats value plurality as a relational condition rather than as a demand for permanent incomparability. Values can sometimes be compared locally, prioritized provisionally, or translated through institutional procedures. The key requirement is that practical commensuration should not be mistaken for proof that the underlying values are intrinsically identical.

Definition 6.423 (Plural value configuration). A *plural value configuration* is the historically and relationally situated set of distinct evaluative considerations materially relevant to a research or application problem, together with the relations, tensions, and provisional comparison procedures through which they enter judgment.

Plural values also imply plural affected positions. A research infrastructure can create openness for one community and exposure for another. An intervention can increase aggregate capability while intensifying dependence for a subgroup. Practical judgment should therefore specify whose values and consequences are represented rather than referring abstractly to a single social preference.

Proposition 6.424 (Value-plurality disclosure). *Where a practical judgment depends on heterogeneous values, the materially relevant value dimensions, affected positions, and any procedure used to compare or prioritize them should remain sufficiently explicit*

for later contestation and revision.

6.26.8 Conflicting Judgments

Aesthetic, epistemic, and normative judgments can conflict. An elegant model can fit the evidence weakly. A well-supported intervention can distribute burdens unfairly. A morally urgent problem can lack a reliable mechanism of action. A technically effective policy can be aesthetically alienating or institutionally corrosive. These conflicts belong inside praxis rather than being treated as defects that disappear once analysis becomes sufficiently sophisticated.

Definition 6.425 (Practical judgment conflict). A *practical judgment conflict* occurs when materially relevant aesthetic, epistemic, normative, institutional, or practical evaluations support incompatible orientations, priorities, or actions within the same praxis configuration.

Conflict requires articulation before adjudication. The first task is to identify which judgment forms disagree and whether the disagreement concerns evidence, values, time horizon, scale, affected population, or representation. Some conflicts can be reduced through further evidence or redesign. Others remain genuine normative tradeoffs.

Proposition 6.426 (Conflict-preserving practical judgment). *Where materially relevant judgment forms remain in tension after clarification and feasible inquiry, practical closure should record the unresolved conflict and the basis of the provisional priority rather than representing the decision as if all evaluative dimensions had converged.*

This principle preserves future revisability. Later evidence, changed circumstances, new affected parties, or altered value priorities can reopen a decision whose earlier closure was reasonable under a different configuration.

6.26.9 Historical Formation of Practical Taste

Judgments concerning elegance, importance, proper evidence, desirable intervention, credible institutions, and acceptable tradeoffs have histories. Research taste develops through training, disciplinary traditions, canonical examples, instruments, institutional incentives, and encounters with prior successes and failures. Practical taste develops through legal traditions, administrative routines, professional norms, social movements, technologies, and cultural expectations.

Bourdieu's relational analysis of fields and habitus is relevant because dispositions of judgment are formed through historically structured participation rather than arising from isolated preference (Bourdieu 1984). McAllister similarly shows that aesthetic criteria in science can acquire historical trajectories (McAllister 1996). GRE uses these insights to make the history of practical taste available for reflexive analysis without reducing present judgment to social determination.

Definition 6.427 (Practical taste). *Practical taste* is the historically formed disposition through which actors or institutions experience some questions, representations, solutions, values, or forms of action as especially fitting, elegant, serious, urgent, credible, or worthy within a field of praxis.

Practical taste can encode accumulated expertise. Experienced researchers may perceive a promising question before they can fully articulate why; practitioners may

recognize an intervention as institutionally unworkable before formal analysis captures the relevant friction. Such tacit judgment deserves neither automatic authority nor automatic dismissal. Its historical and relational formation can be investigated, compared, and subjected to counterevidence.

Remark 6.428 (Taste and accumulated expertise). Historically formed practical taste can function as compressed experiential knowledge while also carrying inherited exclusions, stylistic conventions, and institutional biases. Its epistemic and practical value should therefore be assessed through performance, comparison, provenance, and contestability rather than status alone.

6.26.10 Revisability of Practical Judgment

Practical judgment should remain revisable because its evidential, aesthetic, normative, and institutional conditions can change. New evidence can reveal previously invisible harms. A formerly elegant model can become inadequate after the object changes. A normative priority can shift when new affected parties become visible. A practical design can generate capabilities that make alternatives feasible which were unavailable at the time of the original decision.

Definition 6.429 (Revisable practical judgment). A *revisable practical judgment* is a provisional orientation whose evidential basis, aesthetic criteria, normative commitments, affected relations, and closure conditions remain sufficiently explicit to permit reassessment when materially relevant conditions change.

Revisability does not require perpetual reopening of every decision. Some decisions require institutional stability, predictable expectations, and durable coordination. The relevant problem is to distinguish stability from insulation against correction. Review thresholds can therefore depend on consequence, reversibility, time horizon, newly available evidence, and the materiality of changed conditions.

Proposition 6.430 (Practical-judgment revision). A *practical judgment should become eligible for substantive revision when new evidence, changed relations, newly visible affected positions, altered value configurations, or transformed possibilities materially undermine the conditions that supported its earlier closure.*

The aesthetic and normative conditions developed in this section therefore belong inside the recursive architecture of praxis. They orient questions and actions, participate in institutional selection, and shape the value configuration through which later outcomes are judged. Their historical formation makes them intelligible; their plurality makes conflict expectable; and their revisability prevents inherited taste or normative closure from becoming invisible authority.

The next section turns to AI-assisted research praxis. This transition is especially consequential because AI systems can dramatically expand the generation of representations, models, syntheses, and candidate problems while leaving the judgment of significance, historical fit, relational sensitivity, and normative responsibility incompletely delegated. The distinction among aesthetic, epistemic, and normative orientation established here will therefore become a central constraint on how AI assistance is incorporated into research praxis.

6.27 AI-Assisted Research Praxis

The preceding sections developed research praxis as a historically situated and relational process in which encounter, salience, judgment, orientation, method, preservation, power, and normative responsibility remain analytically distinguishable while continuously interacting. The present section examines how artificial-intelligence systems enter that process. Its role is to specify the epistemic and practical functions that AI can perform within research-dominant praxis without collapsing assistance into authority, automation into understanding, or computational abundance into research value. Its objective is twofold: first, to identify where AI can enlarge the space of search, formalization, simulation, pattern discovery, interpretation, and theory revision; second, to specify the forms of judgment, historical sensitivity, relational sensitivity, verification, infrastructure awareness, and responsibility that remain necessary when those capabilities expand. The discussion proceeds from AI as instrument and dialogic interface through automated research operations, problem abundance, preservation of human judgment, interpretation and theory revision, methodological evolution, epistemic asymmetry, verification and infrastructure dependence, limits of delegation, and the transition from AI-assisted research toward AI-mediated praxis. The method is relational and function-sensitive: AI systems are treated as historically generated research infrastructures whose epistemic significance depends on the relations among models, researchers, data, institutions, participants, computational resources, and downstream uses.

The phrase *AI-assisted research* therefore names a configuration rather than a discrete tool category. A language model used to generate alternative formulations, a machine-learning system used to detect structure in high-dimensional data, an automated theorem prover, a simulation agent, and an AI-supported literature-search system can participate in research through very different epistemic functions. Their outputs can also occupy different positions in the evidential chain. Some outputs remain exploratory representations; others become inputs to formal analysis, empirical selection, interpretation, or practical action. Noy and Zhang's experimental study of generative AI in professional writing tasks provides one concrete example of substantial productivity effects under bounded task conditions, while Bender and colleagues provide an important caution against inferring understanding or epistemic authority from fluent language generation alone (Noy and Zhang 2023; Bender et al. 2021). GRE uses this contrast as a starting point: increased productive capacity can reorganize research praxis without itself settling the epistemic status of what is produced.

Definition 6.431 (AI-assisted research praxis). *AI-assisted research praxis* is a research configuration in which one or more artificial-intelligence systems materially participate in search, representation, generation, comparison, formalization, simulation, interpretation, evaluation, or revision while research responsibility remains distributed through a wider human-institutional-technical relational field.

Definition 6.431 makes two points explicit. AI participation can be substantial without implying autonomous epistemic authority, and research responsibility remains relational even when a machine system performs a large share of visible production. The remaining subsections develop the consequences of this configuration.

6.27.1 AI as Research Instrument

At the most familiar level, AI functions as a research instrument. It can transform inputs, rank documents, generate representations, classify observations, estimate parameters, propose code, construct summaries, or operate within a larger analytical workflow. Instrumental use places AI alongside other epistemic infrastructures, but the analogy should remain qualified. Many AI systems are adaptive, probabilistic, opaque, dependent on large training corpora, and capable of producing plausible outputs outside the domain in which their reliability is well characterized. Their use therefore combines ordinary questions of instrument calibration with questions about provenance, model behavior, hidden preprocessing, training conditions, and output variability.

Definition 6.432 (AI research instrument). An *AI research instrument* is an artificial-intelligence system used to perform a specified epistemic operation within a research workflow, where the operation, target, relevant inputs, output status, and verification pathway are sufficiently explicit for the resulting contribution to be inspected.

Instrumental framing is useful precisely because it resists anthropomorphic overreach. The relevant question is not whether the system “knows” in a general sense, but what operation it performs, what representation it produces, what assumptions enter that operation, and what kind of claim can reasonably inherit support from it. Burrell’s differentiated account of algorithmic opacity is important here because opacity can arise from proprietary secrecy, technical-literacy barriers, or the internal complexity and scale of a model itself (Burrell 2016). Each form produces a different burden for research use.

Proposition 6.433 (Instrument-function traceability). *Where an AI system materially contributes to a research claim, the epistemic function assigned to the system and the pathway from its output to the claim should remain inspectable independently of the system’s apparent fluency, generality, or sophistication.*

6.27.2 AI as Dialogic Research Partner

Generative systems can also participate through dialogue. A researcher may ask for objections, alternative hypotheses, missing assumptions, possible analogies, candidate formalizations, counterexamples, or different explanatory framings. The interaction can resemble discussion because the system returns context-sensitive language and can sustain local argumentative structure across multiple turns. This dialogic form can be generative even when the system lacks the social, historical, practical, or experiential position of a human interlocutor.

The phrase *dialogic research partner* should therefore describe a mode of interaction rather than an equivalence between human and machine agency. The system can widen the accessible space of formulations and contrasts; it can externalize partial thoughts quickly and enable repeated interrogation of a draft idea. Yet its responses remain generated through a technical system whose training history, data composition, internal representations, and institutional constraints differ fundamentally from the situated participation described in Section 6.8.

Definition 6.434 (Dialogic AI research interface). A *dialogic AI research interface* is an AI-mediated interaction in which iterative prompts and responses are used to generate, clarify, challenge, compare, or reorganize research representations without

presuming that the machine contribution carries the situated experience, responsibility, or epistemic authority of a human collaborator.

Bender and colleagues' warning concerning fluent language generation is especially relevant to this distinction (Bender et al. 2021). Dialogue can support research precisely because generated language can function as an exploratory object. Its usefulness does not require that every generated sentence be treated as knowledge.

6.27.3 Automated Search and Synthesis

AI can greatly expand the practical scale at which a researcher searches and provisionally synthesizes literature, archives, datasets, code repositories, and other research materials. Search can become semantically broader, multilingual, and more iterative; synthesis can compare large sets of documents, extract recurring concepts, or identify potential disagreement more rapidly than manual reading alone. This changes the allocation of attention described in Section 6.13: researchers can inspect a larger candidate field before deciding where deeper reading is required.

Search abundance, however, does not eliminate selection. It relocates selection into ranking, query construction, retrieval architecture, inclusion criteria, source provenance, and later verification. An AI-generated synthesis can also compress disagreement or erase the distinction between primary and secondary evidence if its source relations are not preserved. The epistemic advantage of automated synthesis therefore depends on whether it increases access while leaving enough provenance for claims to be checked against their sources.

Proposition 6.435 (Source-preserving synthesis). *AI-assisted search and synthesis should preserve sufficient source identity and claim-level provenance for consequential assertions to be reconstructed from the underlying materials rather than accepted from synthesis alone.*

This principle extends the preservation architecture developed in Section 6.23. The faster synthesis becomes, the more important it becomes to preserve the path from compressed representation back to documentary evidence.

6.27.4 Automated Formalization

AI systems can assist formalization by translating verbal hypotheses into equations, logical relations, causal diagrams, code, network representations, optimization problems, or simulation rules. This capacity can lower the cost of exploring several formal representations of the same conceptual structure and can expose ambiguities that remain hidden in prose. It can also enable researchers without deep expertise in a particular formal language to construct provisional models that later receive specialist scrutiny.

Automated formalization inherits the representational cautions of Sections 6.16 and 6.18. A system can produce a mathematically valid formal object that fails to preserve the intended meaning of the source concept. It can introduce closure assumptions, symmetry, independence, stationarity, metric structure, or optimization criteria that were absent from the original claim. Because fluent code or notation can conceal these shifts, the translation remainder should remain explicit.

Definition 6.436 (AI-assisted formalization). *AI-assisted formalization* is the use of an

AI system to propose, construct, or transform a formal representation of a research claim, with explicit comparison between the source concept, the generated formal structure, the assumptions introduced in translation, and the properties left unrepresented.

Automation can accelerate formal exploration. It does not dissolve the need to ask whether the formal object represents the intended research object.

6.27.5 Automated Simulation

AI can participate in simulation at several levels: generating model code, calibrating components, constructing synthetic agents, proposing parameter regimes, accelerating surrogate models, interpreting simulation output, or adaptively exploring large state spaces. The research advantage is not limited to speed. Automated simulation can widen the set of counterfactual configurations practically available for exploration and can reveal regions of parameter or state space that a researcher would not have inspected manually.

The widening of simulation space increases the importance of function-sensitive model judgment. A simulation can show that a represented mechanism is sufficient to generate a pattern under specified conditions, but it does not thereby establish that the mechanism generated the empirical pattern under investigation. Model-generated trajectories can also become so numerous that the problem shifts from generating possibilities to evaluating which possibilities deserve attention.

Proposition 6.437 (Simulation-abundance burden). *As AI increases the feasible number and complexity of simulations, the epistemic burden increasingly shifts toward specification of model purpose, validation, comparison, sensitivity analysis, and judgment concerning which simulated possibilities are materially relevant to the research question.*

The proposition anticipates a recurrent theme of this section: automation can reduce the scarcity of production while increasing the relative scarcity of judgment.

6.27.6 Automated Pattern Discovery

Machine-learning systems can identify statistical, spatial, temporal, textual, network, or multimodal regularities that are difficult to detect through unaided inspection. Such pattern discovery can generate new encounters in the sense developed in Section 6.10. A cluster, anomaly, latent representation, recurring motif, or predictive dependency can become available to inquiry before a substantive interpretation exists.

The discovered pattern should remain distinct from the relation it is later taken to represent and from the generative process that might explain it. Pattern discovery therefore belongs early in the epistemic chain. The system may reveal a candidate regularity, while historical, interpretive, institutional, formal, or causal inquiry determines what the regularity means and whether it supports a stronger relational claim.

Proposition 6.438 (Pattern-to-relation discipline). *An AI-discovered pattern should enter inquiry first as a candidate regularity whose substantive relational and generative interpretation requires additional warrant appropriate to the claimed object, boundary,*

scale, and historical context.

This discipline protects pattern discovery from becoming an automatic ontology.

6.27.7 Automated Generation of Problems

AI systems can generate possible research questions, conjectures, anomalies, comparisons, missing links, and combinations of previously separate literatures. This capability is significant because problem formation was treated in Section 6.13 as part of inquiry rather than a pre-scientific preliminary. Automated problem generation can enlarge the interrogative space available to a research community.

Yet question generation and question worthiness remain different operations. A system can generate thousands of syntactically coherent and technically difficult problems at very low marginal cost. Many may be redundant, historically unimportant, normatively trivial, poorly connected to evidence, or generated from distinctions that matter only within the system's representational habits. The generative abundance of questions therefore increases the importance of the judgment architecture developed in Sections 6.12 and 6.26.

Definition 6.439 (AI-generated research problem). An *AI-generated research problem* is a candidate object of inquiry proposed substantially through machine-mediated generation, whose research status remains provisional until its conceptual coherence, evidential accessibility, historical and relational relevance, and potential significance are independently assessed.

6.27.8 Abundance of Difficult Problems

When problem generation, formal manipulation, literature synthesis, and simulation become inexpensive, research can enter a condition of problem abundance. The limiting resource is no longer the ability to formulate a difficult task. It becomes the capacity to decide which difficult tasks deserve scarce human attention, institutional commitment, verification, preservation, and long-horizon development.

This shift has direct implications for research evaluation. Difficulty has often functioned as an indirect signal of expertise, scarcity, or potential contribution. AI can weaken that association by making some forms of technical difficulty easier to generate and solve while multiplying unresolved tasks elsewhere. The research system can therefore face a paradox: a larger supply of difficult problems can make difficulty itself a less informative signal of significance.

Definition 6.440 (Research problem abundance). *Research problem abundance* is a condition in which the feasible generation of technically nontrivial research questions substantially exceeds the available capacity for historically informed, relationally sensitive, normatively responsible, and empirically sustained evaluation of their worth.

The condition changes what becomes scarce. Attention, taste, problem selection, verification, and institutional memory can become more valuable precisely because generative production has become cheaper.

6.27.9 Difficulty and Research Worth

Section 6.12 separated difficulty from significance. AI-assisted research makes that separation operationally urgent. A machine can increase apparent difficulty through elaborate formalism, large search spaces, long derivations, or combinations of specialized vocabularies. It can also reduce formerly difficult operations to routine generation. Neither direction establishes the worth of the underlying research question.

Research worth is better treated as a multidimensional and revisable judgment concerning what a problem may disclose, connect, preserve, explain, transform, or make possible. Technical difficulty can remain relevant when it reflects genuine barriers to access or proof, but it should not become a surrogate for epistemic, historical, generative, or normative value.

Proposition 6.441 (Difficulty–worth non-substitution). *The technical difficulty of a problem, whether produced by human or AI-assisted inquiry, cannot by itself establish its research worth; assessments of worth require additional judgment concerning significance, evidential relation, historical position, generative potential, and relevant normative conditions.*

This proposition becomes increasingly important as AI changes the cost structure of research production.

6.27.10 Preservation of Aesthetic Judgment

AI can generate many candidate models, proofs, research questions, titles, visualizations, and conceptual combinations. In such an environment, aesthetic judgment remains relevant because researchers often sense coherence, elegance, depth, tension, or generative promise before a complete epistemic evaluation is available. Section 6.12 treated this judgment as an orienting resource rather than a truth criterion. AI abundance strengthens the need for that distinction.

Aesthetic judgment should not be reduced to selecting the most polished machine output. Machine systems can imitate established styles of scientific elegance and thereby amplify dominant taste. Preserving aesthetic judgment therefore includes preserving the capacity to notice unfamiliar forms that initially appear awkward, heterogeneous, or resistant to conventional compression. McAllister’s historical treatment of scientific beauty is useful precisely because standards of elegance can shift with theoretical development (McAllister 1996).

Proposition 6.442 (Aesthetic judgment under generative abundance). *Where AI can generate many formally coherent candidates, aesthetic research judgment should remain historically aware, open to noncanonical forms, and explicitly separated from evidential warrant.*

6.27.11 Preservation of Historical Sensitivity

AI systems can flatten historical sequence when they compress documents into thematic summaries or generate apparently timeless syntheses. Similar language produced in different periods can conceal different institutions, categories, constraints, and feasible alternatives. Historical sensitivity therefore remains indispensable when AI accelerates cross-period comparison.

Preserving historical sensitivity means retaining temporal provenance, category

change, sequence dependence, and the difference between later interpretation and earlier possibility structures. A generated synthesis that treats a contemporary concept as if it had the same meaning in an earlier institutional setting can create anachronistic coherence. Historical research should therefore use AI to widen access without allowing compression to erase temporal structure.

Definition 6.443 (Historical sensitivity in AI-assisted research). *Historical sensitivity in AI-assisted research* is the preservation of temporal sequence, historically specific categories, institutional conditions, feasible alternatives, and provenance when AI systems search, compare, summarize, or interpret materials across time.

This definition links AI use to the historical disciplines developed in Sections 6.21 and 6.22.

6.27.12 Preservation of Relational Sensitivity

AI systems often transform complex relational phenomena into representations optimized for retrieval, prediction, classification, or generation. Such representations can be useful while suppressing interaction history, asymmetry, institutional embedding, tacit coordination, or differences among relation types. Relational sensitivity requires the researcher to ask what relations are preserved, what relations are inferred, what relations disappear, and which relation types are being treated as comparable.

This issue is especially important in automated network construction or entity extraction. A co-occurrence edge can be mistaken for social relation; a predicted association can be mistaken for causal dependence; a shared label can conceal unequal power. AI therefore increases the value of the translation discipline established in Section 6.18.

Proposition 6.444 (Relational remainder under AI mediation). *When an AI system translates relational phenomena into computational representations, the inquiry should preserve or document materially relevant relational properties that the target representation omits, aggregates, or reclassifies.*

6.27.13 Preservation of Generative Judgment

Generative judgment concerns whether a relation, configuration, method, question, or intervention may open new capacities, connections, representations, or future possibilities. AI can assist this judgment by producing alternatives and simulating consequences, but it can also encourage shallow novelty: endless recombination can look generative while leaving the underlying research field unchanged.

Preserving generative judgment therefore requires attention to downstream structure. A candidate idea has generative promise when it can plausibly reorganize later inquiry, make previously inaccessible relations observable, create reusable conceptual or methodological capacity, connect separated domains, or transform the space of feasible questions. Novel wording alone is insufficient.

Definition 6.445 (Generative judgment in AI-assisted research). *Generative judgment in AI-assisted research* is the assessment of whether an AI-generated or AI-mediated research possibility can plausibly expand or transform subsequent epistemic capacities, relational access, methodological resources, theoretical structures, or spaces of inquiry beyond the immediate artifact produced.

The definition preserves generativity as a relational and temporal property rather than a stylistic impression of novelty.

6.27.14 Normative Responsibility for Research Orientation

AI can influence research orientation before any explicit decision is made. Search rankings, suggested questions, generated literature maps, default benchmarks, and available training data can make some problems easier to notice and pursue than others. Research orientation can therefore become partially delegated through infrastructure even when researchers believe they remain fully autonomous.

Normative responsibility requires these orientation effects to remain visible. The research community must still ask whose problems enter the system, which harms and capabilities are represented, what groups remain weakly documented, and what forms of future value are systematically neglected. Fricker's work on epistemic injustice remains relevant because unequal visibility and credibility can be reproduced within machine-mediated research pipelines (Fricker 2007).

Proposition 6.446 (Orientation-responsibility principle). *The use of AI to rank, recommend, generate, or prioritize research possibilities does not transfer normative responsibility for research orientation from researchers and institutions to the system that produced the recommendation.*

AI can broaden the space of options. Responsibility for which options become research commitments remains embedded in human and institutional praxis.

6.27.15 Human Responsibility for Problem Selection

Problem selection is a particularly concentrated site of responsibility because it allocates scarce attention and shapes future research capacity. AI can generate candidate problems rapidly, but the selection of which problem deserves years of human effort, institutional resources, participant involvement, archival preservation, or practical risk remains a judgment with epistemic and normative consequences.

The word *human* here should not imply isolated individual sovereignty. Problem selection is distributed across researchers, communities, funders, participants, institutions, infrastructures, and sometimes public or political processes. The point is that responsibility cannot be discharged by appealing to machine generation alone. A system has no independent standing to justify why one social problem, historical archive, species, community, or theoretical puzzle should receive priority over another.

Proposition 6.447 (Non-delegation of final problem responsibility). *AI may generate, compare, or criticize candidate research problems, while final responsibility for committing consequential research resources to a problem remains within the human and institutional relations capable of giving reasons, receiving contestation, and bearing responsibility for foreseeable consequences.*

6.27.16 AI-Assisted Interpretation

Interpretation is increasingly AI-assisted when models summarize interviews, compare documents, suggest themes, translate languages, propose readings, or generate competing explanations. Such assistance can be valuable because interpretation of-

ten benefits from contrast. A machine-generated alternative reading can expose assumptions in the researcher's initial account, especially when it is used as a counterposition rather than as an authority.

Interpretive assistance nevertheless encounters strong limits. Meaning depends on historical context, linguistic nuance, institutional practice, relation to audiences, and sometimes tacit or embodied experience. A system can generate plausible interpretations from textual patterns while lacking access to many of these conditions. Bender and colleagues' distinction between form and grounded meaning therefore remains relevant (Bender et al. 2021).

Proposition 6.448 (AI-assisted interpretive plurality). *AI-generated interpretations are most defensible when treated as candidate readings whose provenance, contextual adequacy, relation to primary materials, and divergence from alternative interpretations remain open to inspection.*

This use positions AI as an amplifier of interpretive plurality rather than a final interpreter.

6.27.17 AI-Assisted Theory Revision

Theory revision can also be assisted by AI. Systems can search for counterexamples, trace inconsistencies across a long manuscript, compare theoretical vocabularies, suggest alternative mechanisms, generate formal consequences, or identify tensions between claims and newly incorporated evidence. Such operations can make revision more continuous and less dependent on the researcher's unaided memory.

The danger is that theory revision becomes optimization for local coherence rather than responsiveness to reality. A language model can make a theory more internally fluent while insulating it from counterevidence, especially when it is asked primarily to repair contradictions rather than diagnose whether a contradiction should remain visible. The iterative-reconstruction architecture of Section 6.19 therefore remains essential.

Definition 6.449 (AI-assisted theory revision). *AI-assisted theory revision* is the use of AI systems to identify, generate, compare, or formalize candidate modifications to a theory while preserving traceability to the evidence, anomalies, competing theories, and historical conditions that motivate revision.

Theory revision is strongest when the system helps expose the reason for change rather than merely producing a smoother replacement text.

6.27.18 AI and the Evolution of Research Methods

AI changes research methods by lowering the cost of operations that previously required specialized labor and by creating new hybrid procedures. Coding, transcription, translation, extraction, classification, visualization, formal proof search, simulation, and literature mapping can become integrated into adaptive workflows. New research objects can also emerge because previously inaccessible corpora or high-dimensional datasets become tractable.

The historical analysis of Section 6.21 suggests that these changes should be understood as methodological evolution rather than simple substitution. Existing methods can be reorganized, extended, or partially displaced. Human expertise may shift from

routine execution toward design, verification, interpretation, maintenance, and judgment. At the same time, dependence on AI infrastructure can introduce new forms of opacity and standardization.

Proposition 6.450 (AI-induced methodological redistribution). *As AI automates or accelerates particular research operations, methodological expertise can be redistributed toward problem specification, data and representation design, validation, interpretation, historical contextualization, cross-method correction, and responsibility for downstream use.*

The proposition describes a possible reorganization of research labor rather than an inevitable disappearance of existing expertise.

6.27.19 Epistemic Asymmetry between Researcher and AI

AI-assisted research creates new epistemic asymmetries. A researcher can receive a highly competent output without being able to reconstruct the training process, internal representation, retrieval path, parameter interactions, or institutional choices that produced it. Conversely, the system may process patterns across vast corpora while lacking direct access to the researcher's situated aims, field experience, ethical obligations, tacit knowledge, or responsibility relations.

The asymmetry is therefore multidirectional. Machine scale can exceed human inspection, while human situatedness can exceed machine representation. Burrell's analysis of opacity clarifies one side of this relation, and the Stanford AI Index documents the contemporary concentration of frontier-model development and compute infrastructure in a limited set of industrial actors (Burrell 2016; Stanford Institute for Human-Centered Artificial Intelligence 2026). These conditions make epistemic dependence partly institutional.

Definition 6.451 (Human–AI epistemic asymmetry). *Human–AI epistemic asymmetry* is the unequal distribution of access, scale, reconstructability, contextual position, and responsibility between researchers and AI systems participating in the same research process.

The relevant response is neither complete trust nor complete rejection. It is role-sensitive verification and explicit dependence mapping.

6.27.20 Verification, Contestability, and Audit

AI-assisted research requires verification architectures proportional to the consequence of the machine contribution. Low-stakes brainstorming may require little more than ordinary critical reading. A machine-generated reference, empirical classification, causal claim, code path, or recommendation that materially supports a published conclusion requires stronger reconstruction and checking.

Kroll and colleagues' analysis of accountable algorithms is useful because it shows that consequential computational systems require institutional and technical mechanisms of scrutiny beyond ordinary reliance on a decision maker's explanation (Kroll et al. 2017). Gebru and colleagues similarly show the value of systematic documentation for datasets and their intended uses (Gebru et al. 2021). These insights can be adapted to research workflows.

Definition 6.452 (AI research audit trail). *An AI research audit trail* is a proportion-

ate record of the model or service used, relevant version or configuration where available, input or prompt conditions where materially important, source data or retrieved materials, transformations performed, outputs relied upon, human verification steps, and consequential revisions.

Proposition 6.453 (Consequence-sensitive verification). *The required depth of verification, contestability, and audit should increase with the epistemic centrality, practical consequence, irreversibility, and opacity of the AI-mediated operation.*

This principle prevents verification from becoming either a ritual requirement applied equally to every use or an optional afterthought.

6.27.21 Dependency on AI Research Infrastructure

AI-assisted research depends on infrastructures that include models, compute, cloud services, proprietary APIs, data centers, benchmark ecosystems, dataset pipelines, software libraries, licensing arrangements, and organizational policies. These dependencies can shape which methods are affordable, which languages are well supported, which data remain accessible, and which research institutions can reproduce a result.

Infrastructure dependence also has a temporal dimension. A commercial model can change or disappear; an API can be retired; access conditions can shift; a formerly reproducible result can become difficult to reconstruct. The concentration documented in the AI Index gives these concerns institutional significance (Stanford Institute for Human-Centered Artificial Intelligence 2026). Preservation therefore requires more than saving prompts. It may require recording model identity, version, data interfaces, environment assumptions, and enough intermediate output to enable future reanalysis.

Definition 6.454 (AI research infrastructure dependency). *AI research infrastructure dependency* is the degree to which a research process or claim relies on computational services, models, data pipelines, institutional providers, or technical environments whose continued accessibility and behavior are outside the researcher's direct control.

Infrastructure dependence becomes epistemically relevant when it affects reproducibility, contestability, access equality, or long-term preservation.

6.27.22 Limits of Delegating Research Judgment

The preceding analysis identifies a broad domain of legitimate delegation: search, synthesis, candidate generation, formal manipulation, simulation, pattern detection, and even structured critique can be delegated in part. The boundary becomes more demanding where judgment determines significance, responsibility, interpretation under contested context, acceptable risk, or allocation of scarce attention among heterogeneous values.

This boundary should not be defended through a romantic claim that only unaided human cognition is authentic. Human judgment is itself historically conditioned, institutionally mediated, and fallible. The point is relational responsibility. A research system needs identifiable actors and institutions capable of giving reasons, receiving criticism, revising commitments, and bearing responsibility for consequences. AI out-

puts can inform those judgments without becoming their final normative ground.

Proposition 6.455 (Delegation limit for consequential research judgment). *Research judgment may be computationally assisted to the extent that reasons, evidence, alternatives, and consequences remain contestable, while final responsibility for consequential significance attribution, problem selection, normative orientation, and irreversible research commitments remains within accountable human and institutional relations.*

The principle is deliberately narrower than a claim that every micro-decision must be manually human. It concerns consequential closure.

6.27.23 AI-Mediated Research Praxis

AI-assisted research can become AI-mediated praxis when the system moves from performing bounded operations within a human-organized workflow to shaping the relations through which questions, evidence, collaboration, evaluation, publication, and action are organized. The transition can occur gradually. Recommendation systems influence what literature is read; generative systems influence what questions are formulated; automated evaluation influences which projects are funded; agentic systems coordinate research tasks; machine-generated reports influence practical decisions. AI then becomes part of the relational field that produces research orientation itself.

Definition 6.456 (AI-mediated research praxis). *AI-mediated research praxis* is a research configuration in which AI systems materially participate in organizing the relations among problem selection, evidence production, interpretation, evaluation, collaboration, resource allocation, or action, such that the research field cannot be adequately described by treating AI as an isolated instrument.

This transition increases the need for reflexivity. If AI systems help shape the very categories, attention structures, and institutional decisions through which later evidence is produced, the system participates in the generative conditions of research. The relevant questions therefore extend beyond whether individual outputs are correct. Researchers must ask how AI mediation reorganizes who can participate, what becomes visible, which problems become salient, how authority is distributed, what infrastructures become indispensable, and which future research trajectories are made easier or harder.

Proposition 6.457 (Praxis-transformation threshold for AI mediation). *AI-assisted research approaches AI-mediated praxis when machine systems materially and recurrently shape the relations through which research orientation, evidential production, evaluation, collaboration, or practical closure are organized, rather than merely executing bounded operations selected independently by researchers.*

The proposition provides a transition criterion rather than a fixed technological threshold. The same model can remain a narrow instrument in one project and become infrastructurally mediating in another. This distinction also prepares the next section's analysis of collective and distributed knowledge production: once AI systems participate in the organization of research relations, the unit of inquiry can no longer be the isolated researcher using a tool. It becomes a heterogeneous research collective in which expertise, judgment, memory, and responsibility are distributed across persons, institutions, and technical systems.

6.28 Collective and Distributed Knowledge Production

Section 6.27 concluded by shifting the unit of analysis from an isolated researcher using an AI instrument toward a heterogeneous research collective in which persons, institutions, archives, infrastructures, and computational systems can participate in the organization of inquiry. The present section develops that transition. Its role is to clarify how knowledge production becomes distributed across differentiated relations without presuming that expertise, interpretation, judgment, memory, authority, and responsibility share the same distribution. The objective is to provide a relational account of collective inquiry that can accommodate disciplinary communities, cross-cultural collaboration, institutional memory, and human–AI research configurations while preserving contestability and local accountability. The discussion proceeds through research communities, distributed expertise, interdisciplinary and cross-cultural relations, human–AI collectives, institutional memory, collective interpretation, distributed judgment, distributed responsibility, and the generativity of research communities. The method remains historically situated and function-sensitive: distribution is treated as a property of particular research operations and relations rather than as a single characteristic assigned to a group as a whole.

Collective knowledge production is familiar in the history and sociology of science, yet its implications become sharper under the praxis architecture developed in this chapter. Longino's account of social knowledge emphasizes the epistemic role of criticism, interaction, and transformed background assumptions, while Hutchins demonstrates how cognitive work can be distributed across persons, artifacts, procedures, and organized environments (Longino 1990; Hutchins 1995). GRE draws on these precedents to formulate a narrower proposition. Research communities can become part of the generative conditions of inquiry because they organize access, attention, question formation, interpretation, memory, criticism, and the circulation of provisional judgments. Their epistemic importance therefore extends beyond the aggregation of individually produced findings.

Definition 6.458 (Distributed knowledge production). *Distributed knowledge production* is a research configuration in which materially relevant epistemic functions are performed across differentiated persons, groups, institutions, artifacts, infrastructures, or computational systems, such that the resulting inquiry depends on relations among these contributions.

Definition 6.458 leaves open how wide the distribution is and which functions are distributed. A project can distribute observation while centralizing interpretation; distribute interpretation while centralizing authorization; or distribute computation while concentrating responsibility within a small institutional node. The analytical task is therefore to identify the functions, relations, asymmetries, and closure procedures through which the collective operates.

6.28.1 Research Communities

Research communities provide durable relational environments in which questions acquire salience, methods become intelligible, standards of evidence are learned, criticism becomes routinized, and findings enter shared histories. A community can take many forms: a disciplinary field, laboratory, archive network, professional associa-

tion, distributed open-source project, Indigenous or local knowledge community, interdisciplinary consortium, policy-research organization, or a more temporary collaboration organized around a problem. The relevant feature is sustained relational organization around inquiry rather than formal institutional status alone.

The community participates in research before publication. Training shapes what a researcher notices; shared vocabularies make some distinctions readily expressible; canonical problems influence which questions appear serious; instruments and infrastructures delimit available forms of observation; and peer expectations affect the form in which uncertainty is presented. Section 6.26 described the historical formation of practical taste. Research communities are among the environments through which such taste is reproduced, contested, and revised.

Definition 6.459 (Research community). *A research community is a relatively persistent relational configuration through which participants share, contest, transmit, or transform epistemic resources, research practices, evaluative expectations, records, questions, and interpretive repertoires.*

A community can increase epistemic capacity by widening access to criticism and by preserving knowledge that exceeds one researcher's memory. It can also narrow inquiry when reputational incentives, methodological uniformity, linguistic closure, or inherited categories make some observations difficult to articulate or some questions costly to pursue. Longino's account of critical interaction is useful here because objectivity can be strengthened when criticism has recognized channels of uptake and when relevant perspectives can enter the process (Longino 1990).

The GR perspective adds a generative question: what kinds of future inquiry does a research community make easier to initiate? A community that preserves methods, data, conceptual distinctions, failed attempts, and disagreements can expand the option space available to later researchers. A community that compresses its history into a small set of canonical conclusions can create coordination while reducing reconstructability. The epistemic evaluation of a community therefore concerns both current output and the conditions it generates for subsequent inquiry.

Proposition 6.460 (Community-conditioned inquiry). *Where a research community materially shapes access, problem salience, methodological availability, criticism, or preservation, those relations should be treated as part of the conditions through which the resulting knowledge claim was produced and remains revisable.*

This proposition does not assign a uniform causal role to community membership. Its scope is limited to relations that materially affect the inquiry under examination.

6.28.2 Distributed Expertise

Collective inquiry often depends on expertise that differs in object, scale, medium, and form. Statistical expertise, field familiarity, archival knowledge, experimental technique, software maintenance, linguistic competence, historical contextualization, legal interpretation, participant experience, instrumentation knowledge, and normative analysis can enter the same project without becoming interchangeable. Their distribution creates both productive complementarity and dependence.

Hutchins's analysis of distributed cognition is a useful precedent because it shows that competent performance can emerge through coordination among persons, artifacts, and procedures even where the relevant cognitive work is not located within a

single individual (Hutchins 1995). In research praxis, a similar distribution can occur while preserving stronger distinctions among epistemic roles. A technician can know how an instrument behaves under unusual conditions; a participant can know how an institutional rule is actually encountered; a statistician can identify inferential instability; a historian can recognize that a seemingly stable category changed meaning across periods. The project can depend on each form of expertise while keeping its authority local to the relations in which that competence is relevant.

Definition 6.461 (Expertise distribution profile). An *expertise distribution profile* is the project-relative mapping of which actors or systems possess materially relevant capacities for observation, interpretation, formalization, contextualization, verification, maintenance, judgment, or action, together with the dependencies among those capacities.

The profile is more informative than a generic division between experts and non-experts. Expertise can be deep but local. It can be tacit, experiential, formal, infrastructural, or institutionally certified. Some forms are easier to articulate and audit than others. A collective therefore needs translation relations capable of moving relevant information across expertise boundaries without silently converting local competence into general authority.

Distributed expertise also changes vulnerability. A project can become fragile when one obscure software component, one language specialist, one archive custodian, or one institutional broker carries a function that is poorly documented elsewhere. Conversely, redundancy can increase resilience while raising coordination cost. The relevant design problem is to identify dependencies that materially affect reconstructability, continuity, or interpretation.

Proposition 6.462 (Locality of expertise). *Epistemic authority derived from expertise should be indexed to the domain, operation, evidence, or relation in which the relevant competence is demonstrated, with broader authority requiring additional justification.*

This locality principle protects distributed inquiry from two opposite errors: ignoring specialized competence and allowing specialized competence to expand silently into authority over unrelated judgments.

6.28.3 Interdisciplinary Relations

Interdisciplinary research places heterogeneous conceptual systems, methods, evidential standards, and objects into sustained relation. Its difficulty extends beyond coordination among specialists. Disciplines can organize reality differently: they may define different entities, use different temporal scales, assign different meanings to explanation, and recognize different forms of evidence. Section 6.18 treated translation across methodological representations as an epistemic operation with a remainder. Interdisciplinary collaboration generalizes that problem from methods within a project to partially distinct traditions of inquiry.

A productive interdisciplinary relation therefore requires more than exchanging conclusions. Participants often need to expose assumptions that remain tacit within their home disciplines. A term such as *institution*, *agency*, *value*, *state*, *network*, *field*, or *causation* can carry different inferential commitments across disciplines. Apparent agreement can conceal divergent meanings, while apparent disagreement can arise from differences in scale, object, or representation.

Definition 6.463 (Interdisciplinary translation relation). An *interdisciplinary translation relation* is a documented mapping through which concepts, evidence, methods, or claims from one disciplinary configuration are rendered usable within another while preserving the material differences, assumptions, and residual meanings that remain relevant to interpretation.

Translation can generate new objects of inquiry. A legal category interpreted through historical research may reveal the institutional conditions of its emergence; a dynamical model confronted with ethnographic evidence may expose a missing state distinction; a political-economic account brought into relation with ecological data may change the scale at which a resource process is understood. These gains arise from relational friction as much as from synthesis.

For this reason, interdisciplinary disagreement can be epistemically productive. A method that appears decisive within one disciplinary representation may become partial when another discipline reveals a different causal pathway or historical boundary. The collective should therefore preserve enough disciplinary provenance to reconstruct how a concept or claim changed during translation.

Remark 6.464 (Interdisciplinary remainder). Successful interdisciplinary collaboration can produce locally adequate shared concepts while leaving parts of the participating disciplinary meanings untranslated. Recording such remainders can protect later researchers from treating operational convergence as complete theoretical identity.

The aim is a relation capable of learning across difference while preserving enough difference for mutual correction to remain possible.

6.28.4 Cross-Cultural Knowledge Production

Cross-cultural knowledge production intensifies the problems of translation, situatedness, and unequal epistemic power. Languages, institutions, historical experiences, practical categories, and conventions of evidence can differ across research settings. A concept developed in one context can become misleading when transferred without attention to the relations through which it acquired meaning. Likewise, a locally generated category can be made invisible when publication, funding, indexing, or evaluation systems recognize only the vocabulary of a dominant research center.

Section 6.25 treated unequal evidential resources and representational authority as problems of epistemic justice. Fricker's account of testimonial and hermeneutical injustice provides a relevant precedent for analyzing credibility deficits and unequal participation in the practices through which shared understanding becomes possible (Fricker 2007). In cross-cultural research, the question extends to who has authority to name the object, select the comparison category, translate testimony, determine what counts as context, and decide when interpretation is complete.

Definition 6.465 (Cross-cultural epistemic relation). A *cross-cultural epistemic relation* is a research relation in which materially relevant meanings, categories, evidential practices, or interpretive authorities are distributed across cultural, linguistic, historical, or institutional contexts that need not be presumed to share a complete conceptual frame.

A responsible relation can preserve local categories long enough for their inferential and practical roles to become intelligible before translation into a shared analyt-

ical vocabulary. It can also distinguish translation for coordination from translation as a claim of equivalence. The same English term can carry substantially different local histories, and two different local terms can occasionally support similar practical distinctions without becoming semantically identical.

Cross-cultural collaboration also expands the encounter surface of research. Researchers situated in different environments encounter different anomalies, institutional frictions, sensory arrangements, archives, ordinary practices, and forms of tacit knowledge. This diversity can enlarge the set of contingent encounters from which research questions emerge. Its value depends partly on whether the collective has channels through which unfamiliar observations can become salient before dominant categories classify them as irrelevant.

Proposition 6.466 (Plural access in cross-cultural inquiry). *Where materially different cultural or linguistic positions provide distinct access to a research object, a collective should preserve the provenance of those access relations and provide routes through which locally grounded interpretations can challenge the shared analytical frame.*

The proposition concerns epistemic access rather than an assumption that cultural positions are internally uniform or automatically authoritative. Local interpretation remains open to evidence, disagreement, and revision.

6.28.5 Human–AI Research Collectives

Section 6.27 developed the transition from bounded AI assistance to AI-mediated research praxis. Collective analysis makes that transition more explicit. AI systems can occupy different functional positions within a research collective: retrieval interface, coding assistant, simulation engine, translation system, pattern detector, drafting partner, critique generator, orchestration layer, or agent that coordinates other tools. Their epistemic significance depends on the relations through which these functions are connected to evidence, verification, interpretation, and institutional decision.

A human–AI research collective therefore differs from a researcher who occasionally consults a tool. Machine outputs can circulate among team members, influence what evidence is inspected, determine which anomalies receive attention, structure project memory, or become inputs to later machine operations. Once these feedback relations become recurrent, the AI contribution can shape the collective's trajectory even where individual machine outputs remain candidate contributions without functioning as authoritative conclusions.

Definition 6.467 (Human–AI research collective). *A human–AI research collective is a research configuration in which human participants, AI systems, institutions, data resources, and technical infrastructures perform interdependent epistemic functions whose coordination materially shapes the trajectory or products of inquiry.*

The definition is functional and relational. It does not require treating AI systems as equivalent to human researchers in agency, experience, moral standing, or responsibility. It records their participation in a knowledge-producing configuration where that participation materially affects the research process.

Human–AI collectives can expand productive capacity and increase the diversity of candidate interpretations. They can also create recursive dependence. Machine-generated summaries can shape human attention; human selections can become

prompts for further generation; generated classifications can alter the dataset inspected next; and AI-mediated evaluation can influence which research directions receive resources. The audit and infrastructure-dependency principles of Section 6.27 therefore become collective properties rather than individual workflow concerns.

A further issue concerns heterogeneity of access. Members of a research team may have unequal ability to inspect model behavior, underlying data, system settings, or commercial infrastructure. The collective can therefore contain internal epistemic asymmetries in addition to the human–AI asymmetry already defined in Section 6.27. A transparent role map can help identify which members can verify which operations and where the project depends on opaque external services.

Proposition 6.468 (Role-explicit human–AI collaboration). *Where AI systems materially shape research orientation, evidence processing, interpretation, evaluation, or closure, the collective should keep their functional roles, verification pathways, infrastructure dependencies, and accountable human or institutional decision points sufficiently explicit for reconstruction and contestation.*

This proposition preserves the possibility of extensive machine contribution while keeping epistemic and normative closure connected to accountable relations.

6.28.6 Institutional Memory

Collective knowledge production extends across time. Laboratories, archives, journals, professional communities, research infrastructures, public institutions, and long-running collaborations carry records that allow later inquiry to inherit more than the current members’ personal memories. Institutional memory includes formal repositories and tacit practices: datasets, notebooks, version histories, correspondence, methodological conventions, maintenance knowledge, unresolved disputes, negative results, calibration practices, and remembered reasons for earlier decisions.

Section 6.23 treated evidence preservation as infrastructure for future re-epistemization. Institutional memory is the collective counterpart of that argument. Preservation becomes generative when it allows later researchers to reconstruct earlier evidence and also to understand how a research community arrived at particular categories, methods, or closures. Knowledge commons research offers a useful institutional precedent for treating knowledge resources as objects of collective governance involving access, preservation, enclosure, and stewardship (Hess and Ostrom 2007). Peer-production research likewise shows that durable knowledge production can depend on architectures for coordinating distributed contributions (Benkler 2002).

Definition 6.469 (Institutional epistemic memory). *Institutional epistemic memory* is the organized persistence of records, practices, provenance, contextual knowledge, and reconstructive capacity through which a research collective can retain or recover materially relevant features of earlier inquiry across changes in personnel, technology, or institutional form.

Memory quality depends on more than volume. A repository can preserve large quantities of data while losing the context required to interpret them. Conversely, a concise decision record can retain crucial information about why one model was rejected, why a category was revised, or why a measurement procedure became unreliable. Institutional memory therefore benefits from selective structure: provenance, dependencies, alternative interpretations, failure records, and context can have high

future option value even when they were peripheral to the publication produced at the time.

Institutional forgetting can occasionally be functional. Privacy obligations, legal requirements, security concerns, and maintenance costs can justify deletion or access restriction. The key analytical question is whether the collective understands which future reconstructive capacities are being relinquished when records disappear.

Proposition 6.470 (Memory as future research capacity). *Where preserved records or practices materially affect the ability of later researchers to reconstruct, challenge, reinterpret, or extend earlier inquiry, institutional memory should be treated as part of the collective's future research capacity.*

This framing links preservation to generativity: memory is valuable partly because it changes what later inquiry can become.

6.28.7 Collective Interpretation

Interpretation in a collective can draw on perspectives that differ in expertise, position, language, experience, and theoretical commitment. This plurality can reveal assumptions that remain invisible within a single interpretive standpoint. It can also generate persistent disagreement. The relevant research task is therefore to organize interpretation so that plurality becomes inspectable and corrigible rather than being compressed prematurely into a consensus statement.

Longino's emphasis on transformative criticism is again relevant because critical interaction can alter background assumptions and improve the conditions of objectivity (Longino 1990). The GRE formulation places additional emphasis on provenance and trajectory. An interpretation can change as it passes through different participants. A field observation can be redescribed in disciplinary vocabulary, recoded as a variable, compared with archival evidence, summarized by AI, and incorporated into a theoretical narrative. Each transformation can add insight while also changing what remains visible.

Definition 6.471 (Collective interpretation trajectory). *A collective interpretation trajectory is the sequence of materially relevant interpretive transformations through which observations, records, representations, or claims are redescribed, compared, contested, synthesized, or revised across participants in a research collective.*

Exhaustive recording of conversational moves would rarely be proportionate. Consequential transformations deserve greater attention: reclassification of evidence, rejection of a competing interpretation, translation of a local concept into a general category, or machine synthesis that materially changes the direction of inquiry. The purpose is reconstructability rather than exhaustive surveillance of collaboration.

Collective interpretation also benefits from preserving minority readings when the disagreement concerns uncertain evidence, heterogeneous contexts, or distinct scales. Consensus can be useful for action or publication, yet it can conceal unresolved structure. A later finding may vindicate an interpretation that appeared weak under earlier evidence. Preserving the basis of disagreement can therefore provide future epistemic option value.

Proposition 6.472 (Interpretive plurality preservation). *Where competing interpretations remain materially plausible and their difference affects later inference, a research collective should preserve the principal alternatives and the evidential or conceptual*

basis of their disagreement until sufficient grounds for stronger closure emerge.

The proposition permits interpretations to receive different weight in proportion to their support while preserving enough differentiation to keep uncertainty and disagreement visible at the level relevant to later reconstruction.

6.28.8 Distributed Judgment

Judgment can be distributed without becoming reducible to voting or numerical aggregation. Research collectives make judgments about significance, methodological adequacy, evidential sufficiency, aesthetic promise, ethical acceptability, practical relevance, and readiness for closure. Different participants can be better positioned to judge different dimensions. The difficulty lies in coordinating these judgments when they conflict and when the authority to decide is itself unequally distributed.

Section 6.26 distinguished aesthetic, epistemic, normative, and practical judgment. Collective inquiry adds a second dimension: each judgment form can be distributed across different actors. A statistician may assess inferential robustness; a field researcher may evaluate contextual adequacy; affected participants may identify harms invisible to the analytical team; a principal investigator may control publication; an ethics body may constrain permissible procedures; an AI system may generate candidate evaluations without bearing responsibility for closure.

Definition 6.473 (Distributed judgment configuration). *A distributed judgment configuration is the project-relative arrangement through which different actors or systems contribute to aesthetic, epistemic, normative, practical, or institutional evaluations and through which those evaluations are compared, weighted, contested, or brought to provisional closure.*

A defensible configuration makes the basis of authority visible. Authority can derive from demonstrated expertise, direct exposure to consequences, formal responsibility, methodological competence, legal mandate, or other relevant relations. These bases need not coincide. A project can therefore benefit from distinguishing who contributes a judgment from who has the institutional power to close the decision.

Collective judgment also raises the problem of aggregation. Averaging can be appropriate for some measurements or probabilistic assessments. It becomes less informative when judgments concern heterogeneous values or incompatible interpretations. Deliberation, staged review, role-specific vetoes, explicit dissent, or conditional decisions can preserve structure that a single score would erase.

Proposition 6.474 (Function-sensitive judgment allocation). *The weight assigned to a participant's judgment should be related to the relevant epistemic, experiential, normative, or institutional relation for the decision at issue, with the basis of that weight remaining open to contestation where consequences are substantial.*

The proposition avoids a general hierarchy of participants. Judgment authority is indexed to function and consequence.

6.28.9 Distributed Responsibility

Distributed research can produce a familiar ethical danger: responsibility becomes harder to locate as contributions multiply. Data may be collected by one team, processed by another, modeled by a third, interpreted through AI services, approved by

an institution, and communicated by authors who did not directly inspect the full sequence of transformations. The resulting product can be genuinely collective while the consequences still require identifiable relations of accountability.

Responsibility therefore needs its own distribution map. Epistemic responsibility concerns verification, accurate representation, disclosure of uncertainty, and correction. Normative responsibility concerns treatment of participants, distribution of risks and benefits, and foreseeable consequences. Institutional responsibility concerns governance, infrastructure, access, authorization, and procedures for responding to failure. These forms overlap, yet their overlap does not imply that responsibility is evenly shared.

Definition 6.475 (Responsibility distribution map). *A responsibility distribution map identifies the actors and institutions that hold materially relevant duties of verification, authorization, care, disclosure, correction, preservation, or consequence management within a research collective, together with the relations through which those duties can be exercised and reviewed.*

Human–AI collectives make this especially important. AI systems can participate in causal and epistemic pathways while lacking the institutional position through which research communities presently assign many forms of answerability. Responsibility therefore tends to remain concentrated in the human and institutional relations that choose systems, configure tasks, accept outputs, authorize conclusions, publish results, or deploy downstream actions. The exact distribution depends on the research configuration and on applicable institutional or legal arrangements.

Diffusion of labor can also obscure the ability to correct. A researcher who discovers a serious error may lack authority to retract a dataset; a platform provider may control access to a model needed for reproduction; a journal may control correction procedures; participants affected by a representation may lack a route to contest it. Accountability therefore requires pathways as well as named roles.

Proposition 6.476 (Responsibility retention under distributed production). *As the number or heterogeneity of contributors expands, the traceability of consequential research responsibilities should remain visible. Where responsibility is shared, the collective should preserve identifiable duties and correction pathways proportionate to the consequences of the relevant research operation.*

This principle supports collective production while resisting responsibility evaporation through complexity.

6.28.10 Generativity of Research Communities

The preceding analysis allows research communities to be evaluated as generative structures. A community produces findings, yet it can also generate researchers, vocabularies, methods, infrastructures, habits of criticism, standards of judgment, archives, collaborations, and future questions. These outputs alter the conditions under which later research becomes possible. The generativity of a research community therefore concerns the trajectories it enables as well as the conclusions it currently produces.

Definition 6.477 (Generativity of a research community). *The generativity of a research community is its capacity, within specified historical and institutional conditions, to create, preserve, transform, or widen the relational conditions through*

which future inquiry, criticism, learning, question formation, collaboration, and responsible revision can occur.

Generativity includes the preservation of difference. A community with multiple methodological traditions can possess a larger repertoire for correcting local failures. Cross-cultural collaboration can widen the field of encounter. Institutional memory can make earlier evidence available for re-epistemization. Human–AI systems can increase productive and exploratory capacity. Distributed expertise can make previously inaccessible objects tractable. These capacities become most valuable when the relations among them remain sufficiently open for unexpected observations to alter research orientation.

This point returns to the account of encounter, salience, and judgment developed in Sections 6.10–6.13 and to the AI-era problem of research abundance in Section 6.27. As generative systems make it easier to produce candidate texts, models, hypotheses, simulations, and even candidate research questions, the research community faces a different scarcity structure. Attention, orientation, historical sensitivity, verification, and the capacity to recognize a promising encounter can become relatively more important.

Contingent encounter acquires particular significance within this structure. A field visit, archival fragment, anomalous measurement, conversation, unfamiliar cultural practice, ecological event, technical failure, or unexpected juxtaposition can introduce a relation that was absent from the collective's current model of the problem. Such encounters do not carry their research value automatically. They become generative when researchers recognize a possible significance and allow the encounter to reorganize inquiry.

Aesthetic judgment can participate in this recognition. A researcher may experience an encounter as strange, elegant, dissonant, unexpectedly coherent, or difficult to ignore before a full epistemic justification is available. Section 6.26 distinguished this orienting role from later evidential warrant. Under conditions of AI-mediated abundance, that distinction becomes increasingly consequential. Machine systems can expand the number of internally generated possibilities, while contingent encounters can bring the collective into relation with phenomena, contexts, or combinations that were not selected by its existing symbolic and computational trajectory.

Proposition 6.478 (Contingency-sensitive research generativity). *A research community can increase its generative capacity by maintaining recurrent opportunities for contact with contingent observations, heterogeneous environments, unfamiliar interpretations, and unexpected failures, together with judgment practices capable of recognizing potentially significant encounters before their value is fully formalized.*

The proposition assigns novelty, surprise, and aesthetic attraction an orienting role upstream of evidential evaluation. Research worth remains to be established through the subsequent inquiry through which worthwhile questions can become visible and testable. Subsequent investigation still bears the burden of evidence, interpretation, comparison, and revision.

This insight suggests that AI-rich research environments benefit from deliberate openness to encounters outside the immediate generative loop of models and already formalized corpora. Fieldwork, archives, direct observation, interdisciplinary exchange, cross-cultural collaboration, experimental practice, engagement with affected communities, and sustained attention to anomalies can expose the collective to contingencies that are difficult to specify in advance. The practical form will differ

across research domains, and some fields encounter contingency primarily through instruments, proofs, simulations, or archival evidence rather than physical travel. The common structure is exposure to relations whose significance has not already been settled by the research system's present categories.

Remark 6.479 (Aesthetic judgment under research abundance). As the cost of generating plausible research possibilities declines, aesthetic judgment can become more important as an orienting capacity for deciding which contingent encounters and candidate questions deserve sustained attention. Its role remains preparatory and revisable: aesthetic attraction can open an inquiry without functioning as evidence for the truth of its eventual conclusions.

The generative community therefore combines production with exposure, memory with openness, expertise with translation, and judgment with contestability. Publication volume or internal coherence alone provides an incomplete basis for evaluating its quality. A highly productive collective can still narrow future inquiry if it homogenizes methods, obscures provenance, concentrates interpretive authority, or closes itself to contingent evidence. A slower community can preserve valuable option space if it sustains heterogeneity, reconstructability, and responsible disagreement. Evaluation should therefore remain sensitive to the kinds of future research relations a community produces.

Proposition 6.480 (Collective generativity and future option space). *When evaluating a research collective as a generative structure, relevant considerations can include its capacity to preserve reconstructability, support heterogeneous expertise, enable criticism, encounter unanticipated evidence, cultivate revisable judgment, and create viable pathways for future inquiry beyond its current outputs.*

Collective and distributed knowledge production thus extends the praxis framework from individual research conduct to the organization of epistemic relations. Expertise, memory, interpretation, judgment, and responsibility can be distributed in different ways, and their distributions can evolve historically as institutions and technologies change. Research communities become generative when they coordinate these functions while retaining enough plurality, provenance, and openness for correction and new question formation. The next section turns from the collective that produces knowledge to one of its central products: theory itself. Once theories circulate through communities, infrastructures, representations, and revisions, they can be examined as generative relational objects with their own histories of stabilization, transformation, and re-entry into subsequent inquiry.

6.29 Theory within Generative Relational Inquiry

Section 6.28 treated knowledge production as a distributed praxis in which research communities, institutions, infrastructures, persons, and computational systems participate in differentiated epistemic functions. The present section turns from those productive relations to one of their central products: theory. Its role is to examine theory simultaneously as an epistemic construction oriented toward explanation and as a historically generated object whose concepts, relations, uses, and conditions of persistence can themselves be studied. The objective is to clarify how theories emerge, stabilize, condition inquiry, encounter evidence, compete, hybridize, dissolve, and sometimes re-enter later research under changed conditions. The discussion pro-

ceeds from historical generation and community relations through evidence, method, observation, theory change, competition, hybridization, dissolution, re-emergence, and the revisability of GR. The method remains relational and historically restrained. Treating a theory as historically generated does not settle the truth of its propositions, while evaluating its propositions does not remove the historical relations through which the theory becomes available for evaluation.

This dual perspective is important for GRE because a theory can participate in later inquiry after its initial formulation. It can make distinctions available, organize observations, stabilize vocabularies, suggest mechanisms, define anomalies, orient methods, and provide forms through which evidence becomes comparable. A theory can therefore possess generative effects within research praxis even when later inquiry revises substantial parts of it. Kuhn's historical account of scientific change, Longino's account of socially organized criticism, and the Duhem–Quine tradition concerning the relation between evidence and wider systems of assumptions each provide precedents for examining theory within broader epistemic configurations (Kuhn 1962; Longino 1990; Duhem 1954; Quine 1951). GRE adopts these precedents selectively and keeps the present claim narrower: theories can be analyzed as relational objects whose epistemic standing and historical trajectory remain distinct but interacting dimensions.

Definition 6.481 (Generative relational theory object). A *generative relational theory object* is a historically situated configuration of concepts, propositions, explanatory relations, scope conditions, representations, and inferential commitments that participates in inquiry and can alter the conditions under which later questions, observations, comparisons, methods, and revisions become possible.

Definition 6.481 assigns generativity to the theory's participation in later research rather than to its truth by definition. A theory can generate productive questions while containing errors. It can remain locally useful while losing broader explanatory authority. It can also be historically influential while later evidence undermines its central propositions. These possibilities motivate a layered analysis of theory rather than a single measure of theoretical success.

6.29.1 Theories as Historically Generated Objects

Theories enter research at particular historical moments. Their vocabularies depend on available languages of description; their formal structures depend on mathematical and computational resources; their objects can depend on instruments, classifications, archives, and institutions; and their questions are influenced by the problems that research communities learn to recognize. Historical generation therefore concerns the conditions under which a theoretical configuration becomes thinkable, expressible, investigable, and transmissible.

Historical generation should be distinguished from historical determination. A theory can arise under specific conditions without being exhausted by those conditions. Later researchers can evaluate its arguments, reconstruct its evidence, transfer parts of its conceptual architecture, or discover applications that were not anticipated in its original setting. Hacking's work on historical ontology is useful here because it shows how concepts, classifications, and styles of reasoning can have histories through which objects of inquiry become available in particular forms (Hacking 2002). The present framework extends that sensitivity to theories while preserving

a separate question concerning whether the relations posited by a theory are adequately supported.

Definition 6.482 (Theory formation configuration). *A theory formation configuration is the historically specific set of conceptual, evidential, methodological, institutional, technical, and communicative relations through which a theoretical structure becomes formulable and gains a position within research praxis.*

A formation configuration can include inherited concepts, unresolved anomalies, newly available observations, disciplinary disputes, methodological innovations, political or institutional problems, changes in instrumentation, and encounters with neighboring fields. The relative importance of these relations differs across cases. The concept is intended to make such dependencies inspectable without requiring a single historical cause for theoretical emergence.

Historical analysis also helps distinguish the persistence of a proposition from the persistence of the theoretical structure that once contained it. A mechanism, formal relation, or conceptual distinction can survive after the surrounding theory changes. Conversely, a theory name can persist while its internal commitments change substantially. The history of theory therefore benefits from version-sensitive description.

Proposition 6.483 (Historical traceability of theory formation). *Where the historical conditions of theory formation materially affect the meaning, scope, evidential basis, or later interpretation of a theory, those conditions should remain recoverable in accounts of its development and use.*

This principle supports later re-epistemization. A theory inherited without its formation history can appear more timeless, internally unified, or context-independent than its evidential trajectory warrants.

6.29.2 Theories within Research Communities

A theory becomes research-active through communities that teach, criticize, apply, formalize, translate, preserve, and revise it. Section 6.28 described research communities as relational configurations rather than containers of individual researchers. Theories participate in those configurations by offering shared objects around which disagreement and coordination can occur.

Community uptake can stabilize a theory. Textbooks compress arguments into teachable forms; canonical examples establish expected applications; software libraries encode model families; citation networks preserve particular formulations; journals and conferences create venues in which theory-specific questions are recognized; and training transmits tacit expectations about what counts as a legitimate extension. Stabilization can increase cumulative capacity because researchers can work from common distinctions without reconstructing the entire theory during each inquiry. It can also hide unresolved assumptions when the stabilized form becomes easier to reproduce than to interrogate.

Definition 6.484 (Theory–community relation). *A theory–community relation is a historically situated relation through which a research community preserves, teaches, applies, contests, translates, authorizes, or revises a theoretical configuration.*

The relation can vary within the same community. Some participants may treat a theory as a working framework, others as an object of criticism, others as a source of isolated methods, and others as part of disciplinary history. This plurality matters

because a theory can remain generative even after consensus around its strongest formulation declines.

Longino's account of critical interaction suggests that the epistemic quality of a research community depends partly on the availability and uptake of criticism (Longino 1990). Applied to theory, this implies that preservation and criticism should remain connected. A theory protected from criticism can retain institutional presence while losing epistemic responsiveness; a theory discarded without reconstructable criticism can deprive later researchers of the evidence needed to understand why the change occurred.

Proposition 6.485 (Community-mediated theoretical continuity). *The continuity of a theory within research praxis can depend on community relations that preserve its concepts, evidence, criticisms, and revision history; the epistemic value of that continuity increases when preservation remains compatible with contestability.*

The proposition treats continuity as a research resource rather than as evidence of correctness. Longevity can reflect explanatory usefulness, institutional reproduction, pedagogical convenience, unresolved alternatives, or several of these relations together.

6.29.3 Relations among Theory, Evidence, and Method

Theory, evidence, and method interact recursively. Theories can suggest what evidence would be informative; methods shape which evidence can be produced; evidence can support, differentiate, qualify, or challenge theoretical claims; and theoretical change can alter the interpretation of earlier observations. This interaction complicates a picture in which evidence enters a theory from an epistemically neutral exterior.

Duhem's analysis of physical theory and Quine's later holist argument provide important precedents for recognizing that empirical testing often engages wider networks of assumptions rather than isolated statements (Duhem 1954; Quine 1951). GRE does not require a strong global holism. A more modest methodological consequence is sufficient: when evidence appears inconsistent with a theoretical prediction, inquiry may need to examine the theory together with relevant measurement procedures, auxiliary assumptions, classifications, background models, and boundary conditions.

Definition 6.486 (Theory–evidence–method configuration). *A theory–evidence–method configuration is the research-specific relational arrangement through which theoretical propositions, evidential records, and procedures of observation or analysis jointly participate in the production and evaluation of a knowledge claim.*

The configuration is claim-relative. An auxiliary assumption that matters for one test may be irrelevant to another. A measurement instrument can be central to one evidential pathway and peripheral to a historical reconstruction. This locality helps avoid transforming holism into an unrestricted claim that the elements of a knowledge system are equally implicated across evaluations.

The relation is also temporally structured. A theory can motivate a method that produces new evidence; that evidence can reveal a limitation in the method; the revised method can produce a different evidential record; and the theory may then be reformulated. Section 6.19 described such processes as iterative reconstruction. The-

ory becomes generative within that cycle because it can reorganize later evidential and methodological possibilities even while remaining vulnerable to them.

Proposition 6.487 (Configuration-sensitive theory evaluation). *Where the support or failure of a theoretical claim materially depends on auxiliary assumptions, measurement relations, classification choices, or methodological procedures, evaluation should identify those dependencies before attributing the evidential result to the theory alone.*

This principle does not protect theories from criticism. It clarifies the object of criticism so that revision can target the relations through which the evidential tension was produced.

6.29.4 Theories as Conditions of Observation

Theories can shape observation by directing attention, supplying categories, defining expected contrasts, specifying relevant scales, and making some anomalies recognizable. A researcher trained in one theoretical tradition may notice a relation that remains background noise within another. Theory can therefore participate upstream of explicit explanation.

The influence of theory on observation should remain scoped. Observation can surprise the theory that helped organize it. Instruments can register patterns that researchers did not expect. Field encounters can disclose categories that the initial framework handled poorly. Participants can contest the vocabulary through which researchers interpreted their experience. Historical records can force a distinction absent from the original theory. These possibilities preserve the epistemic significance of contingent encounter developed in Sections 6.10–6.13 and Section 6.28.

Definition 6.488 (Observational conditioning by theory). *Observational conditioning by theory* is the influence of a theoretical configuration on the categories, scales, contrasts, expectations, or salience structures through which researchers organize an encounter with potential evidence.

Conditioning differs from determination. The concept allows theory to influence what is easy to notice without implying that observation can only reproduce prior theoretical commitments. The difference is especially important for a generative relational approach because unexpected relations can enter inquiry through environments, instruments, archives, other communities, and forms of experience that exceed the theory's current organization.

Kuhn's account of paradigms and normal science shows how theoretical commitments can structure recognized problems and puzzle-solving practices (Kuhn 1962). The present framework uses that insight while preserving a stronger role for cross-method correction, contingent encounter, and distributed interpretation. A research community can reduce theoretical closure by maintaining relations through which observations that resist current categories can remain visible long enough to be investigated.

Proposition 6.489 (Observation-opening principle). *A theory contributes to generative inquiry when it organizes observation while preserving practical pathways through which anomalous, contingent, or differently interpreted evidence can become available for criticism and revision.*

The proposition makes openness a property of research relations rather than a psychological virtue attributed to an individual researcher.

6.29.5 Theory Change

Theory change can occur through gradual adjustment, differentiation of scope, reorganization of mechanisms, conceptual replacement, altered formal structure, or more substantial changes in the relations through which a research community interprets its object. A single vocabulary such as “revision” can conceal these different trajectories. The analytical task is therefore to identify what changes and what remains continuous.

Section 6.19 defined theory revision as a change in propositions, mechanisms, scope conditions, conceptual architecture, or explanatory relations. The present subsection adds a historical dimension. A theory can change through a sequence of versions whose relation is neither identity nor total replacement. Later formulations can retain some mechanisms, abandon others, reinterpret earlier evidence, and alter the boundaries within which previous claims remain meaningful.

Definition 6.490 (Theory transition). A *theory transition* is a historically located change between theoretical configurations in which at least one materially relevant proposition, concept, explanatory relation, scope condition, or representational structure is revised, replaced, differentiated, or abandoned.

Theory transitions can be reconstructed along several dimensions: conceptual continuity, evidential continuity, methodological continuity, community continuity, representational continuity, and continuity of the research problems being addressed. A transition may be large along one dimension and modest along another. This multi-dimensional account provides an alternative to describing theoretical history solely through binary categories such as continuity or revolution.

Kuhn’s analysis remains important because some episodes of scientific change involve shifts in exemplary problems, conceptual organization, and standards of inquiry rather than accumulation within an unchanged framework (Kuhn 1962). Popper’s emphasis on criticism and testability provides a different precedent in which theories should remain exposed to possible refutation and revision (Popper 2002). GRE can draw from both without treating either history of science or falsification as a universal template for theory change across heterogeneous research domains.

Proposition 6.491 (Version-sensitive theory change). *Where later theoretical formulations preserve some elements of an earlier theory while revising others, accounts of theory change should identify the relevant continuities and discontinuities rather than treating the transition as either simple accumulation or complete replacement.*

Version sensitivity also supports cumulative reconstruction because later researchers can locate which claims survived, which were narrowed, and which became objects of renewed controversy.

6.29.6 Theory Competition

Research communities often encounter situations in which several theories address overlapping objects while differing in mechanisms, categories, scales, predictions, or explanatory aims. Competition in this setting should not be presumed to produce a single immediate ranking. Theories can differ in the phenomena they illuminate, the evidence they require, the costs of application, and the kinds of questions they make possible.

Definition 6.492 (Theory competition configuration). A *theory competition configu-*

ration is a research situation in which two or more theoretical structures make materially different claims, explanations, classifications, predictions, or research orientations concerning an overlapping domain of inquiry.

Comparison becomes informative when the dimensions of competition are explicit. Predictive performance may matter for one question; historical adequacy, mechanism identification, interpretive fit, formal tractability, or capacity to organize intervention may matter for another. These dimensions can conflict. A theory that compresses observations efficiently can omit relations needed for institutional interpretation. A historically rich theory can be difficult to operationalize for a narrow forecasting task. Such differences call for function-sensitive comparison rather than a single metric of theoretical superiority.

Theory competition can also reveal hidden assumptions. When two theories organize the same evidence differently, their disagreement may expose differences in ontology, scale, category construction, temporal horizon, or evidential relevance. In this sense, competition can be generative before it is resolved.

Proposition 6.493 (Generative role of theoretical disagreement). *When competing theories organize an overlapping evidential domain through materially different assumptions or relations, preserving the disagreement during investigation can help expose otherwise implicit choices concerning scale, category, mechanism, scope, or evidential relevance.*

Resolution may later become possible through new evidence, better translation, narrower scope conditions, or reformulation. In other cases, partial pluralism can remain methodologically useful when theories answer different questions or access different dimensions of the research object.

6.29.7 Theory Hybridization

Theories can also interact through borrowing, translation, recombination, and partial integration. Hybridization differs from simple competition because the interacting theories become resources for constructing a new configuration. Such processes are common in interdisciplinary research, where concepts or models cross boundaries and enter relations for which they were not originally designed.

Hybridization can be productive when imported elements retain enough of their original assumptions to remain intelligible while being adapted to a new problem. It can become misleading when translation erases incompatible ontologies, changes the meaning of key concepts, or joins elements whose inferential roles do not survive the transfer. Section 6.18 treated methodological translation as an operation with possible remainders. A similar discipline is needed for theoretical translation.

Definition 6.494 (Theory hybridization). *Theory hybridization* is the formation of a theoretical configuration through the selective translation, recombination, or reorganization of concepts, mechanisms, representations, or propositions drawn from previously distinguishable theoretical lineages.

The definition does not imply synthesis into a seamless whole. A hybrid theory can preserve internal tensions and domain-specific components. The relevant questions concern what was transferred, what changed meaning, which assumptions were retained, and whether the resulting relations support the claims made from them.

Proposition 6.495 (Translation discipline in theory hybridization). *When theoretical*

elements are transferred across lineages, the resulting account should identify consequential changes in meaning, assumptions, scope, and inferential role, especially where apparent similarity could conceal non-equivalence.

This principle is particularly important for GR because the programme draws from heterogeneous traditions. Relational sociology, pragmatism, systems thinking, dynamical systems, political economy, hermeneutics, historical analysis, and formal relational methods can inform GR without becoming interchangeable descriptions of the same object. Hybridization should therefore preserve productive differences and failed translations rather than presenting theoretical plurality as pre-established unity.

6.29.8 Theory Dissolution

Some theories lose their position as coherent organizing structures. Dissolution can occur when central propositions become difficult to sustain, when the object of inquiry is reclassified, when methods make a previous distinction unnecessary, when a theory fragments into more specialized lineages, or when its useful components are absorbed elsewhere. Institutional decline can also contribute when training, publication venues, archives, or communities that sustained the theory disappear.

Definition 6.496 (Theory dissolution). *Theory dissolution* is a historical process through which a theory ceases to function as a relatively coherent and active organizing structure for a research community, whether through evidential rejection, conceptual fragmentation, absorption, institutional decline, or transformation of its research object.

Dissolution should be distinguished from simple falsification. A theory may dissolve without a decisive refuting observation, and a refuted claim may remain visible within a broader theory that survives through revision. The Duhem–Quine problem cautions against assuming that one adverse result uniquely determines which theoretical component should be abandoned (Duhem 1954; Quine 1951). Historical reconstruction can therefore ask how evidential, conceptual, methodological, and institutional pressures combined across the dissolution trajectory.

Dissolution can also leave epistemic residues. Concepts, datasets, methods, anomalies, examples, and negative results may remain useful after the theory loses coherence. Preserving those residues supports later inquiry and reduces the risk that theory change erases the evidential history from which it emerged.

Proposition 6.497 (Residual value after theory dissolution). *The dissolution of a theoretical structure does not by itself determine the epistemic value of its constituent concepts, evidence, methods, or unresolved problems; these components can require separate evaluation under later research conditions.*

This proposition prepares the possibility of theory re-emergence without implying that earlier theories should be restored as wholes.

6.29.9 Theory Re-Emergence

Theoretical resources can re-enter research after periods of relative neglect. Re-emergence can occur because new evidence becomes available, computational or formal methods make earlier ideas testable, a neighboring field provides a new inter-

pretation, historical conditions make an old problem newly salient, or later theories recover a distinction that had been lost during earlier synthesis.

Definition 6.498 (Theory re-emergence). *Theory re-emergence* is a historically later return of a previously marginal, dissolved, or displaced theoretical element to active inquiry under changed evidential, methodological, conceptual, institutional, or practical conditions.

Re-emergence is therefore a new relation rather than simple repetition. A concept read through later evidence and methods occupies a different research configuration from the one in which it first appeared. Re-epistemization, developed in Sections 6.21–6.23, becomes central here. Later researchers may ask which parts of an earlier theory remain intelligible, which claims depend on obsolete evidence, which distinctions acquire new relevance, and which historical assumptions should remain visible.

Historical preservation increases the possibility of responsible re-emergence. Archives that contain only canonical conclusions make it difficult to reconstruct abandoned alternatives. Records of failed models, contested categories, and unresolved anomalies can reveal theoretical resources that later conditions make newly interpretable.

Proposition 6.499 (Re-emergence through re-epistemization). *When an earlier theoretical element returns under substantially changed research conditions, its renewed use should be evaluated through the evidence, methods, concepts, and scope conditions available in the later configuration rather than through historical authority alone.*

This principle keeps theoretical memory generative while maintaining epistemic discipline.

6.29.10 GR as a Revisable Theory

The preceding analysis applies reflexively to Generative Relational Theory. GR is developed in this book as a research programme and theoretical orientation rather than as a completed ontology. Its concepts of relation, generativity, manifestation, trajectory, field, value conversion, and praxis are intended to organize inquiry while remaining open to differentiation and revision where evidence, conceptual criticism, or neighboring disciplines reveal limitations.

This revisability has several implications. First, GR should distinguish its broad theoretical vocabulary from domain-specific instantiations. A relation that is analytically useful in economics may require a different representation in education, ecology, jurisprudence, or neuroscience. Second, formal resources such as dynamical systems, network representations, field language, or geometric constructions should retain explicit representational scope. Their usefulness in one domain does not establish a universal ontology. Third, empirical findings can motivate changes in GR's conceptual architecture rather than being forced into inherited categories.

Definition 6.500 (GR revisability commitment). The *GR revisability commitment* is the methodological commitment to preserve the reconstructability of GR's concepts, claims, representations, scope conditions, and version history so that materially supported criticism can lead to clarification, differentiation, narrowing, reorganization, or abandonment of theoretical elements.

The commitment is compatible with theoretical ambition. A research programme can pursue broad explanatory questions while stating the provisional status of its cur-

rent architecture. Epistemic humility concerns the correspondence between claim strength and support, not the avoidance of difficult questions.

Popper's emphasis on exposure to criticism and Peirce's fallibilist conception of inquiry provide useful precedents for this orientation, although GR does not reduce revisability to one criterion of falsification (Popper 2002; Peirce 1877). Longino's account of critical interaction further suggests that revisability depends on social pathways through which criticism can be articulated and taken up (Longino 1990). GR therefore treats revisability as both a property of claims and a property of research relations.

Proposition 6.501 (Reflexive application of GR). *GR should be subjected to the same historical, relational, evidential, methodological, and reconstructive scrutiny that it proposes for other theoretical objects, with revisions recorded in forms that allow later researchers to identify changes in scope, meaning, and support.*

A failure to apply this principle would create an asymmetry between GR's account of knowledge and its treatment of itself.

6.29.11 Evolution of the GR Research Programme

A revisable theory requires an account of programme-level evolution. GR can change through empirical work, domain applications, formal developments, conceptual criticism, interdisciplinary encounters, and failed attempts at translation. The programme's evolution should therefore be understood as a lineage of related theoretical configurations rather than as the preservation of an invariant textual core.

Definition 6.502 (GR research-programme trajectory). *A GR research-programme trajectory is the reconstructable sequence of theoretical, methodological, empirical, and domain-specific configurations through which GR develops, including the relations among retained concepts, revisions, abandoned elements, unresolved tensions, and newly opened questions.*

This trajectory can contain branching. Different domains may develop distinct representations of relation or generativity. Some branches may later become mutually translatable; others may reveal genuine differences in scale, ontology, or evidential structure. Premature synthesis would obscure these possibilities. Programme-level coherence can instead come from shared questions and reconstructable relations among branches.

The research programme also has a generative criterion. Its value is not exhausted by the number of phenomena that can be redescribed in GR vocabulary. A productive programme should help researchers encounter new problems, formulate discriminating questions, identify relations previously obscured by existing categories, construct testable or interpretable distinctions, and revise its own architecture when those distinctions fail. Under this criterion, theoretical expansion without increased capacity for inquiry can become terminological accumulation.

Proposition 6.503 (Generative programme evolution). *The evolution of GR is epistemically productive when changes in its theoretical architecture increase or refine the capacity for inquiry, criticism, comparison, explanation, interpretation, or responsible application while preserving enough provenance for later reconstruction of what changed and why.*

Programme evolution also returns to contingent encounter and aesthetic judgment.

New theoretical directions can begin with anomalies, cross-disciplinary encounters, unexpected analogies, empirical failures, or observations whose significance is initially sensed before it is fully justified. Such moments can orient inquiry, while later evidence and criticism determine whether the emerging theoretical relation can be sustained. The generative process therefore joins openness to contingency with disciplined reconstruction.

Remark 6.504 (Theory generation under conditions of abundance). AI-assisted systems can lower the cost of generating candidate theoretical combinations, analogies, formalizations, and extensions. Under such conditions, theoretical generativity depends increasingly on the quality of problem selection, encounter, interpretation, verification, historical reconstruction, and judgment through which candidate structures are differentiated and revised.

Theory as a generative relational object thus occupies several positions at once. It is produced within historical and collective relations; it organizes later observation and method; it remains vulnerable to evidence and criticism; it can compete, hybridize, dissolve, and re-emerge; and its preserved history can become a resource for future inquiry. GR falls within the same architecture. Its development should remain reconstructable, plural enough to encounter counterevidence, and disciplined enough to distinguish theoretical generation from theoretical warrant. The next section turns to a particularly important source of such reconstruction: failure, negative results, and revision. It examines failed inquiry as a possible epistemic and generative resource when the conditions and consequences of failure remain visible.

6.30 Failure, Negative Results, and Revision

Section 6.29 treated theories as historically generated and revisable relational objects. The present section examines a central mechanism through which such revision becomes possible: research failure. Its role is to differentiate several forms of failure that are often compressed into a single retrospective judgment and to clarify which parts of an inquiry each form can place under pressure. The objective is to develop a research praxis in which failed hypotheses, formalizations, measurements, interventions, methods, and theories can remain epistemically legible when their conditions are sufficiently documented. The discussion proceeds from local failures of hypotheses, formalization, and measurement to negative and contradictory results, unsuccessful research interventions, methodological and theoretical failure, the preservation of failure as knowledge, and proportionate revision. The method is diagnostic rather than celebratory. Failure can generate knowledge under some conditions, while poorly identified failure can also mislead inquiry.

Within a generative relational framework, failure is rarely a property of an isolated result. It emerges from a relation among an expectation, a procedure, a research object, a set of conditions, and an evaluative criterion. A prediction can fail while the measurement relation remains uncertain. A formal model can fail because its assumptions are unsuitable for the target rather than because the underlying phenomenon lacks structure. An intervention can fail operationally before it provides a meaningful test of the mechanism it was designed to examine. Conversely, a technically successful study can fail epistemically if its procedures are incapable of discriminating among the interpretations placed upon its result. Research praxis therefore

Table 6.1: Selected loci of research failure and possible revision targets

Failure locus	Diagnostic question	Possible revision target
Hypothesis	Did the expected relation appear under the stated conditions and evidential test?	Local proposition, mechanism, boundary condition, auxiliary assumption
Formalization	Did the formal representation preserve the distinctions and relations required by the research question?	Variables, state space, mapping, assumptions, scale, mathematical structure
Measurement	Did the procedure produce evidence that remains meaningfully related to the intended object or construct?	Instrument, operationalization, classification, sampling, calibration, interpretation
Research intervention	Did the intervention create the intended research condition without introducing decisive distortions?	Protocol, access relation, timing, implementation, ethical design, field relation
Method	Was the method adequate to the question, object, scale, and available evidence?	Method choice, combination, translation, inferential procedure
Theory	Do recurrent evidential and conceptual difficulties place central theoretical relations under sustained pressure?	Scope, architecture, concepts, mechanisms, theory lineage

benefits from locating the failure before deciding what should be revised.

Definition 6.505 (Research-failure configuration). A *research-failure configuration* is a historically and methodologically situated relation in which an inquiry does not satisfy a specified epistemic, representational, measurement, procedural, or theoretical expectation under the conditions in which that expectation was evaluated.

Definition 6.505 makes the criterion and conditions part of the failure description. This helps distinguish a failed attempt from a generalized conclusion about the research object. It also creates a basis for revision: once the locus of failure is sufficiently clear, researchers can ask whether the relevant response concerns the hypothesis, representation, measurement relation, method, scope condition, theory, or research arrangement.

Table 6.1 summarizes the main loci developed in this section. The categories can overlap in practice. Their analytical value lies in preventing a local difficulty from being transferred too quickly to a wider level of theory.

6.30.1 Failed Hypotheses

A failed hypothesis is among the most familiar forms of research failure, yet its interpretation is often less direct than the phrase suggests. A hypothesis can predict a relation that does not appear in the observed evidence, predict a direction or magnitude that is not supported, or fail to discriminate among competing outcomes. Such a result can place pressure on the hypothesis while leaving open which part of the wider research configuration requires revision.

Popper's methodological emphasis on exposing conjectures to possible refutation remains an important precedent for treating adverse results as epistemically significant (Popper 2002). The Duhem–Quine tradition adds a complementary caution: empirical tests commonly depend on auxiliary assumptions, measurement procedures, classifications, and background relations, so an adverse result may not uniquely identify the proposition that should be revised (Duhem 1954; Quine 1951). The present framework combines these insights at a modest level. Failed predictions deserve attention, while diagnosis should remain sensitive to the configuration through which the prediction was tested.

Definition 6.506 (Local hypothesis failure). *A local hypothesis failure occurs when evidence produced under a specified research configuration does not provide the expected support for a hypothesis, while the wider theoretical implications remain open to further diagnosis.*

The adjective *local* is important. A hypothesis can fail because a mechanism was misstated, because a proposed relation operates only under narrower conditions, because the relevant temporal scale differs from the one observed, or because a mediating relation was omitted. These possibilities support differentiated revision. A failed hypothesis can sometimes improve a theory by revealing a boundary that successful confirmation would have left invisible.

Research records should therefore preserve the original hypothesis, its scope conditions, the evidential test, relevant auxiliary assumptions, and the observed deviation. Rewriting the hypothesis after seeing the result can obscure the epistemic history through which the later formulation emerged. A reconstructable record allows later researchers to distinguish initial expectation from post hoc interpretation.

Proposition 6.507 (Diagnostic value of local failure). *When a failed hypothesis is documented together with its testing conditions and relevant auxiliary assumptions, the failure can help identify boundaries, omitted relations, scale dependence, or conceptual distinctions that were weakly visible in the original formulation.*

This proposition describes a possibility rather than a guarantee. Some failed hypotheses remain uninformative because the test was weak, the data were insufficient, or the initial proposition was too indeterminate to discriminate among outcomes.

6.30.2 Failed Formalizations

Formalization can fail even when the research question remains valuable. A model may be mathematically coherent while representing the target poorly; a state space may omit relations needed to interpret the dynamics; an optimization structure may impose an objective that the research object does not possess; a network representation may compress qualitatively different relations into a single edge type; or a tractable model may depend on assumptions whose local consequences dominate the phenomenon of interest.

Such failures are especially relevant to GR and GRE because the programme draws on dynamical systems, networks, geometry, fields, and other formal resources. Section 6.29 emphasized that theoretical hybridization requires translation discipline. The same principle applies within formal work: the act of translating a relational object into variables, states, edges, parameters, functions, or categories can generate a remainder that matters for the research question.

Definition 6.508 (Formalization failure). A *formalization failure* occurs when a formal representation does not adequately preserve, discriminate, or operationalize the relations required for the analytical purpose for which the representation was introduced.

Formalization failure can be mathematical, representational, or inferential. Mathematical failure can involve inconsistency, non-identifiability, numerical instability, or computational intractability. Representational failure can arise when the formal objects erase distinctions that the substantive inquiry requires. Inferential failure can occur when a model supports conclusions that depend more strongly on imposed assumptions than on the evidence to which the model is connected.

Recording unsuccessful formalizations can have substantial future value. A failed state-space construction can show which variables require historical indexing. An unsuccessful metric can reveal that two value forms are insufficiently commensurable for the proposed operation. A network model that produces misleading equivalences can reveal the need for multilayer relations or typed edges. These records can prevent later researchers from repeating an apparently attractive translation without encountering the reasons it was abandoned.

Remark 6.509 (Formal elegance and representational adequacy). Formal elegance can orient attention and support aesthetic judgment during model construction, while representational adequacy remains a separate epistemic question. A beautiful formal structure can fail for the local research purpose, and an inelegant representation can remain empirically useful within a limited domain.

The remark reconnects failure to the distinction developed in Sections 6.10–6.13. Aesthetic judgment can guide inquiry before sufficient evidence is available, yet later evidential and representational evaluation can revise the initial attraction.

6.30.3 Failed Measurements

Measurement failure concerns the relation between an evidential procedure and the object, construct, or distinction it is intended to make observable. It can arise through instrument malfunction, poor calibration, unstable operationalization, inappropriate classification, sampling limitations, reactivity, missingness, historical category drift, or a mismatch between the scale of measurement and the scale of the process being studied.

The GR perspective adds a relational concern. Measurement is itself an intervention into an epistemic relation. A survey question can alter how a respondent frames an experience; a ranking can change the behavior of the institutions it measures; a sensor can capture one physical dimension while leaving relevant contextual relations outside the record; an administrative category can stabilize distinctions that later researchers mistakenly treat as naturally given. Failure can therefore occur even when the instrument functions exactly as designed.

Definition 6.510 (Measurement-relation failure). A *measurement-relation failure* occurs when the evidential relation produced by a measurement procedure becomes inadequate for the inference or distinction assigned to it under the research conditions at issue.

This definition separates technical operation from epistemic adequacy. A scale can be internally reliable while poorly related to the target construct. A database can be

complete relative to an administrative system while excluding populations whose absence matters for the research question. A proxy can correlate with an intended construct during one historical period and lose that relation after institutional change.

Failed measurements can therefore reveal features of the object and the measurement system simultaneously. Unexpected missingness can expose access inequalities. Category instability can reveal historical change in the object being classified. Divergence between instruments can indicate multidimensionality rather than simple error. The diagnostic task concerns which interpretation is supported by the surrounding evidence.

Proposition 6.511 (Measurement failure as relational evidence). *Where a measurement procedure fails in a patterned way, the pattern can provide evidence about the relation among instrument, classification, research population, historical context, and target construct, provided that technical error and alternative explanations remain under examination.*

The qualification is important because patterned failure can also arise from mundane implementation problems. Generativity enters when the failure changes what researchers know to ask about the measurement relation.

6.30.4 Negative Results

A negative result deserves distinction from research failure. A study can competently investigate a hypothesis and produce evidence that does not support the expected effect. Such an outcome may be a successful inquiry whose substantive result is negative, null, absent, or inconsistent with the tested expectation. Conversely, a poorly designed study can produce a statistically non-significant result that offers little information about the underlying relation.

Definition 6.512 (Negative research result). *A negative research result is an evidential outcome that does not support a specified expected relation, effect, mechanism, or difference under a research design capable of giving the outcome interpretable meaning.*

The final clause prevents non-detection from being treated automatically as evidence of absence. The informational value of a negative result depends on design sensitivity, measurement quality, statistical or interpretive adequacy, scope conditions, and the alternatives the study can discriminate among.

The research literature also provides evidence that negative or null findings can receive less visibility than stronger positive findings. Franco, Malhotra, and Simonovits examined a known population of 221 social-science experiments and found that strong results were substantially more likely to be written up and published than null results (Franco et al. 2014). Fanelli's cross-disciplinary work similarly documented changes in the prevalence and visibility of negative findings across scientific literatures (Fanelli 2012). These studies concern particular samples and publication systems, yet they illustrate a wider epistemic risk: when research memory disproportionately preserves supportive outcomes, later theories can be evaluated against a selectively visible evidential history.

This asymmetry is especially consequential for generative research programmes. A failed path can prevent duplicated effort, reveal boundary conditions, or preserve evidence against an attractive mechanism. If these paths disappear from the accessi-

ble record, later researchers may repeatedly rediscover the same limitations or overestimate the stability of the surviving theory.

Proposition 6.513 (Epistemic value of preserved negative results). *Negative results can contribute to cumulative inquiry when their research conditions, design sensitivity, and interpretive limits remain visible enough for later researchers to evaluate what the result constrains and what it leaves open.*

Preservation therefore concerns more than publishing a binary outcome. It concerns maintaining the relations required to interpret the outcome.

6.30.5 Contradictory Results

Research fields frequently contain results that appear to conflict. One study identifies a relation, another does not; one historical reconstruction supports a mechanism, another emphasizes a different sequence; one model performs well at one scale and poorly at another. Contradiction can indicate error, but it can also reveal heterogeneity that an earlier research frame compressed.

Section 6.17 argued that disagreement among competent methods can itself become evidence. The same logic applies to contradictory results. Rather than treating inconsistency as a defect to be averaged away immediately, researchers can ask which relations differ across the studies: population, period, scale, measurement, institutional setting, intervention intensity, model assumptions, evidential access, or interpretive framework.

Definition 6.514 (Contradictory-result configuration). *A contradictory-result configuration is a set of research outcomes whose substantive interpretations are difficult to sustain simultaneously under the same assumed scope conditions, thereby creating pressure to examine differences in evidence, method, context, scale, or theory.*

The phrase *assumed scope conditions* matters because apparent contradiction can dissolve when the studies are shown to concern different relational configurations. A policy mechanism may operate in one institutional environment and not another. A causal relation can reverse when the dominant pathway changes over historical time. A qualitative study can reveal a category distinction that explains heterogeneity hidden in an aggregate estimate.

Proposition 6.515 (Contradiction-driven differentiation). *When well-supported results remain in tension, preserving the tension during diagnosis can help reveal missing scope conditions, latent heterogeneity, scale dependence, historical change, or translation problems that premature synthesis would obscure.*

The proposition does not make contradiction intrinsically productive. Some contradictions result from mistakes, weak designs, or incompatible uses of terminology. The generative possibility lies in disciplined comparison.

6.30.6 Unsuccessful Interventions within Research

Research contains interventions before it reaches application-dominant praxis. Researchers recruit participants, negotiate access, introduce experimental conditions, conduct interviews, build archives, prompt computational systems, select model settings, and modify observational environments. These interventions can fail operationally or epistemically.

An unsuccessful intervention may fail to create the intended condition, may generate substantial reactivity, may produce ethically unacceptable burdens, may encounter institutional resistance, or may interact with the field in ways that make the resulting evidence difficult to interpret. Such outcomes deserve separation from a failed substantive hypothesis. If an experimental manipulation does not meaningfully alter the intended relation, the resulting data provide a weak test of the hypothesis that assumed the alteration occurred.

Definition 6.516 (Research-intervention failure). A *research-intervention failure* occurs when an intervention introduced for the purpose of inquiry does not establish the intended research condition, or establishes it through relations that materially compromise the evidential, ethical, or interpretive purpose of the inquiry.

This form of failure can be particularly informative in field research. Difficulty obtaining access may reveal institutional boundaries that are themselves substantively relevant. Participant resistance can indicate that the research categories conflict with lived classifications. An AI-assisted workflow that repeatedly generates plausible but untraceable claims can reveal an infrastructure-level limitation in provenance rather than a lack of generative capacity.

Ethical diagnosis is part of this analysis. A research intervention can produce informative data and still be inappropriate because the burdens, power relations, or risks are poorly justified. In such cases, practical success does not erase normative failure. Research praxis should preserve that distinction.

Remark 6.517 (Operational and epistemic success). An intervention can succeed operationally while remaining epistemically weak, or fail operationally while revealing consequential relations in the research field. Evaluation benefits from separating these dimensions before drawing broader conclusions.

6.30.7 Methodological Failure

Methodological failure arises when the procedure used to access, compare, infer, interpret, or reconstruct a research object proves inadequate to the question under investigation. The failure can concern a single implementation or a wider family of methods within a particular domain.

A method can fail because its assumptions are violated, because it requires data unavailable in the field, because its categories distort the relevant distinctions, because its temporal resolution misses the process of interest, because it treats dependent observations as independent, or because the form of evidence it produces is poorly suited to the question being asked. Methodological failure can also emerge historically. A procedure that was adequate under one institutional or technical arrangement can become less informative after the object of study changes.

Definition 6.518 (Methodological failure). A *methodological failure* occurs when a method or methodological configuration is insufficiently adequate to the research question, object, evidence, scale, or inferential task for which it is being used.

Methodological pluralism becomes important here. Failure of one mode of access does not establish the superiority of another in general. Historical reconstruction, qualitative inquiry, formal modeling, quantitative estimation, ethnography, legal interpretation, and computational methods expose different aspects of relational objects. A failed method can therefore motivate triangulation, translation, or a change

in the question rather than a hierarchy among disciplines.

Methodological failure can also reveal that the initial question presupposed an unavailable form of evidence. A demand for precise causal attribution may exceed the historical record. A request for a single metric may be incompatible with heterogeneous value forms. A computational classification task may lack a stable target because the categories are institutionally contested. In these cases, revising the question can be more appropriate than forcing the method to produce an answer.

Proposition 6.519 (Question–method co-revision). *When methodological failure arises from a mismatch between the form of the research question and the evidence or relations available for inquiry, revision can appropriately target the question, the method, or their relation rather than treating the method in isolation.*

This proposition aligns with the chapter's broader account of iterative reconstruction.

6.30.8 Theoretical Failure

Theoretical failure concerns a wider level of organization than local hypothesis failure. It becomes relevant when recurrent empirical, conceptual, or methodological difficulties place central relations within a theoretical architecture under sustained pressure. The diagnosis can involve failed predictions, unresolved anomalies, internal tensions, weak transfer across domains, persistent dependence on ad hoc auxiliary assumptions, or inability to discriminate among the phenomena the theory was intended to organize.

Theoretical failure remains historically graded. A theory can lose broad explanatory authority while retaining useful local mechanisms. A conceptual distinction can survive the framework in which it originated. A theory can be narrowed to a smaller domain rather than abandoned. Section 6.29 therefore distinguished theory dissolution from simple falsification and emphasized the residual value that can remain after dissolution.

Definition 6.520 (Theoretical failure). *A theoretical failure is a sustained condition in which central relations, mechanisms, or organizing distinctions of a theory become insufficiently supported, discriminating, coherent, or productive for the scope of inquiry assigned to them.*

The definition contains several possible dimensions because theories perform multiple epistemic functions. A theory can remain empirically serviceable while conceptually confused, or conceptually elegant while repeatedly unsuccessful in empirical discrimination. A theory can explain past evidence yet generate few new questions. Diagnosis should therefore identify which function has weakened and over what scope.

Caution 6.521 (Premature theory rejection and indefinite protection). A single adverse result can provide insufficient grounds for abandoning a wider theoretical architecture, while repeated reinterpretation of adverse evidence can also insulate a theory from meaningful revision. The relevant judgment concerns the accumulated configuration of evidence, auxiliary assumptions, alternative explanations, and the theory's stated scope.

Caution 6.521 expresses the balance needed for an open research programme. Revisability requires exposure to failure together with enough diagnostic patience to

locate what failed.

6.30.9 Failure as Research Knowledge

Failure becomes cumulative research knowledge when later researchers can reconstruct enough of the failed pathway to understand what was attempted, under which conditions, with which assumptions, and with what evidential consequences. The object of preservation is therefore a trajectory rather than a label such as “failed” or “null.”

A useful failure record can include the initial question, hypothesis or objective, relevant theory, research design, data provenance, formal assumptions, measurement choices, implementation conditions, observed result, diagnostic alternatives, subsequent revisions, and remaining uncertainties. The appropriate level of documentation depends on consequence, cost, privacy, security, and feasibility, as discussed in Section 6.23.

Definition 6.522 (Reconstructable failure record). *A reconstructable failure record is a preserved account of an unsuccessful or adverse research trajectory containing enough provenance, conditions, assumptions, evidence, and diagnostic interpretation for later inquiry to evaluate what the episode constrains and which questions remain open.*

Such records can possess option value. A failed model may become informative after a new measurement technology appears. An abandoned hypothesis may acquire a narrower interpretation after a previously hidden subgroup is recognized. An unsuccessful archival search can tell later researchers which sources were unavailable at a particular time. A failed AI workflow can preserve evidence about model version, prompting conditions, and provenance limitations that becomes relevant after infrastructure changes.

Failure records also have a justice dimension. Selective preservation can privilege successful institutional narratives while erasing abandoned approaches, participant objections, negative findings, and unsuccessful interventions. Preserving relevant failure can therefore widen the historical visibility of how knowledge was actually produced. This argument remains subject to ethical limits: some records require restriction, anonymization, or non-retention because preservation itself can create harm.

Proposition 6.523 (Failure memory as future epistemic option). *Where ethically and practically appropriate, preserving reconstructable records of consequential research failures can increase the future capacity to avoid repeated error, reinterpret earlier evidence, recover abandoned alternatives, and diagnose the historical formation of later theories and methods.*

This proposition connects failure memory to the intergenerational research memory developed in the following section.

6.30.10 Revision after Failure

Revision closes the local cycle opened by failure while keeping the wider inquiry re-openable. The central problem is proportionality. An adverse result can justify a small parameter change, a narrower scope condition, a redesigned measurement, a

new method, a reformulated mechanism, or a substantial theoretical reorganization. The appropriate level depends on what the diagnosis can support.

A generative relational approach treats revision as a transformation of a research configuration. Changing one element can alter the interpretation of others. Revising a category can change which observations count as comparable; changing a method can alter the evidential record; narrowing a theory can shift previously anomalous cases outside its intended scope; adding a historical condition can transform a universal-looking proposition into a period-specific one. Revision should therefore preserve enough provenance to make these changes visible.

Definition 6.524 (Proportionate research revision). *A proportionate research revision is a documented change to a hypothesis, representation, measurement, method, scope condition, theoretical relation, or research arrangement whose breadth is matched to the failure diagnosis and the available evidential support.*

Proportionate revision resists two symmetrical temptations. One is overreaction, in which a local failure is converted rapidly into rejection of a wider programme. The other is protective absorption, in which the theory or method is repeatedly modified in ways that make adverse evidence increasingly difficult to count against it. Responsible revision keeps the relation between evidence and change inspectable.

A practical revision sequence can therefore ask: What expectation failed? Under which conditions? Which parts of the research configuration were independently supported? Which alternative diagnoses remain plausible? What is the narrowest revision that addresses the supported diagnosis? Which new observations or comparisons could discriminate among the remaining alternatives? These questions orient revision without presuming that the earliest diagnosis is final.

Proposition 6.525 (Failure-sensitive revision). *Research revision is epistemically stronger when the scope of change remains traceable to the diagnosed locus of failure, competing explanations remain visible where consequential, and the revised configuration creates opportunities for later discrimination among unresolved alternatives.*

The proposition returns failure to generativity. A failure is epistemically productive when it changes the space of inquiry in a discriminating way: a previously hidden boundary becomes visible, a measurement relation is clarified, an attractive formalization is abandoned for documented reasons, or a theoretical architecture is reorganized around evidence it could not previously accommodate. The generative value lies in the transformation of future inquiry rather than in failure itself.

Failure also reconnects with contingent encounter and aesthetic judgment. Researchers can encounter an anomaly whose significance is initially unclear, or experience a formal mismatch that appears aesthetically disturbing before its epistemic importance is established. Such impressions can orient attention toward a possible failure configuration. Later investigation determines whether the anomaly is robust, which relation it concerns, and what level of revision is warranted. In this sense, the openness to encounter developed earlier in the chapter remains compatible with disciplined revision.

The treatment of failure developed here prepares the transition from individual episodes of revision to the infrastructures that make revision cumulative. Negative results, abandoned models, contradictory findings, unsuccessful interventions, and changed theories become more useful when concepts, data, assumptions, relational maps, and disagreement remain accessible across research generations. The next sec-

tion therefore turns from failure-sensitive revision to open and cumulative research practice.

6.31 Open and Cumulative Research Practice

Section 6.30 treated failure, negative results, and revision as parts of a reconstructable research history. The present section develops the institutional and epistemic conditions under which such histories can remain available for later inquiry. Its role is to specify how concepts, data, models, relational maps, assumptions, disagreements, replications, and reinterpretations can become reusable without being detached from the conditions that made them meaningful. The objective is to formulate an open and cumulative research praxis that preserves provenance, contestability, revision histories, and future possibilities of re-epistemization. The discussion proceeds from reusable research objects to transparent assumptions and open disagreement, then to replication, reinterpretation, cumulative revision, research commons, and intergenerational research memory. The method is relational and historical: openness is treated as a governed relation among researchers, artifacts, institutions, rights, infrastructures, and future users, while cumulation is treated as a trajectory of preservation and transformation rather than a simple increase in stored results.

Open research has often been associated with transparency, reproducibility, accessible materials, and infrastructures that permit research objects to circulate beyond their original projects (Nosek et al. 2015; UNESCO 2021). These commitments are important for GRE, yet their epistemic value depends on the relations through which openness is organized. A dataset without provenance can be widely accessible while remaining difficult to interpret. A model can be publicly released while depending on undocumented assumptions or unavailable computational environments. A historical archive can be accessible while its classificatory history remains obscure. Conversely, some research materials may require restricted access because of privacy, legal obligation, community stewardship, security, or other ethically relevant conditions. Openness therefore benefits from being analyzed through access, intelligibility, provenance, governance, and reuse rather than through availability alone.

Definition 6.526 (Open and cumulative research practice). An *open and cumulative research practice* is a research arrangement in which relevant epistemic objects, assumptions, transformations, disagreements, and revision histories are preserved with sufficient provenance and governance to support later examination, reuse, replication, reinterpretation, criticism, or revision under appropriate access conditions.

Definition 6.526 combines openness with cumulation because the two can strengthen one another when research objects remain recoverable across time. It also places governance inside the definition. Research becomes more cumulative when later investigators can determine what was done, under which conditions, with which concepts, and with which unresolved alternatives. The resulting accumulation can contain correction, abandonment, branching, and reclassification alongside retention.

Table 6.2 summarizes several research objects developed in this section and the conditions that can make their reuse epistemically informative.

Table 6.2: Selected research objects and conditions for responsible reuse

Research object	Conditions supporting reuse	Risks when context is lost
Concept	Definition history, scope, neighboring concepts, disputed uses, translation record	Apparent equivalence, category drift, anachronism
Data	Provenance, collection relation, metadata, permissions, transformations, missingness	Decontextualized measurement, hidden selection, invalid transfer
Model	Assumptions, code or specification, parameters, target relation, computational environment	Black-box reuse, scope expansion, apparent precision
Relational map	Boundary, scale, time index, edge semantics, uncertainty, source trace	Reified relations, frozen dynamics, false comparability
Assumption set	Type, role, dependence of conclusions, alternatives, sensitivity	Invisible premises, overgeneralized conclusions
Disagreement record	Competing interpretations, evidence, standards, unresolved points, later revisions	Retrospective consensus, loss of live alternatives
Failure record	Intended test, conditions, observed failure, diagnosis, subsequent revision	Repeated dead ends, publication-memory bias, distorted theory history

6.31.1 Reusable Concepts

Concepts are among the most portable objects in research. Terms such as *institution*, *trust*, *power*, *value*, *relation*, or *generativity* can travel across projects, disciplines, and historical periods. Their portability can support cumulative inquiry by allowing later work to inherit distinctions, compare cases, and refine theoretical structures. The same portability can also conceal changes in meaning. A concept reused across contexts may preserve its label while its boundary, scale, normative loading, or evidential role changes.

For this reason, concept reuse benefits from a recoverable conceptual history. Such a history can include the definition used in a particular project, the problem the concept was introduced to address, neighboring concepts from which it was distinguished, known ambiguities, contested translations, and later revisions. The objective is not to immobilize concepts. Research concepts often gain usefulness precisely because they can be modified. The objective is to make modification visible enough that later comparison remains meaningful.

Definition 6.527 (Reusable research concept). A *reusable research concept* is a concept whose definition, scope, relevant contrasts, and revision history are preserved sufficiently for later investigators to determine what continuity and transformation are involved when the concept is applied in a new inquiry.

This definition is especially important for GR because many of its concepts are intended to operate across domains. A relation in economic inquiry, legal inquiry, ecology, education, or aesthetics may share structural features while retaining domain-specific content. Reuse therefore requires a translation record rather than an assumption of identity. A concept can support cumulative research when later work can say

which properties are being inherited, which are being modified, and which remain unresolved.

Conceptual reuse also has a generative dimension. A well-preserved concept can become a scaffold for questions that its initial formulation did not anticipate. Later investigators may discover new cases, counterexamples, interactions, or formalizations. In this sense, preservation of conceptual provenance creates future research option value. The value arises through the possibility of responsible transformation, rather than through indefinite preservation of an original wording.

6.31.2 Reusable Data

Data reuse extends the temporal and institutional reach of an inquiry. Observations collected for one question can sometimes support later questions, comparisons, replications, historical reconstruction, or methodological testing. The FAIR principles provide an influential infrastructure-oriented account of research data as findable, accessible, interoperable, and reusable, with particular attention to metadata, provenance, licensing, and community standards (Wilkinson et al. 2016). GRE can inherit this emphasis while adding a stronger concern with the relational history through which data came to exist.

A datum is produced through relations among an object or participant, a measurement or recording procedure, classificatory decisions, institutional conditions, material infrastructures, and later transformations. Reusability therefore depends partly on whether these relations remain reconstructable. Variables may have changed definition across waves of a survey. Administrative records may reflect changes in law or eligibility rules. Sensor data may depend on calibration histories. Archival collections may preserve some actors more densely than others. A reusable dataset benefits from documentation that keeps such conditions visible.

Definition 6.528 (Relational data provenance). *Relational data provenance* is the recoverable record of the principal relations through which data were generated, selected, classified, transformed, stored, governed, and made available for later inquiry.

Relational provenance expands ordinary source citation. It can include collection procedures, sampling relations, participant or community conditions, measurement instruments, transformations, exclusions, uncertainty, missingness, access restrictions, and version history. The appropriate level of documentation is problem-relative. A later causal analysis may require different provenance from a descriptive reuse, while historical reinterpretation may require institutional and classificatory context that was peripheral to the original project.

Openness also has ethical limits. Privacy, confidentiality, contractual restrictions, indigenous or community stewardship, security, and risks of re-identification can justify differentiated access. UNESCO's Recommendation on Open Science explicitly places openness within a broader institutional and cultural framework and recognizes diversity of knowledge systems and contexts (UNESCO 2021). An open research praxis can therefore include controlled repositories, trusted access procedures, community-governed permissions, or delayed release where these arrangements preserve both future research possibility and legitimate protections.

6.31.3 Reusable Models

Models can accumulate research capacity when their internal structure and intended use remain recoverable. A statistical model, simulation, formal mechanism, agent-based model, or dynamical representation can be reused to test a new case, compare assumptions, reproduce an earlier result, or expose how conclusions depend on a particular representation. Model reuse can shorten the distance between research projects, yet it can also transport hidden assumptions into new domains.

A reusable model therefore includes more than executable code or equations. Its research record can specify the target phenomenon, conceptual interpretation, variables or state space, parameter meanings, boundary and initial conditions, simplifying assumptions, calibration procedure, computational environment, known sensitivity, and domains in which the model has been evaluated. When code is involved, versioning and dependency information can become part of epistemic provenance because software changes can alter the behavior of a nominally identical procedure.

Definition 6.529 (Reusable model package). A *reusable model package* is a formal or computational representation preserved together with sufficient information about its assumptions, semantics, parameters, implementation, target relation, evaluation history, and scope for later investigators to reproduce, adapt, or criticize its use.

The word *package* denotes an epistemic bundle rather than a required technical format. A concise analytical model may need only equations, definitions, assumptions, and derivation notes. A simulation may require source code, parameter files, random seeds, software dependencies, and example outputs. A machine-learning pipeline may require model version, training-data provenance, evaluation procedures, and preprocessing records. The appropriate bundle follows from the operations that later investigators may need to reconstruct.

Model reuse should preserve the distinction between adaptation and validation. Successful execution in a new environment shows that a procedure can run; it does not by itself establish that the model remains substantively adequate for a new domain. Later users therefore carry a responsibility to reassess the model–target relation. Reusability increases the availability of a model for inquiry while leaving epistemic judgment active.

6.31.4 Reusable Relational Maps

Relational maps occupy a distinctive place in GRE because they can connect observations, actors, institutions, resources, values, flows, dependencies, and temporal transformations within a common representation. Their cumulative value arises when later researchers can compare maps across periods, domains, scales, or interventions. Yet relational maps are particularly vulnerable to reification. A visual or computational edge can appear more stable and more ontologically definite than the evidence warrants.

Reusable relational maps therefore require explicit edge semantics. Researchers should be able to determine whether an edge represents communication, legal authority, material transfer, statistical association, causal dependence, perceived trust, formal membership, or another relation. Directionality, weight, uncertainty, time index, boundary conditions, and source type may also matter. A map that preserves these distinctions can support later remapping when new evidence changes the rep-

resented relation.

Definition 6.530 (Reusable relational map). A *reusable relational map* is a relational representation whose entities, relation types, boundaries, scales, temporal index, evidential sources, uncertainties, and transformation history are documented sufficiently for later comparison, extension, reinterpretation, or correction.

This form of reuse is especially relevant to historical inquiry. A relational map of an institution at one moment may later become one layer in a trajectory showing entry, exit, concentration, fragmentation, or changing forms of authority. The map then functions less as a final picture than as a versioned representation of a historically indexed field.

Relational maps can also preserve disagreement. Researchers may maintain alternative maps when evidence supports competing interpretations of the same field. Such plural representation can be more informative than forcing early convergence. Later evidence can then alter the relative support for the alternatives while preserving the path through which the disagreement developed.

6.31.5 Transparent Assumptions

Cumulative research depends partly on the visibility of assumptions because later researchers inherit consequences produced under those assumptions. Assumptions enter inquiry in several forms: constitutive definitions specify what a research object counts as; simplifying assumptions reduce complexity; identification assumptions support causal or statistical inference; measurement assumptions connect indicators to constructs; normative assumptions shape evaluative criteria; and infrastructural assumptions concern the reliability or accessibility of data, software, archives, or institutions.

Transparency can be improved by linking important assumptions to the claims that depend upon them. A long undifferentiated list of caveats may satisfy a procedural requirement while providing little help to later inquiry. A more useful record states what role an assumption plays, which conclusions depend strongly on it, what alternatives were considered, and which evidence could place it under pressure.

Definition 6.531 (Assumption dependency record). An *assumption dependency record* is a structured account connecting a consequential research assumption to the concepts, methods, models, interpretations, or conclusions whose warrant materially depends on it.

This record supports cumulative revision because later investigators can alter one assumption and identify which parts of the argument require reconsideration. It also reduces the tendency for assumptions to become invisible through repeated citation. A proposition that travels across a literature can gradually appear self-standing even when its original support depended on narrow conditions. Recoverable assumption dependencies make such inherited conditions easier to re-examine.

Transparency should remain proportionate. Research can contain tacit competencies and background knowledge that are difficult to exhaustively document. The practical objective is to preserve assumptions whose loss would materially alter interpretation, replication, or transfer. This standard keeps transparency connected to epistemic function rather than to indiscriminate documentation.

6.31.6 Open Disagreement

Cumulative research can advance through disagreement as well as convergence. Competing interpretations may draw attention to different evidence, scales, mechanisms, or values. Section 6.17 treated disagreement among competent methods as potentially diagnostic; Section 6.30 showed that contradictory results can identify unresolved differences in research configuration. Open research practice extends this principle by preserving the structure of serious disagreement rather than recording only the view that later became dominant.

Definition 6.532 (Open disagreement record). An *open disagreement record* preserves competing research interpretations together with the evidence, assumptions, methods, standards of evaluation, and unresolved points that distinguish them, while allowing later evidence or argument to alter their relative standing.

Such records can take many forms: parallel interpretations in an article, registered commentary, adversarial collaboration, versioned annotations, debate archives, or repositories that preserve rejected alternatives alongside accepted revisions. Their epistemic value lies in future reconstructability. A later researcher may possess evidence that changes the significance of an earlier disagreement, or may discover that the disagreement arose from different boundaries or definitions rather than incompatible observations.

Open disagreement also protects against retrospective flattening. Once a field converges, earlier alternatives can appear obviously mistaken because the later conceptual vocabulary is projected backward. Preserving the arguments that made an alternative plausible at the time supports more accurate history of inquiry and can reveal assumptions that the dominant trajectory later inherited without further examination.

Openness toward disagreement does not imply equal evidential standing. Some positions can become weakly supported, empirically contradicted, or conceptually incoherent. A cumulative practice preserves their history when that history remains informative while allowing current evaluation to reflect the available evidence. The distinction between preservation and endorsement is therefore central.

6.31.7 Replication

Replication is one mechanism through which research claims can be tested beyond the conditions of their initial production. Large coordinated replication projects have shown that reproducibility itself can become an empirical research object rather than a background assumption (Open Science Collaboration 2015). Within a relational framework, replication is especially informative when researchers specify which relations and conditions are intended to remain similar and which are allowed to vary.

Definition 6.533 (Relational replication profile). A *relational replication profile* specifies the elements of an earlier research configuration that a replication seeks to preserve, the elements that differ, and the evidential question those similarities and differences are intended to address.

This profile helps distinguish several purposes of replication. A close replication may test whether a result can be reproduced under procedures that approximate the original arrangement. A replication across institutions or populations may examine portability. A replication at a later historical moment may test temporal stability. A

conceptual replication may change operationalization while examining whether a proposed relation remains detectable. Each design answers a different question, and differences between original and replication conditions become part of the interpretation.

Replication therefore contributes to cumulative research through structured comparison rather than through a binary label of success or failure. A divergent result may indicate sampling variation, measurement differences, historical change, context dependence, implementation failure, or a weaker original claim than previously believed. The diagnostic approach developed in Section 6.30 remains applicable. Replication can place pressure on a claim while leaving open the level at which revision is warranted.

Transparent materials and reusable data, models, and protocols can lower the cost of replication (Nosek et al. 2015). Yet replication also requires judgment. Procedures may be copied faithfully while the relevant social or institutional relation has changed. Conversely, a modified procedure may preserve the underlying research relation more effectively than literal duplication. Relational replication therefore asks what fidelity means for the claim under examination.

6.31.8 Reinterpretation

Research can accumulate by returning to existing evidence with new concepts, methods, questions, or historical knowledge. Section 6.23 described evidence preservation as infrastructure for future re-epistemization. Reinterpretation is one process through which that future capacity is realized. Archived interviews can be read through categories that were unavailable to the original researchers. Historical administrative data can acquire new meaning after institutional reforms reveal previously hidden selection mechanisms. An old model can be reconsidered under a new understanding of scale or boundary.

Definition 6.534 (Research reinterpretation). *A research reinterpretation is a historically situated re-examination of preserved evidence, concepts, models, or records under a changed question, method, theoretical framework, or body of contextual knowledge, with the earlier interpretation retained as part of the research history.*

Retaining the earlier interpretation matters because reinterpretation is itself historically situated. A newer reading can provide greater explanatory power or evidential fit while remaining open to later revision. Preserving successive interpretations allows researchers to study how the epistemic object changed across time and what new evidence or conceptual resources made the change possible.

Reinterpretation also supports interdisciplinary cumulation. A legal archive may later be examined through economic or sociological questions; ecological data may acquire political significance; an educational dataset may support research on institutional inequality. Such transfers can be productive when the original collection relation and categories remain visible. They become risky when later analysts treat inherited variables as transparent representations of the concepts required by the new field.

The capacity for reinterpretation strengthens the value of rich provenance. Documentation that seemed peripheral during the original project may later become decisive. This creates a practical reason for preserving contextual information around consequential research objects when the expected future use is uncertain.

6.31.9 Cumulative Revision

Cumulation in a generative relational research programme is better represented as a versioned trajectory than as a stack of increasingly complete findings. Research histories include retained claims, modified definitions, abandoned models, recovered alternatives, changed evidence standards, and new questions produced by earlier failures. The cumulative element lies partly in the preservation of these transformations and in the capacity to learn from them.

Definition 6.535 (Cumulative research revision). A *cumulative research revision* is a traceable modification of a research object or claim that records what is retained, altered, withdrawn, newly introduced, or left unresolved relative to an earlier version.

Cumulative revision can operate at several scales. A local revision may change one parameter or measurement procedure. A conceptual revision may alter the definition of a central term. A methodological revision may replace an inferential strategy. A theoretical revision may reorganize relations among several concepts. A field-level revision may change standards of acceptable evidence. The version history should therefore identify the scale of change rather than treating each new publication as an undifferentiated addition.

This view allows research to accumulate through correction. A withdrawn claim can contribute to later knowledge if its evidential history remains reconstructable. A discarded method can remain useful as a record of why a particular approach failed under certain conditions. An abandoned concept can later reappear with a narrower scope. Cumulation therefore includes selective forgetting at the level of active practice while preserving enough historical memory for later recovery.

Proposition 6.536 (Traceable cumulation). *Within a research programme that expects continuing revision, cumulation is strengthened when consequential changes remain traceable to the evidence, assumptions, disagreements, or failures that motivated them.*

Proposition 6.536 states a design principle rather than a universal law of scientific development. Its practical implication is that version control, revision notes, provenance records, and linked evidence can be epistemic infrastructure. They help later researchers distinguish a changed conclusion from a silently changed question.

6.31.10 Research Commons

Open and cumulative research requires infrastructures through which epistemic objects can be shared, maintained, governed, and contested. Research commons provide one institutional vocabulary for these arrangements. Work on knowledge commons emphasizes that shared knowledge resources raise questions of access, enclosure, preservation, intellectual property, contribution, and governance that differ in important ways from natural-resource common-pool problems (Hess and Ostrom 2007). GRE can use this insight to treat openness as an institutional design problem rather than a simple release decision.

Definition 6.537 (Research commons). A *research commons* is a governed arrangement through which a community or network preserves, shares, maintains, and develops research resources under rules concerning access, contribution, attribution, stewardship, revision, and legitimate restriction.

Research commons can include data repositories, code archives, shared ontologies,

bibliographic infrastructures, community archives, open laboratory protocols, model libraries, preprint systems, or collectively maintained relational maps. Their governance can vary substantially. Some resources can be openly downloadable; others may use tiered access, trusted research environments, community permission, or stewardship committees. The relevant question is whether the governance arrangement sustains epistemic access while respecting the rights and vulnerabilities attached to the resource.

Commons also require maintenance. File formats decay, links disappear, software dependencies become obsolete, metadata standards change, and institutional funding ends. Preservation therefore involves labor and resource allocation. A repository that accepts deposits without maintaining interpretability may preserve bytes while losing epistemic usability. Sustainable research commons need stewardship capacities that include migration, curation, documentation, access management, and mechanisms for correcting records.

Attribution and contribution relations also matter. Open resources can depend on work that receives limited recognition: data cleaning, archival description, software maintenance, translation, community liaison, replication, and documentation. If cumulative research relies increasingly on reusable infrastructures, evaluation systems may need to recognize these forms of epistemic labor. This is especially relevant in AI-assisted research, where visible outputs can be produced rapidly while the maintenance of trustworthy underlying resources remains comparatively costly.

Research commons therefore connect epistemology to political economy. Questions of who funds infrastructure, who contributes labor, who governs access, who receives credit, and who can contest classification affect the future generativity of the research field. These issues will reappear later in the book's treatment of knowledge, value, and power.

6.31.11 Intergenerational Research Memory

The longest temporal horizon of cumulative research concerns intergenerational memory. Researchers inherit concepts, datasets, archives, methods, unresolved disputes, failures, and institutional practices from investigators separated from them by time, institution, or geography. The quality of that inheritance shapes which questions can be reopened and which historical trajectories remain visible. Intergenerational research memory is therefore more than storage. It is the preservation of sufficient structure for later investigators to recognize what an epistemic object was, how it was produced, and why earlier researchers considered it significant.

Definition 6.538 (Intergenerational research memory). *Intergenerational research memory* is the institutionally and materially sustained capacity of later researchers to recover consequential research objects, their provenance, interpretive histories, unresolved alternatives, and conditions of revision across extended temporal intervals.

This memory can preserve successful results and failures together. Section 6.30 argued that reconstructable failure records can carry future epistemic option value. The same principle applies more broadly. A dataset may become useful after a new method emerges. An apparently peripheral archival note may become important after a political or institutional transformation. A rejected interpretation may acquire new relevance after evidence unavailable to the earlier debate is discovered. Preser-

vation creates the possibility of such later encounters without determining which preserved object will become significant.

Here the relation between memory and contingency becomes especially important. Archives, repositories, model libraries, and historical records enlarge the encounter surface available to future researchers. A later investigator may encounter an overlooked anomaly, forgotten concept, failed experiment, or abandoned relation whose significance was invisible in the earlier period. Aesthetic judgment can participate in the recognition of such generative potential: a strange pattern, elegant relation, unexpected analogy, or unresolved tension may attract attention before its epistemic importance is established. The evidential work begins after this recognition. Inter-generational memory therefore supports contingency by preserving heterogeneous materials from which future inquiry can emerge.

AI systems may increase the searchable range of research memory by supporting retrieval, comparison, translation, and synthesis across large archives. They can also compress provenance when generated summaries detach claims from their original context or when changing model infrastructures make earlier outputs difficult to reconstruct. AI-assisted cumulative research consequently benefits from source recoverability, version information, and clear separation between preserved records and later machine-generated interpretations. The generative capacity of AI becomes more valuable when it remains coupled to inspectable historical materials.

Proposition 6.539 (Future epistemic option value). *Preserving a research object together with sufficient provenance can create future epistemic option value when later questions, methods, evidence, or historical conditions make possible an informative use that was unavailable or unanticipated at the time of preservation.*

Proposition 6.539 does not imply indiscriminate retention. Storage, curation, privacy protection, security, and stewardship have costs, and some materials may require destruction or restricted retention. The proposition identifies a reason to evaluate preservation prospectively: deletion can close future trajectories that current researchers are poorly positioned to foresee.

Open and cumulative research practice therefore links several commitments developed throughout Chapter 6. Inquiry is historically situated, methods and standards evolve, evidence remains partially incomplete, research is distributed across communities and infrastructures, theories are revisable objects, and failure can become knowledge when it remains reconstructable. Openness supports these commitments when research objects remain accessible under legitimate conditions, intelligible through provenance, and contestable through preserved alternatives. Cumulation supports them when later work can inherit prior achievements while also reconstructing their limits, revisions, and abandoned paths.

The resulting research programme remains bounded by practical and ethical limits. Documentation can become burdensome; infrastructures can fail; openness can expose vulnerable people or communities; preservation can reproduce classificatory harms; replication can be infeasible; and cumulative systems can privilege what is easiest to standardize. These limits require explicit treatment before Chapter 7 turns from research praxis to concrete methodology. Section 6.32 therefore examines the limits of research praxis itself.

6.32 Scope and Boundaries of Research Praxis

The preceding sections have described research praxis as relational, historically situated, methodologically plural, reflexive, increasingly distributed, and capable of cumulative revision. These capacities can expand what inquiry is able to encounter, represent, test, and preserve. They also operate within boundaries. This section identifies several such boundaries in order to clarify the conditions under which research claims remain proportionate to the practices that support them. The objective is neither to establish a general skepticism about inquiry nor to convert limitation into a virtue. It is to distinguish forms of partiality, dependence, and incompleteness that can persist even in careful research, and to show how these limits can become methodological design constraints. The discussion proceeds through partiality, interpretation, historical and institutional situatedness, computation, evidence, normativity, reflexivity, methodological integration, and the classification of praxis itself.

Definition 6.540 (Praxis limit). *A praxis limit is a boundary on what a research configuration can presently encounter, represent, infer, integrate, evaluate, or justify under its available relations, evidence, methods, institutions, computational resources, and historical conditions.*

Definition 6.540 is deliberately conditional. Some boundaries can be displaced when instruments improve, archives open, communities change, computational resources expand, or alternative methods become available. Other boundaries arise from more persistent features of inquiry, including finite attention, selective representation, dependence on interpretation, and the difficulty of occupying the full range of relevant standpoints within one research configuration. A useful account of limits therefore asks which boundary is being encountered, what produces it, whether it is movable, and what follows for the strength of the claim.

A limit can also be generative. A mismatch between what a project seeks to know and what its present configuration can support may redirect inquiry toward new evidence, collaborators, scales, or concepts. This possibility does not make the limit desirable in itself. It indicates that recognizing a boundary can become part of research orientation. The same aesthetic judgment that notices an anomaly or an unexpectedly fertile relation can sometimes notice the shape of a research programme's own insufficiency. Epistemic work then begins by determining whether that impression identifies a durable boundary, a temporary obstacle, or a weakness in the current representation.

6.32.1 Irreducible Partiality

Research proceeds through selection. Investigators choose objects, scales, variables, archives, participants, time intervals, languages, methods, and forms of representation. These selections can be justified and revised, yet they also produce a perspective from which some relations become comparatively visible while others remain peripheral. Section 6.8 located the researcher within a relational field; the present subsection draws a consequence from that location. A research configuration can achieve substantial knowledge without exhausting the relations through which its object exists.

Proposition 6.541 (Situated partiality). *For research on relational and historically evolving objects, the warrant of a claim is strengthened when the claim identifies the di-*

mensions, scales, populations, temporal ranges, and evidential relations through which the object has been accessed, while leaving open dimensions that the research configuration did not adequately examine.

Proposition 6.541 treats partiality as a condition to be described rather than a defect to be concealed. A national dataset may support strong claims about measured distributions while providing limited access to meanings produced within particular communities. An ethnographic study may reveal fine-grained relational mechanisms while leaving population prevalence uncertain. A formal model may clarify possible dynamics while remaining agnostic about whether its state variables correspond closely to an empirical system. The relevant limitation differs across these cases.

Partiality also occurs across scale. A relation that appears stable within an organization can depend on wider legal, infrastructural, ecological, or geopolitical arrangements. Conversely, a macro-level regularity can obscure local heterogeneity that becomes causally important under changing conditions. Multi-scale analysis can reduce some blind spots, although adding scales also increases demands on evidence and interpretation. The aspiration to include more relations can therefore encounter diminishing epistemic returns when integration becomes too weak to support the additional complexity.

This perspective cautions against equating partial knowledge with arbitrary knowledge. A telescope provides a partial view of the sky while still enabling highly warranted observations. A bounded archive can support reliable historical claims about the documents it contains while leaving questions about absent voices unresolved. Partiality concerns the relation between a claim and its accessible field. Its methodological implication is scope discipline: conclusions should travel only as far as their evidential and representational relations plausibly permit.

6.32.2 Interpretive Dependence

Research evidence becomes informative through concepts, categories, background assumptions, and interpretive practices. Contextual empiricism emphasizes that evidential relevance can depend on background assumptions and that critical interaction among perspectives contributes to the assessment of those assumptions (Longino 1990). Within the framework developed in this chapter, interpretive dependence appears whenever an observation has to be classified, translated, compared, or connected to a claim.

A recorded interview, for example, does not arrive with a uniquely determined analytical category. A statistical coefficient acquires substantive meaning through choices about operationalization, model structure, population, and causal interpretation. A legal document can be read as doctrine, institutional artifact, historical record, or evidence of a power relation. Each reading can be disciplined by evidence while still depending on an interpretive frame.

Definition 6.542 (Interpretive dependence). *Interpretive dependence* is the dependence of an evidential or theoretical conclusion on concepts, classifications, background assumptions, or meaning-making practices that mediate the relation between encountered material and the claim drawn from it.

Interpretive dependence introduces at least two limits. First, some assumptions can remain tacit until disagreement, failure, or translation makes them visible. Second, alternative interpretations can sometimes remain compatible with the same

available evidence. Section 6.18 treated translation as an operation with a remainder; interpretive dependence is one reason that remainder can matter. Moving from testimony to coded category, from institutional rule to variable, or from historical description to model parameter can preserve analytically useful structure while losing other relations.

The response is not to suspend interpretation. Research without interpretation would have difficulty connecting observations to questions. A more workable response is to make consequential interpretive choices contestable. Researchers can preserve primary materials where legitimate, state classification rules, compare plausible readings, invite criticism from differently positioned participants, and identify conclusions that depend strongly on one interpretive choice. Such practices can narrow uncertainty without claiming to eliminate mediation.

Interpretive plurality can also become excessive if alternative readings are treated as equally informative without further comparison. Evidence, coherence, domain knowledge, predictive performance, explanatory reach, and critical scrutiny can change the relative standing of interpretations. Humility therefore coexists with discrimination. The existence of interpretive dependence supports careful comparison rather than an inference that interpretation is unconstrained.

6.32.3 Historical Situatedness

Research questions, methods, categories, and standards of significance develop within historical trajectories. Kuhn's account of normal science and scientific change remains one influential description of how problem selection can be organized by historically specific disciplinary commitments (Kuhn 1962). Sections 6.21 and 6.22 extended this concern to the evolution of methods and evaluation. Historical situatedness places a limit on the ease with which present categories can be projected backward or present findings projected forward.

An economic category may acquire meaning within a particular institutional order. A diagnostic category can change with clinical practice and classification systems. Administrative data can preserve distinctions created for a previous policy regime. A model calibrated during one technological period may lose relevance after infrastructures or behavior change. These examples differ in substance, yet they share a temporal problem: the relations that make a category or regularity intelligible can themselves evolve.

Caution 6.543 (Temporal transport). A claim supported within one historical configuration should be transported across periods with attention to changes in institutions, categories, technologies, populations, meanings, and measurement relations that could alter the object under study.

Historical situatedness can also affect what researchers are able to recognize. Later investigators sometimes possess conceptual resources that make an earlier pattern visible in a new way. Earlier researchers may preserve distinctions that later standardization has erased. Section 6.31 therefore treated intergenerational research memory as infrastructure for reinterpretation. The limit here is reciprocal: present researchers can recover earlier materials, yet their reconstruction is also performed from a later historical position.

This reciprocity encourages versioned knowledge. Rather than asking whether a category or theory is simply timeless or obsolete, researchers can examine the pe-

riod in which it was generative, the relations it represented successfully, the transformations that weakened its fit, and the residual questions it leaves available for later inquiry. Historical reconstruction can then support transport without presuming invariance.

6.32.4 Institutional Dependence

Research requires infrastructures. Funding, laboratories, universities, archives, journals, legal permissions, data platforms, professional associations, ethics review, computing systems, and employment relations can affect which inquiries are feasible and which results become visible. Institutional dependence therefore concerns more than administrative context. It can shape access, time horizons, categories, incentives, standards of credibility, and the distribution of epistemic authority.

Bourdieu and Wacquant's reflexive sociology provides one established vocabulary for examining how fields, positions, and forms of capital enter intellectual practice (Bourdieu and Wacquant 1992). The relational approach taken here is compatible with the narrower proposition that research positions can influence access and orientation without mechanically determining the truth or falsity of a resulting claim. Section 6.25 similarly separated epistemic justice from evidential warrant while showing that power can affect whose observations receive uptake.

Institutional dependence can create several types of limit. Proprietary datasets can make external scrutiny difficult. Short funding cycles can discourage research whose evidential horizon is long. Publication incentives can favor visible positive findings over less dramatic negative results, as discussed in Section 6.30. Language regimes can make some communities easier to cite than others. Security or privacy rules can legitimately restrict access while also limiting independent verification. Research employment can place practical constraints on which questions an investigator is able to pursue.

Proposition 6.544 (Institutional condition of inquiry). *When institutional arrangements materially affect research access, incentives, preservation, contestability, or interpretive authority, those arrangements form part of the conditions under which the resulting knowledge claims are produced and evaluated.*

Proposition 6.544 does not imply that institutional origin settles epistemic standing. A privately funded result can be well supported; a publicly funded result can be weak. The proposition instead identifies institutional relations that may become relevant to assessment. Disclosure, independent replication, plural funding sources, community governance, open materials, or protected access arrangements can sometimes reduce particular dependencies. Other dependencies remain because sustained research requires organized resources of some kind.

The methodological challenge is therefore to distinguish dependence from capture. Dependence is widespread wherever inquiry requires infrastructure. Capture is a stronger diagnosis involving a relation in which institutional interests substantially constrain questions, evidence, interpretation, or dissemination in ways that undermine the relevant epistemic or ethical standards. That distinction should be established through evidence rather than presumed from organizational affiliation.

6.32.5 Computational Limits

Computational capacity expands the range of models, simulations, searches, comparisons, and AI-assisted operations available to research. It also has boundaries. Turing's formalization of effective computation established that well-defined mathematical decision problems can exist for which a general mechanical procedure is unavailable (Turing 1937). Many practical research limits arise at less fundamental levels: tractability, memory, data quality, algorithmic approximation, model size, energy, latency, and human capacity to inspect computational outputs.

These levels should be distinguished. A problem can be computable in principle while remaining impractical at the required scale. A tractable algorithm can operate on data that poorly represent the relevant relation. A powerful predictive system can remain difficult to interpret for the purpose at hand. An AI system can rapidly generate candidate explanations while leaving source verification or normative judgment unresolved. Section 6.27 therefore treated computational abundance as capable of relocating scarcity toward orientation, judgment, verification, and responsibility.

Definition 6.545 (Computational research limit). A *computational research limit* is a boundary arising from formal computability, practical tractability, resource requirements, data representation, model architecture, or the capacity to validate and interpret computational operations within the relevant research task.

This definition prevents several different problems from being collapsed into one claim that a task is “too complex.” If the main limitation is runtime, approximation may be appropriate. If the limitation lies in representation, more computation can amplify the wrong abstraction. If the limitation lies in validation, a larger model can increase the volume of outputs faster than the research community can evaluate them. If the limitation is formal, engineering effort may not remove it within the stated problem class.

Computational limits also have institutional dimensions. Access to advanced computing, proprietary models, specialized datasets, and technical expertise is uneven. Consequently, the practical frontier of computable research differs across laboratories, countries, organizations, and historical periods. A method that appears reproducible in principle may be difficult to reproduce under materially different infrastructure. Reporting computational dependencies therefore contributes to the scope discipline developed throughout this chapter.

6.32.6 Evidential Limits

Evidence is frequently incomplete, selective, noisy, historically damaged, or produced through measurement relations that require interpretation. Section 6.24 developed research under incomplete evidence; the present subsection concerns a broader limit on inferential closure. Quine's holistic account of confirmation emphasized that statements confront experience within wider webs of belief (Quine 1951), while contemporary discussions of underdetermination distinguish several ways in which available evidence can leave more than one theoretical response open (Stanford 2023).

Within a generative relational framework, evidential limits can arise because the object itself changes while it is being studied, because relevant relations leave weak traces, because records were produced for purposes different from the research question, or because causal pathways are only partially observable. Evidence can also be

abundant while remaining narrow: millions of transactions may describe behavior within a platform while offering limited information about activity excluded from that platform.

A useful response is graded warrant. Claims can be differentiated by the strength, diversity, independence, and relevance of the evidence supporting them. Convergent evidence from different methods can increase confidence when the methods have sufficiently independent failure modes. Contradictory evidence can indicate heterogeneity, measurement problems, historical change, or a weakness in the proposed relation. Missing evidence should remain visible where its absence could materially alter the conclusion.

Caution 6.546 (Closure under incomplete evidence). Practical research closure can be appropriate before epistemic completion when the remaining uncertainty, missing evidence, and plausible alternatives are documented at a level proportionate to the consequence of the claim or decision.

Caution 6.546 restates the distinction between practical closure and epistemic completion developed in Section 6.24. It becomes especially important in applied and policy-relevant research, where postponing judgment can itself have consequences. The appropriate evidential threshold can vary with reversibility, stakes, available alternatives, and the cost of additional inquiry. The limitation is therefore not resolved by one universal threshold.

Preservation can mitigate some evidential limits over time. New methods can recover patterns from old data, newly opened archives can alter historical interpretation, and later observations can test earlier conjectures. Yet some evidence disappears irreversibly. Research design can consequently include preservation as a prospective response to uncertainty about which traces future inquiry may require.

6.32.7 Normative Limits

Research praxis often intersects with questions of justice, welfare, responsibility, legitimacy, harm, and desirable futures. Evidence can inform these questions by describing consequences, distributions, causal pathways, institutional histories, and feasible alternatives. It can also reveal that a normative proposal rests on mistaken empirical assumptions. Such contributions do not by themselves establish a uniquely warranted ranking among plural values.

Normative limits become visible when empirical findings are asked to carry evaluative conclusions for which additional premises are required. A finding that one policy increases aggregate income does not by itself settle the importance of distribution, rights, ecological effects, or procedural legitimacy. Evidence that an intervention is effective at achieving a specified objective does not establish that the objective should dominate competing aims. Conversely, normative commitments that ignore relevant empirical consequences can become practically fragile.

Definition 6.547 (Normative remainder). A *normative remainder* is the portion of an evaluative judgment that remains dependent on ethical, political, legal, aesthetic, or other value commitments after the relevant empirical and causal questions have been examined as far as the research configuration presently permits.

The normative remainder does not imply that evaluation is arbitrary. Reasons can be articulated, principles compared, affected parties consulted, legal commitments

interpreted, and consequences examined. The point is that empirical research and normative justification have partly distinct burdens. Section 6.26 distinguished aesthetic, epistemic, normative, and practical judgment for a similar reason: interaction among these forms of judgment is common, while substitution among them can obscure what supports a conclusion.

Normative limits also constrain research itself. Some evidence could be obtained only through practices that are ethically unacceptable. Some datasets should remain restricted because disclosure would expose vulnerable people. Some experimental interventions may create risks disproportionate to their expected epistemic value. These constraints reduce accessible evidence while expressing commitments that form part of responsible inquiry. The epistemic cost should be acknowledged rather than treated as if the inaccessible evidence did not exist.

6.32.8 Limits of Reflexivity

Reflexivity helps researchers examine how their positions, categories, instruments, incentives, and interventions participate in knowledge production. Section 6.20 treated reflexivity as a disciplined investigation of plausible pathways through which research can modify its field. Reflexivity itself remains situated. A researcher can identify some assumptions while remaining unaware of others; a team can criticize an institutional arrangement while sharing background commitments that make another arrangement difficult to imagine.

This creates a recursive problem. A reflexive account can itself become an object of reflexive examination. Further reflection may expose new assumptions, yet the process does not yield an obvious point at which the investigator can claim complete self-transparency. Bourdieu and Wacquant's reflexive programme is useful here precisely because reflexivity is directed toward the social conditions of intellectual practice rather than reduced to introspective sincerity (Bourdieu and Wacquant 1992).

Proposition 6.548 (Bounded reflexivity). *Reflexive inquiry can improve the visibility and contestability of consequential research conditions without requiring a claim that the researcher or research collective has made its own position fully transparent.*

Bounded reflexivity suggests several practical supports: diverse collaborators, external critique, participant feedback, audit trails, preregistered assumptions where appropriate, institutional disclosure, version histories, and deliberate comparison with alternative conceptual schemes. These practices create additional viewpoints from which hidden dependencies can become visible. They also carry costs and can generate new blind spots. A larger deliberative group may increase perspective diversity while creating coordination pressures that suppress minority interpretations.

Reflexivity therefore benefits from proportionality. Research on a consequential classification system may warrant extensive examination of researcher position and institutional incentives. A narrowly technical calibration may require less. Reflexivity becomes unproductive when it expands without a plausible relation to the warrant, ethics, or consequences of the research object. The relevant question is which reflexive pathway could materially alter interpretation or responsibility.

6.32.9 Limits of Methodological Integration

Methodological pluralism can expose relations that one method alone would miss. Sections 6.14–6.18 developed this argument through plural inquiry, mutual correction, and translation across representations. Integration nevertheless has limits. Formal, quantitative, historical, ethnographic, interpretive, legal, and computational methods can operate with different objects, standards of evidence, temporalities, and forms of abstraction. Their outputs may be mutually informative without becoming fully commensurable.

A temptation in interdisciplinary research is to seek one super-representation into which each method can be translated. Such a representation can be useful for a specific problem, yet the translation can remove precisely the feature that made one method informative. Turning a legal distinction into a binary variable can support statistical analysis while losing doctrinal ambiguity. Converting an ethnographic relation into a network edge can make structural comparison possible while compressing meaning and temporal sequence. Rendering historical change as model states can reveal dynamics while weakening the specificity of contested periodization.

Definition 6.549 (Integration remainder). An *integration remainder* is a consequential feature of a method, evidence form, or representation that is not adequately preserved when heterogeneous research outputs are combined within a common analytical structure.

Integration remainders suggest that synthesis can preserve interfaces rather than demand complete fusion. A study may place a formal model beside historical reconstruction and specify where they constrain one another. Quantitative results can define a population pattern while qualitative inquiry investigates mechanisms in selected cases. Legal analysis can establish institutional categories that become conditions in an economic model while retaining doctrinal uncertainties outside the model. These arrangements support coordination without claiming a single metric of validity.

Methodological conflict can also remain unresolved. Two well-executed approaches may generate interpretations that remain unreconciled because they rely on different boundaries, scales, or ontological commitments. Section 6.17 treated such disagreement as potentially diagnostic. The limit of integration is reached when additional translation would create more apparent unity than epistemic gain. Preserving the disagreement can then be more informative than forcing synthesis.

6.32.10 Limits of Praxis Classification

Chapter 6 has distinguished research-dominant and application-dominant praxis through their principal contradictions and orientations. This distinction organizes the transition between the present chapter and the application-oriented chapters that follow. It should also remain available for revision. Actual projects can combine inquiry, intervention, administration, care, advocacy, design, and institutional maintenance in configurations that change over time.

A field experiment, for example, may begin as research-dominant praxis and become application-dominant when participants depend on the intervention. A humanitarian programme may begin with urgent application and later generate a research infrastructure. A public-interest technology project may alternate rapidly be-

tween design, evidence gathering, deployment, monitoring, and political negotiation. Human–AI research collectives can further blur older institutional cues because generation, evaluation, and operational action can occur within the same technical workflow.

Caution 6.550 (Praxis classification). The categories of research-dominant and application-dominant praxis should be used as analytical orientations whose relevance is assessed from the configuration's current contradictions, responsibilities, and closure conditions, rather than inferred solely from the institution or occupation in which the activity occurs.

This caution preserves the analytical value of classification while acknowledging mixed and transitional cases. Classification can be revised when the principal contradiction changes. Some projects may also contain several sub-configurations with different orientations: a clinical trial can include research-dominant analysis, application-dominant patient care, regulatory evaluation, and infrastructure maintenance at the same time. The task is to identify which orientation governs the particular decision or relation under examination.

The classification also has normative consequences. Research-dominant praxis may tolerate extended uncertainty that application-dominant praxis may not permit to the same degree. Application can impose duties of care or reversibility that a purely epistemic description would understate. Conversely, urgency in application can create pressure to present provisional evidence as settled. Identifying the dominant praxis orientation helps specify which closure conditions and responsibilities are currently salient without pretending that one category exhausts the project.

The limits developed across this section therefore function as a map of methodological obligations. Partiality calls for scope discipline. Interpretive dependence calls for contestable classification and recoverable translation. Historical situatedness calls for temporal specification and versioned knowledge. Institutional dependence calls for attention to access, incentives, and authority. Computational limits call for distinctions among computability, tractability, representation, and validation. Evidential limits call for graded warrant and documented uncertainty. Normative limits call for explicit value premises and ethical constraints. Bounded reflexivity calls for proportionate examination of the researcher's own conditions. Integration limits call for preserved remainders and interfaces among methods. Praxis classification calls for revisable orientation rather than fixed institutional labels.

Taken together, these limits do not close the research programme. They help specify where methodological design begins. A methodology can be understood partly as an organized response to recurrent limits of praxis: a way of choosing observations, constructing representations, testing relations, preserving uncertainty, and making revision possible under finite conditions. The closing section of this chapter therefore turns from the general praxis of inquiry to the methodological commitments that prepare Chapter 7.

6.33 Research Methodology within GRE Praxis

The chapter has approached research through praxis before turning to methodology. This ordering matters because methods enter inquiry within a prior configuration of questions, relations, institutional conditions, evidential access, judgments, responsi-

bilities, and limits. The role of this closing section is deliberately limited: it translates the praxis-level commitments developed in Sections 6.1–6.32 into requirements that later methodology should satisfy. It does not specify procedures for identifying relations, reconstructing configurations, attributing generative effects, or assembling a complete research project. Those tasks belong to Chapters 7–9. The present section instead identifies what method choice, method combination, evidential reasoning, formalization, and later practical reuse remain answerable to when research is treated as historically situated and relational praxis.

A methodology can be understood here as an organized relation among a research question, a provisional object, a field of possible evidence, a set of operations for producing or interpreting evidence, standards of warrant, and procedures for revision. This formulation places technique inside a wider design problem. A survey, archival reconstruction, simulation, interview, network model, statistical estimator, ethnography, legal analysis, or AI-assisted workflow acquires methodological meaning through the role it performs within that relation.

Definition 6.551 (Methodological configuration). A *methodological configuration* is a revisable arrangement linking a research question, provisional research object, boundary and scale choices, evidence-generating or evidence-interpreting operations, inferential standards, ethical constraints, and procedures for comparison and revision.

Definition 6.551 provides a bridge between research praxis and the more concrete discussions that follow. It also preserves the chapter's emphasis on relationality. A method is rarely informative in isolation from the object it constructs, the evidence it can access, the transformations it performs, and the claims for which it is used.

6.33.1 Research Praxis and Research Design

Research design gives a practical form to an orientation of inquiry. The preceding chapter sections have shown that orientation can begin before evidence is complete and can be influenced by contingent encounter, salience, aesthetic judgment, institutional position, prior theory, available methods, and practical constraints. Research design converts that open orientation into a sufficiently structured configuration for inquiry to proceed.

This conversion should remain visible. A design does more than choose a sample or schedule a sequence of methods. It specifies what is being treated as the provisional object of inquiry, which relations enter the analytic field, which boundaries and scales are initially relevant, what kinds of evidence could alter the working interpretation, and which forms of uncertainty are expected to remain. In relational research, design therefore includes decisions about the architecture through which an object becomes investigable.

The chapter's distinction between research-dominant and application-dominant praxis also affects design. Research-dominant praxis can sometimes preserve uncertainty for longer periods because its principal activity is inquiry. Application-dominant praxis can impose earlier closure when decisions have to be made under finite time, responsibility, or resource conditions. Section 6.32 cautioned that these categories are orientations rather than institutional identities. Design should consequently respond to the current contradiction and responsibility structure of the project rather than infer its methodological form from whether the work takes place

in a university, government, company, community organization, or laboratory.

Proposition 6.552 (Praxis-conditioned design). *A research design is methodologically stronger when its boundaries, evidence strategy, revision procedures, and closure conditions are explicitly related to the dominant questions, responsibilities, and limits of the praxis configuration in which the inquiry occurs.*

Proposition 6.552 does not require a complete map of the research situation before inquiry begins. Such completeness would conflict with the partiality and iterative reconstruction developed earlier in the chapter. It asks instead for recoverable design reasoning. Researchers should be able to explain why a particular object, boundary, scale, evidence source, or sequence of operations was initially selected and what kinds of encounter could justify changing that selection.

This creates a place for contingency within design. A design can be disciplined without becoming closed to the unexpected. Section 6.10 treated encounter as a basic moment of inquiry, while Sections 6.11–6.13 distinguished salience, judgment, and orientation. Methodological design can preserve channels through which anomalous observations, new archives, participant interpretations, unexpected model behavior, or cross-disciplinary encounters can reorganize the inquiry. The design is therefore structured enough to produce comparable evidence and open enough to register when its own structure has become part of the problem.

6.33.2 Method Selection

Method selection follows from the research problem more plausibly than from allegiance to a methodological camp. Section 6.14 defended methodological pluralism by treating historical, interpretive, qualitative, quantitative, formal, computational, legal, and institutional approaches as partially irreducible modes of access. The implication for selection is that a method should be justified by the relation between its operations and the question it is expected to illuminate.

This requires attention to both capability and distortion. A method makes some relations comparatively accessible while rendering others indirect or invisible. Administrative data can provide extensive coverage while inheriting categories created for administrative purposes. Interviews can reveal meaning and situated interpretation while remaining selective with respect to participants and retrospective accounts. Formal models can expose structural consequences of explicit assumptions while depending on the adequacy of those assumptions. Network representations can reveal patterns of connectivity while omitting relations that are difficult to encode as edges. AI-assisted systems can increase search, synthesis, and generation while creating new burdens of provenance, verification, and responsibility.

Methodological adequacy is therefore target-relative. The same method can be highly informative for one question and weak for another. The relevant question is not whether a method is advanced, fashionable, computationally powerful, or traditionally authoritative. It is whether its evidential and representational operations are appropriate to the claim being pursued.

Definition 6.553 (Methodological adequacy). *Methodological adequacy is the degree to which a method's operations, assumptions, evidential access, and characteristic limitations are suitable for investigating the specified research object and supporting the intended class of claims.*

Methodological adequacy can change during research. A question initially framed as a problem of distribution may become a problem of classification after archival inquiry reveals that the categories have changed historically. A network model can become insufficient when fieldwork shows that apparently identical ties carry different institutional meanings. A qualitative interpretation may require quantitative comparison when the inquiry shifts from mechanism discovery toward prevalence. Method selection should therefore remain revisable in response to what the research process reveals.

This revisability also helps protect contingent encounter from being filtered out too early. A method can guide attention without exhausting the possible significance of what is encountered. When something appears important outside the method's representational vocabulary, the appropriate response may be to extend the method, add another method, revise the object, or preserve the encounter for later inquiry. Aesthetic judgment can initiate that redirection by recognizing an unusual relation or pattern; epistemic judgment then determines whether the resulting methodological change is warranted.

6.33.3 Method Combination

Method combination becomes useful when different methods provide access to different properties of the same research configuration or when one method can test assumptions that another method leaves weakly examined. Sections 6.16–6.19 developed this possibility through plural inquiry, mutual correction, translation, and iterative reconstruction. Combination is therefore more demanding than placing several methods beside one another.

A combined design should specify the relation among its components. One method may generate categories that another estimates at scale. Historical inquiry may define the temporal boundaries within which a statistical model is meaningful. Interviews may identify mechanisms later represented formally. A simulation may expose implications that return the researcher to an archive in search of previously unnoticed evidence. Legal analysis may identify institutional constraints that change the interpretation of observed behavior. These relations can be sequential, recursive, comparative, nested, or partially independent.

Proposition 6.554 (Relational method combination). *Method combination becomes epistemically informative when the contribution of each method, the translations among representations, and the points at which methods can confirm, challenge, or reframe one another are made sufficiently explicit for the combined inference to be reconstructed.*

This proposition preserves the idea of a translation remainder from Section 6.18. Moving from interview themes to variables, from archival categories to model states, or from legal concepts to network relations can create useful correspondences while leaving some meaning behind. A combined methodology should record consequential transformations rather than allow them to disappear inside a final integrated result.

Combination can also reveal disagreement that should remain unresolved. Section 6.17 treated disagreement among competent methods as potentially informative. Historical evidence and contemporary survey evidence may describe different periods rather than mutually falsifying accounts. A formal model and an ethnographic

reconstruction may disagree because the formal variables omit a locally decisive relation. Two datasets may diverge because their sampling infrastructures reach different populations. Integration is strongest when it can diagnose these differences rather than convert them prematurely into one number or narrative.

The practical consequence is selective combination. Adding methods can increase evidential coverage, but it also increases translation costs, interpretive complexity, resource demands, and opportunities for incoherence. The methodological question concerns which additional relation of evidence is worth constructing. A smaller configuration with clear mutual correction can be more informative than a broad collection of weakly connected methods.

6.33.4 Requirements Carried into Relational Inquiry

Relational inquiry requires standards suited to claims about relations, configurations, fields, and relational histories. Chapter 5 developed the epistemic side of this problem, including evidence for relational claims, uncertainty, higher-order relations, fields, identity, persistence, and attribution. Research praxis adds design requirements concerning how these standards are operationalized.

At a minimum, a relational claim should clarify what entities or provisional entities participate in the relation, what kind of relation is proposed, the scale and temporal interval at which it is asserted, the evidence through which the relation is accessed, and the uncertainty surrounding its identification. Depending on the question, further requirements may include direction, intensity, reciprocity, duration, dependence, symbolic mediation, institutional embedding, or relations among relations. Chapter 7 develops these dimensions in procedural detail.

The chapter's ontological suspension remains important here. A network edge, field coordinate, statistical dependence, legal relation, interview-reconstructed obligation, or historical connection can function as a representation of a relation without establishing that these representations share one ultimate ontology. Methodological standards should therefore distinguish representational usefulness from ontological commitment.

Claim 6.555 (Minimum relational specification). *Within the present framework, a relational claim should ordinarily identify its candidate relation, relevant participants or positions, boundary and scale, temporal scope, evidential route, and principal uncertainty at a level sufficient for later scrutiny and revision.*

The qualifier in Claim 6.555 is intentional. Some exploratory inquiries begin before several of these dimensions can be specified with confidence. The claim concerns reporting and warrant rather than the requirement that inquiry begin with a fully defined relational ontology. Exploratory research can discover the relevant relation through the inquiry itself, provided that later claims preserve the history of that reconstruction.

Relational standards also involve negative and absent relations. Failure to observe a connection can arise from genuine absence, limited access, poor measurement, inappropriate scale, or a representation that does not readily encode the relevant form of relation. Chapter 7 therefore treats missingness and relation uncertainty as methodological objects rather than residual nuisances. This continues the discipline developed in Section 6.30, where negative results were separated from failed research.

6.33.5 Requirement to Distinguish Relational and Generative Claims

Generative inquiry asks a stronger class of questions than relational identification alone. It concerns what relations, configurations, institutions, resources, or interventions contribute to the formation of subsequent capacities, relations, structures, values, constraints, or possibility spaces. Chapter 5 distinguished evidence that a relation exists from evidence that a relation contributes to a later generative effect. Methodology should preserve that distinction.

A generative claim therefore requires attention to sequence and transformation. Researchers need to specify the target of generation, the relevant temporal horizon, the proposed pathway or mechanism, plausible alternative explanations, and the evidence connecting earlier conditions to later changes. The generative effect can also be scale-dependent. A relation that expands one actor's capacity can constrain another actor or narrow a collective possibility space. Normative evaluation should consequently remain distinct from the descriptive claim that generation occurred.

Definition 6.556 (Generative methodological burden). The *generative methodological burden* is the additional evidential and interpretive work required to move from identifying a relation or configuration to supporting a claim about its contribution to later capacities, relations, structures, values, constraints, or possibilities across a specified temporal and relational scope.

This burden can be addressed through several forms of evidence: longitudinal observation, historical reconstruction, mechanism tracing, comparative analysis, intervention, simulation, formal analysis, repeated observation, and combinations of these approaches. The appropriate configuration depends on the target. A claim about institutional capacity formation can require a different evidence architecture from a claim about network diffusion, educational development, value conversion, or ecological regeneration.

Generative inquiry also benefits from preserving branch points and unrealized possibilities. A trajectory that produced one observed outcome may have passed through moments at which alternative relations could plausibly have generated different paths. Historical and counterfactual analysis can help identify such branching, while formal or computational models can clarify possible dynamics under explicit assumptions. These representations should remain proportionate to the available evidence. A simulated possibility is evidence about the implications of a model; it is not by itself evidence that the modeled pathway occurred historically.

The distinction between generation and desirability remains methodologically important. A process can be highly generative in the sense of producing new capacities or relations while also producing domination, exclusion, extraction, ecological damage, or unequal conversion power. Later GRE chapters therefore require descriptive generative inquiry to interface with normative and political-economic analysis rather than allowing the language of generation to carry an implicit positive valuation.

6.33.6 Formal and Empirical Methods within Research-Dominant Praxis

Formal and empirical methods can perform complementary roles within research-dominant praxis. Section 6.16 distinguished major modes of inquiry, while Sec-

tion 6.17 emphasized mutual correction. The transition to methodology requires a more operational statement of this relation.

Formal methods can clarify assumptions, derive implications, identify structural possibilities, expose internal inconsistency, compare dynamic regimes, or construct representations whose consequences are difficult to track verbally. Empirical methods can assess whether the relevant relations, distributions, mechanisms, or trajectories appear in observed settings and can challenge assumptions that seemed plausible inside a formal representation. Historical and interpretive methods can further identify whether formal variables preserve the meaning, sequence, and institutional specificity of the phenomena they are meant to represent.

The resulting relation is recursive. Formalization can suggest measurements. Measurement can reveal heterogeneity that requires a new formal distinction. Historical inquiry can show that a parameter or category changes meaning across periods. Field observation can reveal an omitted interaction. Simulation can expose a possible attractor that motivates a new empirical search. An unexpected empirical pattern can become a contingent encounter whose aesthetic or theoretical salience redirects formal work.

Remark 6.557 (Formal–empirical reciprocity). Formal and empirical methods can be organized as reciprocally revising instruments: formalization makes assumptions and implications comparatively explicit, while empirical and historical inquiry test the adequacy, scope, and interpretation of those representations.

This reciprocity should not be converted into a requirement that each project contain both formal and empirical components. Some questions are appropriately historical, interpretive, conceptual, legal, or theoretical. The relevant requirement is local adequacy. Where formal and empirical methods are combined, their interface should make clear which statements arise from assumptions, which arise from observed evidence, and which depend on the translation between them.

AI-assisted research adds another layer to this interface. AI systems can help generate formalizations, code, candidate models, literature syntheses, interpretations, or empirical patterns. Their contribution can accelerate recursive inquiry while increasing the importance of provenance and verification. The chapter's earlier conclusion remains applicable: greater generative capacity can relocate scarcity toward orientation, judgment, checking, and responsible closure. Methodology should therefore record where machine-mediated transformations materially enter the evidential chain.

6.33.7 Reuse of Methods within Application-Dominant Praxis

Methods developed for research-dominant praxis often travel into application. Statistical estimators become decision tools; simulations become planning instruments; ethnographic findings influence service design; network analysis informs intervention; legal interpretation structures compliance; AI systems classify cases or generate recommendations. Reuse creates continuity between research and application, but it also changes the conditions under which methodological adequacy should be evaluated.

An application places methods inside a decision relation. The method can affect access, allocation, treatment, exposure, classification, prioritization, or institutional response. This can raise requirements concerning timeliness, interpretability, robust-

ness, reversibility, distributive effects, contestability, and responsibility that were less central in the original research setting. A model that is useful for exploratory explanation may be insufficient for allocating high-stakes resources. An interpretive category developed for analysis may become harmful when operationalized as an administrative label. A historical association can be informative without supporting intervention.

Caution 6.558 (Method transfer across praxis). When a method moves from research-dominant into application-dominant praxis, its previous evidential performance should not be treated as sufficient evidence of practical adequacy. The decision context, affected relations, error consequences, reversibility, normative constraints, and available forms of contestation require renewed assessment.

Caution 6.558 follows from the chapter's broader account of praxis. Method transfer changes relations. It can alter who is affected, what counts as failure, how quickly revision can occur, and who bears the cost of error. The method itself may also become generative: classification can reorganize behavior, prediction can change institutional response, and intervention can create the evidence later used to evaluate the method.

This makes monitoring part of methodological reuse. Application can generate new evidence about the method under conditions that were absent from research. Unexpected outcomes can require recalibration, redesign, suspension, or return to research-dominant inquiry. The coupling between research and application developed in Section 6.6 therefore continues methodologically as a cycle of deployment, observation, interpretation, revision, and renewed judgment.

The distinction also protects against methodological prestige. A method does not become suitable for application merely because it is mathematically sophisticated, statistically accurate, historically respected, or generated by a powerful AI system. Practical adequacy depends on the relations through which the method acts and on the responsibilities attached to those relations.

6.33.8 Methodological Requirements Carried into Chapter 7

The boundary between research praxis and methodology can now be stated without pre-empting the methodology itself. Research praxis identifies conditions that later methods must respect: finite attention, situated access, contingent encounter, historically changing objects, institutional power, incomplete evidence, plural representations, distributed knowledge, machine mediation, cumulative memory, and persistent limits. The methodological chapters determine how those conditions are operationalized for particular kinds of inquiry.

Several requirements therefore carry forward into Chapter 7. A method should remain answerable to a specified question and provisional object; boundary and scale choices should be inspectable; evidential provenance and uncertainty should remain recoverable; translation among representations should preserve material remainders; method combinations should have stated epistemic roles; and revision should remain possible when new evidence changes the object or the adequacy of the method. These are requirements on methodology, not a procedure for relational inquiry.

A further requirement concerns claim levels. Evidence that a relation exists, evidence that a relation has a consequence, and evidence that a relation contributes to

a later generative change impose different burdens. Chapter 6 establishes the need to preserve those differences but leaves their methodological articulation to Chapters 7 and 8. The same boundary applies to formal and computational representations: their assumptions and inferential roles should be explicit, while the choice and evaluation of particular relational or generative representations belongs to the chapters that develop those methods directly.

Proposition 6.559 (Praxis-to-methodology transition). *Within the present framework, research praxis constrains methodology by requiring explicit relations among question, object, evidence, method, representation, warrant, responsibility, and revision; the concrete procedures that satisfy those requirements remain specific to the form of inquiry.*

The proposition preserves the role of encounter and judgment without turning them into methodological steps. A method can structure access while remaining revisable when an unanticipated relation, source, anomaly, or representational failure becomes consequential. Under conditions of abundant AI-assisted generation, this requirement becomes especially important because the availability of candidate explanations or formalizations does not establish their evidential relevance.

Chapter 7 begins at this boundary. It owns the concrete methodology of relational inquiry: specification of relational objects, boundaries and scales, evidential access, reconstruction, comparison, measurement, validation, ethics, and reporting. Chapter 8 owns the additional burdens of generative attribution. Chapter 9 owns project-level integration. Chapter 6 therefore closes with methodological answerability rather than a preliminary version of the procedures developed later in Part III.

References

- Althusser, Louis (2006). *For Marx*. Trans. by Ben Brewster. London: Verso.
- Anderson, P. W. (1972). "More Is Different: Broken Symmetry and the Nature of the Hierarchical Structure of Science". In: *Science* 177.4047, pp. 393–396. DOI: [10.1126/science.177.4047.393](https://doi.org/10.1126/science.177.4047.393).
- Aristotle (2014). *Nicomachean Ethics*. Trans. by C. D. C. Reeve. Indianapolis: Hackett Publishing Company.
- Battiston, Federico, Giulia Cencetti, Iacopo Iacopini, Vito Latora, Maxime Lucas, Alice Patania, Jean-Gabriel Young, and Giovanni Petri (2020). "Networks beyond Pairwise Interactions: Structure and Dynamics". In: *Physics Reports* 874, pp. 1–92. DOI: [10.1016/j.physrep.2020.05.004](https://doi.org/10.1016/j.physrep.2020.05.004).
- Bender, Emily M., Timnit Gebru, Angelina McMillan-Major, and Margaret Mitchell (2021). "On the Dangers of Stochastic Parrots: Can Language Models Be Too Big?" In: *Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency*, pp. 610–623. DOI: [10.1145/3442188.3445922](https://doi.org/10.1145/3442188.3445922).
- Benkler, Yochai (2002). "Coase's Penguin, or, Linux and The Nature of the Firm". In: *Yale Law Journal* 112.3, pp. 369–446. DOI: [10.2307/1562247](https://doi.org/10.2307/1562247).
- Bordalo, Pedro, Nicola Gennaioli, and Andrei Shleifer (2012). "Salience Theory of Choice Under Risk". In: *The Quarterly Journal of Economics* 127.3, pp. 1243–1285. DOI: [10.1093/qje/qjs018](https://doi.org/10.1093/qje/qjs018).
- Bourdieu, Pierre (1977). *Outline of a Theory of Practice*. Trans. by Richard Nice. Cambridge: Cambridge University Press. DOI: [10.1017/CB09780511812507](https://doi.org/10.1017/CB09780511812507).

- Bourdieu, Pierre (1984). *Distinction: A Social Critique of the Judgement of Taste*. Trans. by Richard Nice. Cambridge, MA: Harvard University Press.
- (1991). *Language and Symbolic Power*. Ed. by John B. Thompson. Cambridge, MA: Harvard University Press.
- Bourdieu, Pierre and Loïc J. D. Wacquant (1992). *An Invitation to Reflexive Sociology*. Chicago: University of Chicago Press.
- Burrell, Jenna (2016). “How the Machine ‘Thinks’: Understanding Opacity in Machine Learning Algorithms”. In: *Big Data & Society* 3.1. DOI: [10 . 1177 / 2053951715622512](https://doi.org/10.1177/2053951715622512).
- David, Paul A. (1985). “Clio and the Economics of QWERTY”. In: *American Economic Review* 75.2, pp. 332–337.
- Desrosières, Alain (1998). *The Politics of Large Numbers: A History of Statistical Reasoning*. Trans. by Camille Naish. Cambridge, MA: Harvard University Press.
- Dewey, John (1910). *How We Think*. Boston: D. C. Heath & Company.
- (1922). *Human Nature and Conduct: An Introduction to Social Psychology*. New York: Henry Holt and Company.
- (1925). *Experience and Nature*. Chicago: Open Court Publishing Company.
- (1934). *Art as Experience*. New York: Minton, Balch & Company.
- (1939). *Theory of Valuation*. Chicago: University of Chicago Press.
- Duhem, Pierre (1954). *The Aim and Structure of Physical Theory*. Trans. by Philip P. Wiener. Princeton, NJ: Princeton University Press.
- Einav, Liran and Jonathan Levin (2014). “Economics in the Age of Big Data”. In: *Science* 346.6210, p. 1243089. DOI: [10 . 1126/science.1243089](https://doi.org/10.1126/science.1243089).
- Epstein, Joshua M. and Robert Axtell (1996). *Growing Artificial Societies: Social Science from the Bottom Up*. Cambridge, MA: MIT Press. ISBN: 9780262050531.
- Espeland, Wendy Nelson and Michael Sauder (2007). “Rankings and Reactivity: How Public Measures Recreate Social Worlds”. In: *American Journal of Sociology* 113.1, pp. 1–40. DOI: [10 . 1086/517897](https://doi.org/10.1086/517897).
- Espeland, Wendy Nelson and Mitchell L. Stevens (1998). “Commensuration as a Social Process”. In: *Annual Review of Sociology* 24, pp. 313–343. DOI: [10 . 1146/annurev . soc.24.1.313](https://doi.org/10.1146/annurev.soc.24.1.313).
- Fanelli, Daniele (2012). “Negative Results Are Disappearing from Most Disciplines and Countries”. In: *Scientometrics* 90.3, pp. 891–904. DOI: [10 . 1007/s11192-011-0494-7](https://doi.org/10.1007/s11192-011-0494-7).
- Foucault, Michel (1982). “The Subject and Power”. In: *Critical Inquiry* 8.4, pp. 777–795. DOI: [10 . 1086/448181](https://doi.org/10.1086/448181).
- Fraassen, Bas C. van (1980). *The Scientific Image*. Oxford: Oxford University Press. DOI: [10 . 1093/0198244274.001.0001](https://doi.org/10.1093/0198244274.001.0001).
- Franco, Annie, Neil Malhotra, and Gabor Simonovits (2014). “Publication Bias in the Social Sciences: Unlocking the File Drawer”. In: *Science* 345.6203, pp. 1502–1505. DOI: [10 . 1126/science.1255484](https://doi.org/10.1126/science.1255484).
- Frickel, Scott, Sahra Gibbon, Jeff Howard, Joanna Kempner, Gwen Ottinger, and David J. Hess (2010). “Undone Science: Charting Social Movement and Civil Society Challenges to Research Agenda Setting”. In: *Science, Technology, & Human Values* 35.4, pp. 444–473. DOI: [10 . 1177/0162243909345836](https://doi.org/10.1177/0162243909345836).
- Fricker, Miranda (2007). *Epistemic Injustice: Power and the Ethics of Knowing*. Oxford: Oxford University Press. DOI: [10 . 1093/acprof:oso/9780198237907.001.0001](https://doi.org/10.1093/acprof:oso/9780198237907.001.0001).

- Frischmann, Brett M. (2012). *Infrastructure: The Social Value of Shared Resources*. New York: Oxford University Press. DOI: [10.1093/acprof:oso/9780199895656.001.0001](https://doi.org/10.1093/acprof:oso/9780199895656.001.0001).
- Gadamer, Hans-Georg (2004). *Truth and Method*. Trans. by Joel Weinsheimer and Donald G. Marshall. 2nd ed. London: Continuum.
- Gangl, Markus (2010). “Causal Inference in Sociological Research”. In: *Annual Review of Sociology* 36, pp. 21–47. DOI: [10.1146/annurev.soc.012809.102702](https://doi.org/10.1146/annurev.soc.012809.102702).
- Gebru, Timnit, Jamie Morgenstern, Briana Vecchione, Jennifer Wortman Vaughan, Hanna Wallach, Hal Daumé III, and Kate Crawford (2021). “Datasheets for Datasets”. In: *Communications of the ACM* 64.12, pp. 86–92. DOI: [10.1145/3458723](https://doi.org/10.1145/3458723).
- Georgescu-Roegen, Nicholas (1971). *The Entropy Law and the Economic Process*. Cambridge, MA: Harvard University Press.
- Getzels, Jacob W. and Mihaly Csikszentmihalyi (1976). *The Creative Vision: A Longitudinal Study of Problem Finding in Art*. New York: John Wiley & Sons.
- Giddens, Anthony (1984). *The Constitution of Society: Outline of the Theory of Structuration*. Cambridge: Polity Press.
- Giere, Ronald N. (2004). “How Models Are Used to Represent Reality”. In: *Philosophy of Science* 71.5, pp. 742–752. DOI: [10.1086/425063](https://doi.org/10.1086/425063).
- (2006). *Scientific Perspectivism*. Chicago: University of Chicago Press. DOI: [10.7208/chicago/9780226292144.001.0001](https://doi.org/10.7208/chicago/9780226292144.001.0001).
- Gramsci, Antonio (2007). *Prison Notebooks*. Ed. and trans. by Joseph A. Buttigieg. Vol. 3. New York: Columbia University Press.
- Habermas, Jürgen (1971). *Knowledge and Human Interests*. Trans. by Jeremy J. Shapiro. Boston: Beacon Press.
- Hacking, Ian (2002). *Historical Ontology*. Cambridge, MA: Harvard University Press.
- Hansmann, Henry and Reinier Kraakman (2000). “The Essential Role of Organizational Law”. In: *The Yale Law Journal* 110.3, pp. 387–440.
- Hart, H. L. A. (2012). *The Concept of Law*. Ed. by Joseph Raz, Penelope A. Bulloch, and Leslie Green. 3rd ed. Oxford: Oxford University Press.
- Hess, Charlotte and Elinor Ostrom, eds. (2007). *Understanding Knowledge as a Commons: From Theory to Practice*. Cambridge, MA: MIT Press. ISBN: 9780262083577.
- Holme, Petter and Jari Saramäki (2012). “Temporal Networks”. In: *Physics Reports* 519.3, pp. 97–125. DOI: [10.1016/j.physrep.2012.03.001](https://doi.org/10.1016/j.physrep.2012.03.001).
- Husserl, Edmund (2012). *Ideas: General Introduction to Pure Phenomenology*. Trans. by W. R. Boyce Gibson. London: Routledge.
- Hutchins, Edwin (1995). *Cognition in the Wild*. Cambridge, MA: MIT Press. ISBN: 9780262082310.
- IFRS Foundation (2018). *Conceptual Framework for Financial Reporting*. London: IFRS Foundation.
- James, William (1890). *The Principles of Psychology*. 2 vols. New York: Henry Holt and Company.
- Kant, Immanuel (1987). *Critique of Judgment*. Trans. by Werner S. Pluhar. Indianapolis, IN: Hackett Publishing Company.
- Kivelä, Mikko, Alex Arenas, Marc Barthélemy, James P. Gleeson, Yamir Moreno, and Mason A. Porter (2014). “Multilayer Networks”. In: *Journal of Complex Networks* 2.3, pp. 203–271. DOI: [10.1093/comnet/cnu016](https://doi.org/10.1093/comnet/cnu016).
- Kroll, Joshua A., Joanna Huey, Solon Barocas, Edward W. Felten, Joel R. Reidenberg, David G. Robinson, and Harlan Yu (2017). “Accountable Algorithms”. In: *University of Pennsylvania Law Review* 165.3, pp. 633–705.

- Kuhn, Thomas S. (1962). *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press.
- Longino, Helen E. (1990). *Science as Social Knowledge: Values and Objectivity in Scientific Inquiry*. Princeton, NJ: Princeton University Press.
- MacKenzie, Donald (2006). *An Engine, Not a Camera: How Financial Models Shape Markets*. MIT Press. ISBN: 9780262134606.
- Manski, Charles F. (2008). *Identification for Prediction and Decision*. Cambridge, MA: Harvard University Press. ISBN: 9780674026537.
- Mao, Tse-tung (1967). *Selected Works of Mao Tse-tung, Volume I*. Includes “On Contradiction” (August 1937). Peking: Foreign Languages Press.
- Marx, Karl (1859). *Zur Kritik der politischen Ökonomie*. Berlin: Franz Duncker.
- (1994). *Marx: Selected Writings*. Ed. by Lawrence H. Simon. Indianapolis: Hackett Publishing Company.
- Marx, Karl and Friedrich Engels (1970). *The German Ideology*. Ed. by C. J. Arthur. New York: International Publishers.
- McAllister, James W. (1996). *Beauty and Revolution in Science*. Ithaca, NY: Cornell University Press.
- Merleau-Ponty, Maurice (2012). *Phenomenology of Perception*. Trans. by Donald A. Landes. Abingdon, Oxon: Routledge.
- Murmann, Johann Peter (2003). *Knowledge and Competitive Advantage: The Coevolution of Firms, Technology, and National Institutions*. Cambridge: Cambridge University Press. DOI: [10.1017/CB09780511510953](https://doi.org/10.1017/CB09780511510953).
- Nelson, Richard R. (1994). “The Co-evolution of Technology, Industrial Structure, and Supporting Institutions”. In: *Industrial and Corporate Change* 3.1, pp. 47–63. DOI: [10.1093/icc/3.1.47](https://doi.org/10.1093/icc/3.1.47).
- Newman, M. E. J. (2003). “The Structure and Function of Complex Networks”. In: *SIAM Review* 45.2, pp. 167–256. DOI: [10.1137/S003614450342480](https://doi.org/10.1137/S003614450342480).
- North, Douglass C. (1990). *Institutions, Institutional Change and Economic Performance*. Cambridge: Cambridge University Press.
- Nosek, Brian A., George Alter, George C. Banks, et al. (2015). “Promoting an Open Research Culture”. In: *Science* 348.6242, pp. 1422–1425. DOI: [10.1126/science.aab2374](https://doi.org/10.1126/science.aab2374).
- Noy, Shakked and Whitney Zhang (2023). “Experimental Evidence on the Productivity Effects of Generative Artificial Intelligence”. In: *Science* 381.6654, pp. 187–192. DOI: [10.1126/science.adh2586](https://doi.org/10.1126/science.adh2586).
- Open Science Collaboration (2015). “Estimating the Reproducibility of Psychological Science”. In: *Science* 349.6251, aac4716. DOI: [10.1126/science.aac4716](https://doi.org/10.1126/science.aac4716).
- Ostrom, Elinor (1990). *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge: Cambridge University Press. DOI: [10.1017/CB09780511807763](https://doi.org/10.1017/CB09780511807763).
- (2005). *Understanding Institutional Diversity*. Princeton, NJ: Princeton University Press. DOI: [10.2307/j.ctt7s7wm](https://doi.org/10.2307/j.ctt7s7wm).
- (2010). “Beyond Markets and States: Polycentric Governance of Complex Economic Systems”. In: *American Economic Review* 100.3, pp. 641–672. DOI: [10.1257/aer.100.3.641](https://doi.org/10.1257/aer.100.3.641).
- Peirce, Charles S. (1877). “The Fixation of Belief”. In: *Popular Science Monthly* 12, pp. 1–15.
- Pierson, Paul (2000). “Increasing Returns, Path Dependence, and the Study of Politics”. In: *American Political Science Review* 94.2, pp. 251–267. DOI: [10.2307/2586011](https://doi.org/10.2307/2586011).

- Popper, Karl R. (2002). *The Logic of Scientific Discovery*. 2nd ed. London: Routledge.
- Porter, Theodore M. (1995). *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life*. Princeton, NJ: Princeton University Press.
- Quine, W. V. (1948). "On What There Is". In: *The Review of Metaphysics* 2.5, pp. 21–38.
- (1951). "Two Dogmas of Empiricism". In: *The Philosophical Review* 60.1, pp. 20–43. DOI: [10.2307/2181906](https://doi.org/10.2307/2181906).
- Rawls, John (1999). *A Theory of Justice*. Revised. Cambridge, MA: Harvard University Press.
- Ricoeur, Paul (1991). *From Text to Action: Essays in Hermeneutics, II*. Trans. by Kathleen Blamey and John B. Thompson. Evanston, IL: Northwestern University Press.
- Sen, Amartya (1987). *On Ethics and Economics*. Oxford: Basil Blackwell.
- (1999). *Development as Freedom*. Oxford: Oxford University Press.
- Sewell William H., Jr. (1992). "A Theory of Structure: Duality, Agency, and Transformation". In: *American Journal of Sociology* 98.1, pp. 1–29. DOI: [10.1086/229967](https://doi.org/10.1086/229967).
- (1996). "Historical Events as Transformations of Structures: Inventing Revolution at the Bastille". In: *Theory and Society* 25.6, pp. 841–881. DOI: [10.1007/BF00159818](https://doi.org/10.1007/BF00159818).
- Simon, Herbert A. (1971). "Designing Organizations for an Information-Rich World". In: *Computers, Communications, and the Public Interest*. Ed. by Martin Greenberger. Baltimore, MD: Johns Hopkins Press, pp. 37–72.
- Stanford, Kyle (2023). *Underdetermination of Scientific Theory*. Stanford Encyclopedia of Philosophy, substantive revision 4 April 2023. URL: <https://plato.stanford.edu/entries/scientific-underdetermination/>.
- Stanford Institute for Human-Centered Artificial Intelligence (2026). *AI Index Report 2026*. Stanford, CA: Stanford University. URL: <https://hai.stanford.edu/ai-index/2026-ai-index-report>.
- Tesfatsion, Leigh (2006). "Agent-Based Computational Economics: A Constructive Approach to Economic Theory". In: *Handbook of Computational Economics, Volume 2: Agent-Based Computational Economics*. Ed. by Leigh Tesfatsion and Kenneth L. Judd. Amsterdam: North-Holland, pp. 831–880.
- Turing, A. M. (1937). "On Computable Numbers, with an Application to the Entscheidungsproblem". In: *Proceedings of the London Mathematical Society* s2-42.1, pp. 230–265. DOI: [10.1112/plms/s2-42.1.230](https://doi.org/10.1112/plms/s2-42.1.230).
- UNESCO (Nov. 23, 2021). *Recommendation on Open Science*. Paris: United Nations Educational, Scientific and Cultural Organization. URL: <https://www.unesco.org/en/legal-affairs/recommendation-open-science>.
- Veblen, Thorstein (1914). *The Instinct of Workmanship and the State of the Industrial Arts*. New York: The Macmillan Company.
- Wilkinson, Mark D., Michel Dumontier, IJsbrand Jan Aalbersberg, et al. (2016). "The FAIR Guiding Principles for Scientific Data Management and Stewardship". In: *Scientific Data* 3, p. 160018. DOI: [10.1038/sdata.2016.18](https://doi.org/10.1038/sdata.2016.18).
- Winsberg, Eric (2010). *Science in the Age of Computer Simulation*. Chicago: University of Chicago Press.
- Wittgenstein, Ludwig (2009). *Philosophical Investigations*. Ed. by P. M. S. Hacker and Joachim Schulte. 4th ed. Chichester: Wiley-Blackwell.
- Woodward, James (2003). *Making Things Happen: A Theory of Causal Explanation*. New York: Oxford University Press. ISBN: 9780195155273. DOI: [10.1093/0195155270.001.0001](https://doi.org/10.1093/0195155270.001.0001).

Chapter 7

Methodologies of Relational Inquiry

This chapter develops the methodological architecture of relational inquiry within Generative Relational Theory (GR) and Generative Relational Economics (GRE). Its role within Part III is to translate the ontological, epistemological, and praxis-level commitments developed in Chapters 4–6 into concrete disciplines for specifying, observing, reconstructing, comparing, measuring, validating, and reporting relations. Chapter 6 treated research as historically situated praxis involving judgment, institutional position, methodological plurality, contingent encounter, revision, and responsibility. The present chapter moves one level closer to research design. It asks what a researcher has to specify before a relational claim can become methodologically accountable, what different forms of evidence can support, how heterogeneous methodological traditions can correct one another, and where relational inquiry reaches the evidential threshold beyond which generative attribution requires a different methodological layer.

The chapter therefore treats methodology as a revisable architecture of epistemic access rather than as a menu of techniques. The ontological distinctions of Chapter 4 remain operative throughout. Analytical entities, relations, fields, institutions, network nodes, latent positions, spatial regions, and higher-order structures can be useful research objects without being elevated into final ontological commitments. The epistemology of Chapter 5 remains equally active: manifestations and representations provide mediated access to relational reality; similar manifestations can remain compatible with different relational configurations; observation is partial and positioned; boundaries and scales affect what becomes visible; and stronger claims require explicit inferential bridges. Chapter 6 adds the praxis constraint that method selection, interpretation, data production, preservation, AI assistance, and reporting occur within historically and institutionally situated relations. In condensed form, ontology constrains reification, epistemology constrains over-inference, and research praxis constrains decontextualized technique.

These constraints support a methodologically plural chapter. Historical, interpretive, qualitative, quantitative, empirical, formal, computational, network, spatial, temporal, legal, institutional, and field-based approaches can each provide distinctive forms of access to relational phenomena. Their differences are analytically conse-

quential. Documentary evidence can preserve institutional traces while inheriting administrative categories; ethnography can disclose tacit practice while remaining bounded by field access; interviews can reconstruct experience and meaning while being shaped by memory and elicitation; legal analysis can establish formal positions while leaving practical enactment open; network analysis can reveal structural organization while depending on node and edge construction; statistical models can quantify dependence while leaving substantive meaning underdetermined. The chapter therefore evaluates methods by the epistemic work they perform in relation to a specified research question rather than by a general hierarchy among traditions.

The first methodological commitment is question-prior design. A research method becomes adequate relative to an object, claim, boundary, scale, temporal horizon, evidential environment, and intended inference. This ordering matters because method-first inquiry can silently reshape the research object around what the preferred technique can observe. A relational question can require several forms of evidence whose translations remain partial. Methodological combination therefore concerns complementarity and mutual correction as much as synthesis. Where representations remain only partially translatable, the unresolved remainder should remain visible rather than being erased through forced integration.

The chapter's second commitment concerns explicit construction of the research object. Relational inquiry often begins before the relata, boundaries, scales, or relation types are fully settled. Entities can be provisional; relations can be observed, inferred, latent, institutional, historical, symbolized, negative, or uncertain; relational identity can persist through some transformations while dissolving under others; and configurations can contain dyadic, triadic, higher-order, nested, or second-order structures. Research design therefore requires versionable object specification. Revision can increase complexity when evidence reveals omitted structure, and it can simplify an initially elaborate object when the additional structure proves unnecessary for the target claim.

The third commitment concerns the distinction between manifestation and relation. A transfer, message, contract, administrative code, spatial co-presence, interview statement, institutional role, or statistical association can provide evidence about a relation without exhausting its meaning or structure. This distinction motivates the chapter's repeated use of profiles, provenance chains, uncertainty records, and inferential bridges. The purpose of these devices is not bureaucratic completeness. They make visible which transformations connect encountered evidence to a relational claim, which assumptions enter that transformation, and where later researchers could revise the inference. This discipline becomes increasingly important when AI systems participate in retrieval, classification, entity resolution, translation, coding, summarization, modeling, or relation extraction, because computational abundance can otherwise hide the historical and representational conditions under which evidence became legible.

A further commitment concerns contingency and judgment. Relational inquiry remains partly open at the design stage because research designs encounter anomalies, unexpected documents, unanticipated actors, new relation types, field discontinuities, measurement failures, and changing institutional conditions. Contingent encounter can therefore redirect object specification, boundary construction, scale selection, or evidential strategy. Aesthetic judgment can make an unexpected pattern salient before its epistemic significance is established. The methodological task

is to preserve this generative role of encounter while requiring subsequent verification, alternative explanation, provenance, and claim calibration. In the AI era, where candidate models, classifications, explanations, and formalizations can be produced at comparatively low marginal cost, this capacity to recognize which encounter deserves sustained inquiry becomes more consequential.

The internal structure of the chapter follows six movements. The first movement, Sections 7.1–7.2, establishes the transition from research praxis to relational methodology and maps the major traditions of social-science inquiry. Section 7.1 translates the commitments of Chapters 4–6 into methodological constraints: research questions precede method preference; relational objects remain provisional; adequacy is target-relative; methods can be combined while preserving translation remainders; and method selection remains revisable. Section 7.2 then compares historical-interpretive and qualitative, quantitative-empirical, formal-computational, and mixed or multi-method traditions according to their forms of epistemic access. The section rejects a simple qualitative–quantitative binary as too coarse for the range of relational questions developed later in the chapter.

The second movement, Sections 7.3–7.9, constructs the relational research object. Section 7.3 develops provisional entities, candidate relations, higher-order relations, configurations, fields, institutions, symbolic objects, historical objects, and revisable object specifications. Section 7.4 treats analytical boundaries as explicit hypotheses about relevance and tractability and introduces permeability, sensitivity, revision, and boundary remainders. Section 7.5 distinguishes boundary from scale and develops individual, dyadic, organizational, community, institutional, field, cross-scale, and multiscale inquiry while preserving scale remainders. Sections 7.6 and 7.7 separate relation identification from relation characterization: the former asks what warrants a claim that a relation is present, absent, latent, institutional, historical, or otherwise identifiable; the latter examines direction, intensity, duration, reciprocity, dependence, constraint, enablement, asymmetry, multiplexity, and meaning. Section 7.8 adds temporal identity and persistence, and Section 7.9 extends inquiry from individual relations toward configurations, higher-order structures, relations among relations, motifs, and topology.

The third movement, Sections 7.10–7.16, examines major modes of evidential access and situated reconstruction. Documentary inquiry distinguishes records from the institutions and infrastructures that produce them and treats provenance and documentary silence as part of the evidential problem. Archival inquiry examines selection, custody, arrangement, preservation, access, archival power, and the difference between a historical configuration and the archival configuration through which its traces survive. Ethnographic inquiry develops situated observation, tacit practice, field position, and reflexive field notes. Interview-based inquiry distinguishes narrative, experiential, mnemonic, contradictory, and relational accounts while preserving the conditions under which testimony is elicited. Legal inquiry separates legal status, institutional interpretation, and enacted practice; institutional inquiry reconstructs rules, roles, authority, coordination, memory, boundaries, and transformation across formal and informal layers. Comparative relational inquiry then develops claim-relative and graded comparability, distinguishing relational equivalence from functional equivalence and preserving comparative remainders where cases remain only partially commensurable.

The fourth movement, Sections 7.17–7.25, develops broader methodological

families and relational representations. Section 7.17 maps mainstream historical-interpretive social-science methods through their epistemic functions, including case study, comparative history, historical institutionalism, process tracing, archival and documentary research, interviews, ethnography, discourse analysis, legal and institutional interpretation, conceptual history, genealogy, and thick description. Section 7.18 provides the quantitative-empirical counterpart through sampling, measurement, regression, panels, time series, multilevel models, experiments, quasi-experiments, missing data, robustness, and sensitivity analysis while making the relational content of identification assumptions explicit. Sections 7.19 and 7.20 develop network and higher-order relational analysis, separating nodes and edges from the objects they represent and distinguishing pairwise structure from jointly constituted or second-order relations. Sections 7.21 and 7.22 address statistical and causal relational inference, including dependence, latent structure, interference, spillover, network confounding, relational counterfactuals, and the distinction between an empirical relational graph and a causal graph. Sections 7.23–7.25 then develop spatial, temporal, and field-based relational analysis, treating geographical proximity, relational distance, mobility, accessibility, territory, formation, persistence, rhythm, temporal gaps, field position, gradients, overlapping fields, and distributed conditions as distinct analytical objects.

The fifth movement, Sections 7.26–7.31, turns from reconstruction toward the quality, governance, and recoverability of relational claims. Section 7.26 treats measurement as a transformation from relational manifestations into indicators, proxies, composites, and other representations, with explicit attention to validity, error, standpoint, and invariance. Section 7.27 examines missing actors, missing relations, hidden relations, strategic concealment, unequal observability, archival loss, and digital omission while preserving the distinction between missingness and substantive absence. Section 7.28 develops triangulation through convergence, complementarity, tension, contradiction, shared dependence, and preservation of irreducible disagreement. Section 7.29 then organizes validation around construct, historical, relational, boundary, scale, representation, cross-method, and external dimensions, while preserving a validation remainder for unresolved alternatives and transfer limits. Section 7.30 extends research ethics from isolated participants toward relational privacy, third-party exposure, vulnerable relations, representational and classification harm, data governance, reciprocity, and responsibility. Section 7.31 closes this movement by making reporting itself part of methodological accountability through explicit boundary, scale, representation, assumptions, uncertainty, alternative models, provenance, reproducibility, and reinterpretability.

The sixth movement, Section 7.32, defines the generative-attribution threshold of relational inquiry. It specifies what relational findings can be carried forward, why consequence claims require an additional inferential bridge, and which questions remain open when a project asks what a relation or configuration contributes to later capacities, constraints, structures, trajectories, or possibilities. The section stops at that threshold. Chapter 8 owns the methodology of mechanisms, trajectories, feedback, path dependence, criticality, multiscale generation, formal dynamics, structural transformation, option spaces, and other stronger forms of generative attribution.

Across these movements, the chapter follows a common principle of scoped methodological accountability. Relational inquiry can remain ambitious without requiring exhaustive representation of the relational world. A study can construct

bounded objects, choose a defensible scale, use partial evidence, adopt formal representations, and reach strong local conclusions when the transformations connecting evidence to claim remain sufficiently explicit and when materially relevant uncertainty and counterevidence remain visible. Methodological rigor therefore lies partly in knowing what the selected method makes available, what it transforms, what it leaves outside the immediate representation, and what kinds of later revision the preserved research record permits. This architecture prepares the transition from knowing relations to investigating generation while keeping stronger claims proportionate to the evidence that supports them.

7.1 Relational Methodology in Research Praxis

Chapter 6 approached research methodology through the prior category of praxis. That ordering established that method selection occurs within a configuration of questions, relations, judgments, institutional conditions, evidential access, historical location, responsibilities, and limits. The present section begins Chapter 7 by carrying that result into relational methodology. Its role is to specify how the ontological and epistemological commitments developed in Chapters 4 and 5 constrain the methodological architecture of relational inquiry, and how the praxis analysis of Chapter 6 turns those constraints into practical design requirements. The section proceeds through research praxis as methodological constraint, the priority of research questions, the provisional construction of relational objects, methodological adequacy, method combination, revisability, and the limits of method transfer. The objective is not to select a preferred technique. It is to establish the conditions under which a technique can become adequate to a relational research problem.

The transition is important because relational vocabulary by itself underdetermines methodology. Chapter 4 distinguished ontological reality, relational reality, and manifestational reality while retaining ontological suspension. Chapter 5 then treated knowledge as mediated through manifestation, traces, representations, observation, boundaries, scale, history, and unequal epistemic access. Chapter 6 placed these epistemic conditions inside research praxis, where researchers encounter, judge, select, translate, revise, preserve, and sometimes intervene in the fields they study. Relational methodology therefore inherits constraints from three directions: the reality under study may exceed its manifestations; access to that reality is partial and mediated; and research operations themselves occur within consequential relations.

This inheritance gives methodology a limited but demanding function. It should organize inquiry so that the relation between research question, object specification, manifestation, evidence, representation, inference, and revision remains sufficiently visible for the resulting claim to be examined. A method can contribute to that task without settling the ultimate ontology of the object or exhausting the possible ways in which the object can later be known.

Proposition 7.1 (Ontological–epistemic–methodological continuity). *Within the present framework, relational methodology is stronger when its design choices remain traceable to the ontological restraint, epistemic access conditions, and praxis-level responsibilities that motivate those choices.*

Proposition 7.1 expresses continuity rather than derivation. Ontology does not me-

chanically determine a method, and epistemology does not supply a unique procedure. The same ontological and epistemic conditions can support several methodological configurations. Their adequacy depends on the question, target, evidence, scale, history, and consequences of inquiry. This underdetermination is a reason for methodological judgment rather than a defect to be concealed.

7.1.1 Research Praxis as Methodological Constraint

Research praxis constrains methodology because methods operate within relations that precede and exceed their technical procedures. The researcher occupies positions with respect to participants, institutions, archives, infrastructures, computational systems, disciplinary communities, funding structures, and publics. These positions shape access, categories, recording practices, feasible interventions, and the practical consequences of representation. A technically well-executed procedure can therefore remain methodologically weak if it ignores conditions that materially affect what the procedure is able to observe or support.

The ontology developed in Chapter 4 provides a first constraint. Ontological suspension discourages the conversion of an analytical representation into a final claim about what reality ultimately is. A network representation, for example, can be useful when ties and positions make an explanatory difference, yet the graph does not thereby become the ontology of the field. A legal category can be indispensable for studying institutional authority without exhausting the relational reality of the persons and practices classified through it. A statistical variable can capture a regularity while remaining one manifestational representation among several possible access routes. Relational methodology should therefore distinguish the reality being investigated from the representation through which the inquiry currently renders it tractable.

The three-register architecture creates a second constraint. Ontological, relational, and manifestational questions can intersect, but they are not interchangeable. A manifestation can provide evidence of a relation without being identical to the relation. A stable institutional representation can participate in sustaining a relational reality while still omitting other relations that matter to the inquiry. An observed change in manifestation can reflect a change in relational reality, a change in the manifestation process, a change in recording practice, or some combination of these. Methodological design should remain sensitive to these possibilities when moving from observed traces toward relational claims.

Chapter 5 adds the inverse problem of manifestation. Similar manifestations can sometimes be compatible with different underlying relational configurations, while similar relations can become manifest differently across institutional, historical, cultural, or technological contexts. This limits simple reverse inference from record to relation. Administrative categories, platform data, interview statements, archival traces, legal classifications, behavioral observations, and machine-generated indicators can each be informative, but their evidential meaning depends partly on the processes through which they became available.

Research praxis adds a third constraint by situating these epistemic problems inside activity. A researcher chooses where to look, which archive to enter, whom to interview, what to formalize, which anomaly deserves attention, when to stop collecting evidence, and when a provisional interpretation is sufficiently warranted for the

current purpose. These choices are shaped by finite time and attention. They can also be redirected by contingent encounter. Methodology should consequently provide structure while preserving routes through which unexpected evidence can alter the design.

Definition 7.2 (Praxis-constrained methodology). A *praxis-constrained methodology* is a methodological configuration whose research object, evidence strategy, inferential operations, ethical conditions, and revision procedures are specified in relation to the situated constraints and responsibilities of the inquiry in which they operate.

Definition 7.2 does not require researchers to produce an exhaustive sociology of their own project before investigation begins. The relevant requirement is proportionality. Conditions that materially shape access, representation, interpretation, or consequence should enter methodological reasoning at a level appropriate to the claim. Other background relations can remain outside the immediate design until evidence gives reason to reconsider them.

This formulation also preserves the distinction between research-dominant and application-dominant praxis developed in Chapter 6. A method used primarily to understand a field can tolerate forms of provisionality that become less acceptable when the same method is used to allocate resources, classify persons, prioritize cases, or trigger institutional action. The technical operation may remain similar while the praxis configuration changes. Methodological adequacy therefore benefits from renewed assessment when the relation between inquiry and consequence changes.

7.1.2 Research Questions before Method Selection

Relational methodology begins more coherently from the research question than from allegiance to a method. The question specifies what difference the inquiry seeks to understand and what kind of claim would count as an informative response. Method selection can then be evaluated by asking whether a procedure provides appropriate access to the evidence needed for that claim.

This ordering helps avoid a recurrent methodological inversion. Researchers can possess expertise in a technique and then search for objects that fit the technique's available representation. Network analysis can encourage the world to appear as nodes and edges; regression can encourage the world to appear as variables and conditional associations; ethnography can privilege enacted meaning and situated practice; archival research can privilege preserved traces; formal modeling can privilege structures that can be explicitly parameterized. Each orientation can be productive. Difficulty arises when the representational affordances of the method silently become criteria for what counts as an important research object.

The epistemology of Chapter 5 suggests a different sequence. A question should first identify the epistemic target with sufficient precision to guide access. Is the inquiry asking whether a relation exists, how it is experienced, how it is institutionally represented, whether it persists across time, how it differs across scale, or how it becomes visible through particular manifestations? These questions can concern the same empirical setting while requiring different evidential relations.

The distinction between relational and generative questions is especially important. Chapter 5 treated evidence for relational claims separately from evidence for generative claims because identifying a relation does not by itself establish what that relation contributes to later change. Chapter 8 will develop the additional method-

ological burden of generative inference. Chapter 7 therefore concentrates first on the methodological work required to identify, characterize, reconstruct, compare, measure, interpret, and validate relations.

Research questions can also remain layered. A project may begin with a descriptive question about the existence of a relation, encounter evidence suggesting a historical transformation, and later develop a generative question about how that transformation altered capacities or future possibilities. Such development need not indicate poor initial design. It can represent learning. The methodological requirement is to make the shift in question visible because the evidential burden changes with it.

Proposition 7.3 (Question-prior method selection). *Method selection is better grounded when the intended claim and its evidential target are specified before the authority, availability, novelty, or technical sophistication of a particular method is allowed to organize the research problem.*

The proposition remains compatible with exploratory inquiry. A researcher can enter a field without a sharply stabilized hypothesis and can allow observation, archives, dialogue, or computational exploration to generate candidate questions. The relevant priority is logical rather than strictly chronological. When a method is used to support a substantive claim, the researcher should be able to state what question the method is serving and why its operations are informative for that question.

This is also where contingent encounter and aesthetic judgment enter methodology. A research question can arise because an unexpected pattern, phrase, institutional inconsistency, visual structure, failed model, or cross-disciplinary analogy appears unusually salient. Such recognition can precede evidential justification. The methodological task begins when the initial attraction is converted into a researchable question whose object, evidence, alternatives, and uncertainty can be examined. Aesthetic judgment can orient attention without becoming a substitute for epistemic warrant.

7.1.3 Relational Objects of Inquiry

A relational object of inquiry is constructed provisionally from a reality that may exceed the analytical object. This statement follows directly from the ontological restraint of Chapter 4. Research needs objects sufficiently stable to be investigated, yet the construction of such objects should not be confused with proof that reality itself is partitioned in exactly the same way.

Objects can take several forms. The inquiry may focus on an entity and the relations through which its capacities are produced; a dyadic or multilateral relation; a network or higher-order configuration; an institution; a field; a symbolic object; a historical trajectory; or a relation between manifestations and the realities they help disclose or sustain. The methodological question is whether the chosen object specification makes consequential relations sufficiently visible for the research purpose.

This requires attention to provisional entityhood. A person, firm, household, organization, state, platform, legal category, or dataset can be treated as an analytical entity when doing so supports the inquiry. Relational analysis may then decompose some of the relations that make the entity effective without requiring the entity to disappear analytically. The relevant resolution depends on the question. A firm can be a useful unit for one analysis and a heterogeneous configuration of labor, ownership, contracts, technologies, routines, and infrastructures for another.

Relational objects also inherit the problem of manifestation. A recorded relation is not automatically equivalent to a relation as lived, enacted, institutionalized, or historically constituted. A friendship edge extracted from a platform, an administrative household category, a contractual relation, a citation link, a financial transfer, and an interview account of trust are different forms of evidence. They can refer to relations with different degrees of overlap. Methodological design should therefore state the operation by which a manifestation is being treated as evidence for a relational object.

Definition 7.4 (Provisional relational object). A *provisional relational object* is an analytically specified entity, relation, configuration, field, institution, symbolic form, or historical object whose boundaries and relevant properties are stabilized sufficiently for inquiry while remaining open to revision when evidence indicates that the specification omits, conflates, or misrepresents consequential relations.

The word *provisional* carries epistemic rather than merely stylistic force. Boundary choice can change the object. Scale can reveal relations invisible at another resolution. Historical change can make a previously adequate category misleading. Machine-mediated observation can create new relational indicators while increasing distance between the analyst and the process through which those indicators were produced. Participant interpretation can reveal that a formally identical relation carries heterogeneous meanings. A relational object should therefore preserve a revision path.

The three-register architecture further suggests that some projects may need multiple linked objects. One object can concern a relational reality, another its manifestational forms, and another the institutional or symbolic representation through which those manifestations are recorded. Their relation can itself become part of the inquiry. This is especially important where classifications are performative. A legal, administrative, statistical, or algorithmic representation can begin as a manifestation of a relation and later participate in reorganizing the relation it represents.

Chapter 7 will develop these issues in detail through object specification, boundary construction, scale selection, relation identification, persistence, and configuration reconstruction. The present subsection establishes the general discipline: relational objects are analytical achievements whose adequacy depends on what they allow the inquiry to see, compare, and revise.

7.1.4 Methodological Adequacy

Chapter 6 defined methodological adequacy as the fit between a method's operations, assumptions, evidential access, limitations, research object, and intended claims. Relational inquiry adds several dimensions to that criterion because relations are often accessed indirectly and because their identity can depend on boundary, scale, history, and representation.

A method can be adequate along one dimension and limited along another. Administrative records can support broad temporal coverage while inheriting institutional categories whose meaning changed. Interviews can recover experiential and interpretive relations while remaining selective with respect to memory, participation, and retrospective reconstruction. Ethnography can reveal tacit practice and situated meaning while covering a comparatively bounded field. Network data can expose patterns of connectivity while reducing heterogeneous relations to edge structures.

Formal models can clarify implications of relational assumptions while depending on the adequacy of the chosen abstraction. Statistical methods can characterize uncertainty and conditional patterns while remaining sensitive to measurement and identification assumptions. These differences invite target-relative evaluation rather than a general hierarchy.

Ontology and epistemology add further adequacy questions. Does the method distinguish manifestation from the relation inferred from it? Does it preserve uncertainty where the inverse problem remains underdetermined? Are boundaries, scales, and temporal intervals explicit enough to understand the scope of the claim? Can the representation accommodate multiple realization or historical transformation? Does the evidence-production process systematically privilege relations that are institutionally legible while making other relations difficult to observe? Can the inferential path be reconstructed and contested?

Definition 7.5 (Relational methodological adequacy). *Relational methodological adequacy* is the degree to which a methodological configuration provides warranted access to the specified relational object while making its principal representational choices, boundary and scale conditions, evidential limitations, uncertainties, and revision pathways commensurate with the intended claim.

This definition includes ethical and justice-sensitive dimensions where they are epistemically material. Unequal capacity to create records can generate biased relational maps. Exclusion from institutional categories can produce apparent absence. Strategic concealment can alter observed network structure. A research design that treats these patterns simply as missing data can lose substantive information about the field. Methodological adequacy may therefore require examining how observability itself is relationally distributed.

Adequacy is also historical. A method can work well under one manifestation regime and become weaker after institutional or technological change. A stable survey item can cease to measure the same relation after the meaning of a category changes. A platform interface can alter interaction while preserving the same database field. An archival series can contain a discontinuity created by a change in administrative procedure. Historical sensitivity therefore belongs inside methodological validation rather than being added only as contextual narrative.

Epistemic humility provides the final discipline. Methodological sophistication should not be treated as evidence of comprehensive access. A powerful model, large dataset, rich archive, long ethnography, or advanced AI system can expand what can be investigated while leaving important relations outside the current representation. Adequacy concerns fitness for a stated claim, not epistemic mastery of the field.

7.1.5 Method Combination

Method combination follows from partial access rather than from a general preference for methodological multiplicity. Several methods can be useful when the research question contains components that become visible through different evidential interfaces. Combination is most informative when each method has a defined role and when their translations and disagreements remain inspectable.

The epistemology of manifestation explains why combination can matter. A relation may leave documentary, behavioral, testimonial, institutional, spatial, temporal, or computational traces that are related without being equivalent. Documentary in-

quiry can reveal formal decisions; interviews can reveal how those decisions were interpreted; ethnography can show how they are enacted; quantitative data can characterize distribution; historical inquiry can reconstruct change; formal analysis can expose structural implications. The combined design can therefore approach different aspects of the same relational problem.

Combination should preserve methodological difference. Translating narrative into variables, contracts into network edges, field observations into coded categories, or historical episodes into model states can enable comparison while producing remainders. The relation between methods is epistemically stronger when these remainders remain visible. Apparent convergence can otherwise be manufactured by forcing heterogeneous evidence into a common representation.

Disagreement can also be informative. If archival evidence and contemporary interviews produce different relational histories, the discrepancy can indicate memory transformation, archive selection, category change, institutional power, or genuine historical discontinuity. If a network model identifies a central actor while ethnographic observation finds little practical authority, the difference can reveal a gap between connectivity and influence. Method combination should therefore support mutual correction as well as confirmation.

Proposition 7.6 (Complementarity with preserved remainder). *A multi-method relational design is strengthened when each method has an explicit evidential role, translations between representations are documented, and residual disagreement is preserved when the available evidence does not warrant synthesis.*

The proposition also limits methodological accumulation for its own sake. Adding methods can increase cost, interpretive complexity, and opportunities for inconsistency. A single method can be sufficient when its access and assumptions are adequate to a narrowly specified question. Combination becomes useful when it improves access, tests representational dependence, exposes boundary sensitivity, or provides genuinely complementary evidence.

AI-assisted research creates a new form of combination because computational systems can mediate search, coding, translation, formalization, synthesis, and interpretation across methods. Their contribution can accelerate comparison while obscuring provenance if intermediate transformations are not retained. A relational methodology using AI should therefore treat machine-mediated transformations as part of the methodological chain, especially where they affect inclusion, classification, inference, or interpretation.

7.1.6 Revisability of Method Selection

Method selection should remain revisable because inquiry can change what is known about the object and about the adequacy of the method itself. Chapter 5 treated relational knowledge as revisable; Chapter 6 extended that principle to theories, research designs, collective knowledge production, failure, and cumulative research memory. Methodology inherits the same architecture.

Revision can be triggered by several kinds of encounter. New evidence can show that an assumed relation is absent. A participant can identify a category mismatch. Archival material can reveal that a supposedly stable variable changed meaning. A formal model can expose an inconsistency in the conceptualization. An unexpected empirical pattern can reveal an omitted scale. A machine-generated classification can

perform poorly for a subgroup because the training representation omitted relevant relations. A contingent encounter can make a previously peripheral phenomenon appear generatively important enough to justify a redesign.

The possibility of revision does not imply continuous methodological instability. Research requires periods of stabilization so that evidence can be compared and claims can be evaluated. The practical issue is whether the design has procedures for distinguishing ordinary noise from evidence that places meaningful pressure on the current object, boundary, scale, or method.

Definition 7.7 (Method revision trigger). A *method revision trigger* is an observation, contradiction, failure, historical discontinuity, representational mismatch, ethical constraint, or other evidentially relevant development that gives reason to reassess one or more elements of the current methodological configuration.

Revision should be localized where possible. A measurement failure can require a new indicator without requiring abandonment of the research question. A boundary failure can require a wider field without invalidating the underlying evidence. A historical discontinuity can require periodization rather than a new method. A persistent contradiction across methods can eventually require revision of the object itself. This proportionality preserves cumulative knowledge while remaining responsive to failure.

Contingent encounter and aesthetic judgment are especially significant at this point. A method leaves some possible significance outside its initial anticipation because research value can become visible only after an unexpected juxtaposition, anomaly, or pattern appears. Aesthetic judgment can make such an encounter salient by registering elegance, strangeness, tension, symmetry, discontinuity, or generative possibility. Methodological revision begins when that salience is converted into a question that can be investigated. In AI-rich research environments, this human or collective capacity can become more consequential because internally generated candidate explanations are abundant while encounters with poorly represented realities remain comparatively scarce.

Revisability also supports future re-epistemization. Preserving earlier versions of a method, object specification, coding scheme, model, dataset, and interpretive rationale allows later researchers to reconstruct why a design once appeared adequate and why it changed. Methodological history then becomes part of the evidence available to future inquiry.

7.1.7 Limits of Method Transfer

Methods travel across disciplines, populations, institutions, historical periods, technologies, scales, and praxis configurations. Such transfer can be productive because a method developed in one domain can reveal structures that another domain has not yet represented clearly. The transfer also creates a risk of carrying hidden assumptions into a field where their original justification is weaker.

Ontology provides one reason for caution. Similar representations can correspond to differently constituted relational objects. An edge in a citation network, a kinship network, a financial network, and a command network shares a graph-theoretic form while representing relations with different meanings, persistence conditions, asymmetries, and consequences. Formal similarity can support comparison without establishing ontological equivalence.

Epistemology provides a second reason. Manifestation relations vary. Administrative records produced in one jurisdiction may have only partial counterparts in another. A survey category can travel linguistically while changing relational meaning. Digital traces can appear standardized across platforms while being generated through different interfaces and incentives. A measure validated in one historical period can become unstable after institutional change. Transfer therefore requires renewed examination of the relation between manifestation, evidence, and target.

Praxis provides a third reason. A method can move from research-dominant inquiry into application-dominant use, where errors affect allocation, access, classification, treatment, or institutional response. The consequences of false positives, false negatives, exclusion, delay, opacity, or category mismatch can then change the adequacy threshold. Practical transfer can also make a representation performative: once a classification is used administratively, actors may adapt to it and institutions may reorganize around it.

Caution 7.8 (Method transfer across relational settings). Methodological performance established in one relational setting provides evidence for possible transfer, while adequacy in the receiving setting requires renewed attention to object constitution, manifestation processes, boundary and scale conditions, historical context, affected relations, and consequences of error.

Caution 7.8 supports disciplined borrowing rather than methodological isolation. A transferred method can remain highly useful when its assumptions are examined and its representation is adapted to the new target. Comparative work can even use transfer failure as evidence: the point at which a measure, category, model, or procedure ceases to travel can reveal a consequential difference in relational organization.

The same principle applies to GRE itself. Relational vocabulary should not be imposed uniformly across domains simply because the framework is designed to travel. A relation that matters in economics may be weakly informative in another domain; a generative mechanism identified in education may not transfer to humanitarian practice; a representation useful for institutional analysis may obscure interpersonal meaning. The broader GR framework gains from domain transfer when it preserves the possibility that neighboring disciplines and empirical fields can revise its categories.

Section 7.1 therefore establishes the methodological starting point of the chapter. Research praxis constrains the design; ontological suspension limits reification; the three-register architecture separates reality from its manifestations without severing their relations; epistemology specifies mediated access, uncertainty, boundary, scale, history, justice, and revisability; and methodological judgment organizes these conditions around a research question. The sections that follow can now examine concrete traditions and procedures while retaining this architecture. Section 168 turns first to major traditions of social science inquiry, with the aim of clarifying their different evidential capacities and possibilities for mutual correction before the chapter moves into object specification, relational identification, reconstruction, measurement, validation, and reporting.

7.2 Major Traditions of Social Science Inquiry

Section 7.1 established that relational methodology inherits constraints from ontology, epistemology, and research praxis. The present section places that framework in dialogue with several major traditions of social science inquiry. Its role is comparative and reconstructive: it identifies the characteristic forms of access offered by historical-interpretive and qualitative inquiry, quantitative-empirical inquiry, formal and computational work, and mixed or multi-method research. The objective is to clarify how these traditions can contribute to relational inquiry, where their characteristic remainders arise, and how methodological disagreement can become a source of correction. The discussion proceeds from the major traditions to their dialectical relation, mutual correction, question-prior method selection, and the limits of a binary qualitative–quantitative division. The method of comparison follows the ontology and epistemology of Chapters 4 and 5: each tradition is considered through the manifestations it can access, the relations it can render visible, the inferential operations it supports, and the forms of uncertainty that remain after those operations.

A methodological tradition is more than a list of techniques. It is a historically organized cluster of research questions, evidential habits, representations, standards of warrant, institutional practices, and judgments about what counts as an informative result. Traditions can overlap, borrow from one another, and change internally. Researchers can also combine practices that originated in different lineages. The category therefore functions as a map of recurrent orientations while leaving researcher identities and combinations of practice open.

Definition 7.9 (Methodological tradition). A *methodological tradition* is a historically developed configuration of research questions, evidential practices, representational forms, inferential standards, and evaluative habits that organizes recurrent ways of gaining access to a field of inquiry.

Definition 7.9 keeps the focus on access and inquiry. A tradition can make some relations comparatively visible while leaving others weakly represented. Historical reconstruction can disclose sequence and category formation while providing limited leverage on population-level prevalence. Statistical designs can estimate distributions or conditional contrasts while leaving the meaning of a category dependent on prior conceptual and measurement work. Formal models can expose logical consequences and mechanism possibilities while remaining sensitive to their assumptions and target specification. Qualitative inquiry can reconstruct situated meaning and practice while requiring disciplined attention to transfer beyond the studied setting. These are characteristic tendencies whose expression depends on the local research configuration.

Table 7.1 summarizes the comparative structure used throughout the section.

The table presents a plural architecture with several forms of epistemic access. Relational inquiry can draw from each tradition when the research question and object make that access informative. The relevant standard is methodological adequacy as developed in Section 7.1: the fit among question, object, manifestation, evidence, inference, scale, history, and consequence.

Table 7.1: Methodological traditions as partially distinct modes of epistemic access

Tradition	Characteristic access	Relational contribution	Characteristic remainder
Historical-interpretive and qualitative	Meaning, sequence, practice, experience, documents, situated categories	Relational meaning, process, institutional formation, context, contingency	Transfer, archive or access asymmetry, interpretive dependence
Quantitative-empirical	Distributions, contrasts, associations, interventions, repeated observations	Pattern, magnitude, uncertainty, conditional relation, causal identification under assumptions	Measurement validity, omitted relations, transport, model dependence
Formal and computational	Explicit assumptions, logical structure, simulation, network or agent configurations	Mechanism possibility, structural consequence, counterfactual exploration, complex configuration	Stylization, parameter dependence, representation-world gap
Mixed and multi-method	Coordinated access through several evidential and inferential modes	Triangulation, complementarity, contradiction diagnosis, translation across representations	Integration loss, commensuration pressure, unresolved translation remainder

7.2.1 Historical-Interpretive and Qualitative Traditions

Historical-interpretive and qualitative traditions provide access to dimensions of social reality that are often expressed through sequence, meaning, practice, narrative, classification, experience, institutional memory, and context. Their evidential materials can include archives, correspondence, legal and administrative records, interviews, field observation, material artifacts, texts, images, organizational routines, and traces of everyday interaction. Their contribution to relational inquiry lies especially in reconstructing how relations are understood, enacted, contested, institutionalized, remembered, and transformed through time.

Interpretive work has a long methodological association with attention to meaning in context. Geertz’s account of interpretive anthropology gave influential form to the idea that cultural analysis requires dense contextual interpretation and resists treating observed conduct as self-explanatory data (Geertz 1973). GRE need not inherit that framework wholesale to recognize the methodological point. A manifestation acquires evidential significance through a field of relations. The same gesture, category, document, payment, or institutional procedure can carry different meanings under different histories and symbolic arrangements. Qualitative inquiry can therefore contribute to the inverse problem of manifestation by examining the processes through which an observed trace becomes intelligible.

Historical inquiry adds sequence and temporal dependence. The relation visible at one moment may have been generated through earlier classifications, institutional reforms, conflicts, settlements, exclusions, or technological changes. Hacking’s historical ontology is one precedent for examining how categories and objects become possible within historically specific practices of classification and reasoning (Hack-

ing 2002). Abbott similarly emphasizes temporality, events, cases, and the theoretical assumptions embedded in social-science methods (Abbott 2001). For relational inquiry, these perspectives support attention to relation formation, persistence, path dependence, turning points, and historical changes in the meaning of apparently stable variables.

Qualitative evidence also permits close examination of relational heterogeneity. Two persons assigned the same institutional category can occupy markedly different relational positions. An organizational rule can be experienced as protection in one relation and constraint in another. A formal partnership can coexist with distrust, asymmetric dependency, or symbolic exclusion. Interviews and ethnographic observation can reveal these differences when the research design preserves the distinction between participant interpretation, researcher interpretation, and the wider institutional conditions in which both are situated.

This interpretive capacity carries characteristic limits. Access can be selective. Archives preserve some actors and episodes more densely than others. Interview accounts are situated in time, relation, memory, and interaction. Field access can depend on trust, institutional permission, language, status, and researcher position. Interpretation also involves judgment. These conditions call for provenance, reflexivity, comparison, negative cases, and explicit reasoning about alternative interpretations. Their methodological significance lies in specifying where warrant is generated and where uncertainty remains, while still permitting disciplined interpretation.

Within the three-register architecture, historical-interpretive and qualitative methods often move closely among manifestation and relational reconstruction. A document, narrative, or observed practice is a manifestation. The researcher asks what relational reality it supports, how that relation was historically generated, and which alternative reconstructions remain compatible with the evidence. Ontological suspension remains useful here because an interpretive category can organize evidence without becoming a final assertion about the ultimate nature of the social object.

Proposition 7.10 (Contextual access). *Historical-interpretive and qualitative inquiry can strengthen relational analysis when contextual reconstruction changes the evidential meaning of observed manifestations, candidate relations, or their historical boundaries.*

Proposition 7.10 gives these traditions a precise methodological role. Context matters where it changes what a record, action, category, or relation warrants. The proposition also guards against decorative contextualization. Additional description contributes methodologically when it alters identification, interpretation, comparison, or inference.

7.2.2 Quantitative-Empirical Traditions

Quantitative-empirical traditions organize inquiry through systematic measurement, repeated observations, explicit comparison, statistical representation, experiments, quasi-experiments, surveys, administrative records, and related forms of structured evidence. Their characteristic strength lies in making patterns, distributions, magnitudes, uncertainty, conditional associations, and some forms of causal contrast examinable across observations.

For relational inquiry, quantitative methods can answer several distinct questions.

They can estimate how frequently a relation appears under a specified operationalization, how relational characteristics vary across populations or institutions, whether outcomes differ under contrasting relational exposures, how uncertainty changes across models, or whether a proposed relation remains visible after adjusting for specified alternatives. Network statistics and repeated relational data can additionally characterize position, clustering, reachability, assortativity, temporal persistence, and other features that are difficult to infer reliably from a small number of observations.

Causal inference provides a particularly important quantitative-empirical interface. Counterfactual and intervention-oriented approaches clarify that causal claims require stronger identification conditions than descriptive association. Gangl surveys experimental, quasi-experimental, and statistical approaches to causal identification in sociological research (Gangl 2010), while Woodward develops an interventionist framework for reasoning about causal explanation and invariance (Woodward 2003). Within GRE, these traditions can contribute to relational causal questions when the intervention, comparison, treatment, outcome, and relevant relational pathways are specified with sufficient care.

The epistemological constraints from Chapter 5 remain active. Measurement is a transformation from a manifestational field into a research representation. A numerical variable can stabilize comparison while also compressing distinctions. An administrative indicator may reflect legal eligibility, recording practice, institutional incentives, and missingness together with the phenomenon that the researcher seeks to study. Statistical precision therefore differs from ontological or conceptual adequacy. A narrow confidence interval around a weakly specified variable can still leave the central relational object uncertain.

Quantitative research also makes assumptions visible in productive ways. Sampling rules, model specifications, error structures, identification assumptions, inclusion criteria, and sensitivity analyses can expose points at which a conclusion depends on design choices. This explicitness supports revision and replication. It also permits disagreement to become more localized: researchers can ask whether the main difference concerns measurement, functional form, population, identification, boundary, or interpretation.

The characteristic remainder often concerns what the operationalization leaves outside the model. A survey variable for trust may compress several relational histories. A dyadic measure may omit institutional mediation. A population estimate can conceal subgroups whose relations differ structurally. A treatment effect can be informative within the studied design while transport to another historical or institutional setting remains uncertain. These remainders invite further inquiry and help specify where quantitative results require additional relational reconstruction.

Caution 7.11 (Precision and relational specification). Increasing numerical precision can leave unresolved uncertainty about the relational object, its boundary, its measurement process, and the historical conditions under which the estimate is intended to travel.

Caution 7.11 preserves the distinction between uncertainty internal to a statistical representation and uncertainty about the adequacy of the representation itself. Both can matter, and they may require different methodological responses.

7.2.3 Formal and Computational Extensions

Formal and computational approaches extend social inquiry by making assumptions, structures, mechanisms, and dynamic consequences explicit enough to analyze systematically. Formal models can clarify the implications of a proposed mechanism or set of constraints. Computational models can explore configurations whose interactions become difficult to track analytically. Network analysis can represent patterned relations among entities, and agent-based models can examine how local interactions among heterogeneous agents can generate aggregate patterns. Newman provides a broad account of network structure and dynamics (Newman 2003), while Epstein and Axtell demonstrate a constructive agent-based approach to social simulation (Epstein and Axtell 1996).

These approaches can make several contributions to relational inquiry. First, they can expose hidden assumptions. A verbal explanation can rely on an implicit sequencing rule, information structure, or interaction topology that becomes visible once the model is formalized. Second, they can test internal coherence. A proposed set of relations may fail to generate the outcome attributed to it under the stated assumptions. Third, they can support counterfactual exploration by varying parameters, structures, or initial conditions. Fourth, computational representations can reveal emergent patterns that arise from repeated interaction without requiring those aggregate patterns to be inserted directly into the model.

Formalization also provides a disciplined language for relational architecture. Graphs, matrices, state variables, transition rules, spatial structures, and dynamical systems can represent different aspects of a field. Yet Chapter 4's ontological restraint remains especially important here. A graph is a representation of selected relations under specified semantics. An agent is a modeled entity with defined capacities. A field variable is an analytical construction. Their mathematical exactness supplies precision within the representation while leaving the ontology of the social world an additional question.

The representation-world gap therefore becomes a central methodological object. A computational model can be internally elegant while its mapping to empirical relations remains weak. A simulation can generate a target macro-pattern through several incompatible micro-mechanisms. A network can reproduce observed degree distributions while omitting relation meaning, institutional authority, or historical sequence. Formal and computational inquiry gains epistemic strength when the pathway between model elements, empirical manifestations, and the target relation is documented and tested.

This is also where contingent encounter matters. Formal systems tend to explore possibility within a specified representational space. Empirical anomalies, field encounters, archival surprises, or interpretive contradictions can reveal that the relevant space was poorly specified. Aesthetic judgment may initially draw attention to an unexpected pattern or structural elegance, while later empirical work determines whether that attraction tracks a significant relation. The productive relation between formalization and encounter is therefore iterative.

Definition 7.12 (Formal-computational remainder). *A formal-computational remainder is a materially relevant aspect of the research object, evidence relation, meaning structure, historical condition, or uncertainty that is left outside a formal or computational representation used in the inquiry.*

Definition 7.12 permits purposeful simplification; a model can bracket potentially relevant features when their omission is explicit and proportionate to the research task. The methodological task is to identify remainders whose omission could alter the interpretation or transfer of the result. This keeps simplification analytically useful while preserving recoverability of what the simplification brackets.

7.2.4 Mixed and Multi-Method Research

Mixed and multi-method research coordinates several forms of evidence or inference within one research programme. Mixed-methods scholarship has developed explicit designs for integrating qualitative and quantitative components across data collection, analysis, and interpretation (Creswell and Plano Clark 2018). Relational inquiry can extend this logic beyond a simple pairing of qualitative and quantitative techniques by treating method combination as a problem of coordinated epistemic access.

A multi-method design can serve several functions. One method can establish a pattern while another reconstructs its meaning. Historical inquiry can identify institutional changes that define the temporal boundary of a statistical comparison. Interviews can expose measurement categories that require revision. Network analysis can identify structurally unusual cases for qualitative follow-up. Formal modeling can clarify a candidate mechanism that later empirical work tests. Documentary analysis can reveal that a variable's administrative meaning changed during the observation period. These combinations become methodologically valuable when each contribution is linked to a distinct inferential task.

Integration also creates translation problems. A qualitative category may need to become a coding scheme. A historical sequence may be summarized as a periodization variable. An interview-based relational distinction may become an edge type in a network. A formal mechanism may be translated into observable implications. Each transformation can preserve some properties and lose others. Chapter 6 described this problem as translation with remainder. Multi-method research therefore benefits from recording what is preserved, transformed, or left unresolved at each interface.

Method combination can also produce contradiction. An estimated association may coexist with interview evidence that challenges the proposed mechanism. Archival reconstruction may reveal that the comparison groups were generated by different institutional processes. A simulation may require behavioral assumptions inconsistent with field observation. Such contradictions can become diagnostically useful. They may reveal differences in scale, boundary, time, measurement, or meaning and thereby redirect attention toward the research configuration.

Definition 7.13 (Methodological complementarity). *Methodological complementarity* is a relation among methods in which distinct forms of access contribute non-identical evidence or inference to a shared research problem while the translations and remainders among those contributions remain visible.

Complementarity differs from accumulation by volume. Adding a second method strengthens the design when it changes what can be known, checked, or revised. Repeating the same assumption through two differently formatted procedures can create an appearance of triangulation without materially expanding epistemic access.

7.2.5 Dialectical Relation among Methodological Traditions

The relation among methodological traditions can be understood dialectically when their differences generate pressures that alter the research object, assumptions, or design. The relevant dialectic occurs through concrete contradictions in inquiry. A statistical regularity can conflict with an historical reconstruction. A participant interpretation can conflict with an institutional classification. A formal mechanism can fail to produce an empirically observed transition. A close case study can reveal a variable that a large-sample design had treated as homogeneous. These tensions can motivate reconstruction at a higher level of methodological specificity.

This dialectical view differs from a search for final synthesis. Some disagreements can be resolved by better evidence or improved specification. Others arise because methods answer different questions or preserve different aspects of the object. A historical explanation of how an institution formed and a quantitative estimate of one institutional effect can both be warranted without collapsing into one representation. Their relation becomes productive when each can expose assumptions or blind spots in the other.

Methodological contradiction can therefore have several outcomes. It can reveal measurement error, boundary mismatch, scale mismatch, historical change, divergent semantics, model misspecification, selection effects, or an inadequately differentiated research question. It can also remain unresolved after careful inquiry. Preserving that unresolved remainder can be epistemically preferable to forcing agreement through premature commensuration.

Proposition 7.14 (Dialectical methodological revision). *When competent methods generate materially different accounts of a shared research object, the disagreement can justify revision of the object's specification, evidential boundaries, scale, temporal framing, or inferential assumptions before it justifies a general ranking of the methods themselves.*

Proposition 7.14 turns disagreement into a research prompt. It asks which part of the configuration is under pressure and what additional evidence could discriminate among the competing reconstructions.

7.2.6 Mutual Methodological Correction

Methodological pluralism becomes substantive when traditions can correct one another. Historical inquiry can identify temporal breaks that weaken pooled statistical estimates. Quantitative analysis can show that an interpretation based on a salient case has limited prevalence in a larger population. Qualitative work can reveal that a survey category conflates distinct meanings. Formal modeling can expose an inconsistency in a verbal mechanism. Empirical observation can show that a formally coherent mechanism lacks the conditions required for operation. Computational analysis can identify relational patterns whose meaning then requires contextual inquiry.

Mutual correction relies on standards appropriate to the claim under examination. A statistical estimate receives corrective pressure from an interview when the interview reveals a problem in measurement, mechanism, boundary, interpretation, or transport. A formal model contributes corrective pressure when it exposes a logical implication, hidden assumption, or mechanism constraint that changes the historical claim.

The concept of mutual correction therefore preserves asymmetry where the evidential situation warrants it. Some methods may be more informative for a particular question. Some evidence may place stronger pressure on a claim. Methodological pluralism permits differential weight across techniques when that weighting is connected to the research object and inferential task. The justification should arise from local evidential relevance and inferential adequacy.

Definition 7.15 (Mutual methodological correction). *Mutual methodological correction* occurs when evidence or inference generated through one methodological configuration identifies a materially relevant weakness, omission, boundary condition, or alternative interpretation in another configuration, leading to a more adequate specification of the shared research problem.

This definition also clarifies why methodological communities benefit from heterogeneous expertise. Correction often requires someone capable of recognizing what a representation suppresses. A historian, statistician, ethnographer, legal scholar, network scientist, or computational modeler may detect different weaknesses because their traditions train attention toward different manifestations and inferential risks. Collective research praxis can therefore become more generative when disagreement is institutionally organized as a resource for revision.

7.2.7 Research Object and Question before Methodological Camp

The comparative analysis returns to the principle established in Section 7.1: the research object and question should guide method selection. Methodological identity can be intellectually productive because traditions accumulate expertise, standards, and communities of criticism. Difficulty arises when allegiance to a camp determines in advance what the object is allowed to become.

An inquiry into trust illustrates the problem. If trust is specified only as a survey score, the research may gain population-level comparability while losing the historical and relational processes through which trust formed. If trust is approached only through interview narratives, the inquiry may recover meaning and trajectory while leaving prevalence and distribution weakly specified. If trust is represented only as a network property, structural embedding becomes visible while symbolic or experiential dimensions may recede. A formal model can clarify self-reinforcing mechanisms while depending on assumptions about updating, memory, and interaction. The object therefore changes with the access relation established by the method.

A question-prior design asks which aspects of trust matter for the present inquiry. Is the aim to identify a relation, reconstruct its historical formation, estimate its distribution, compare institutions, study its symbolic manifestation, test a causal mechanism, or examine its self-reinforcing dynamics? Several questions may require several methods. The methodological configuration can then be justified by the epistemic work each component performs.

This principle also matters for AI-assisted research. AI systems can make methodological templates, code, statistical routines, formal models, and literature syntheses rapidly available. Ease of execution can tempt research toward methods that are computationally convenient or well represented in training data. Question-prior methodology places orientation earlier in the sequence. Contingent encounters, aesthetic judgment, disciplinary knowledge, and ethical consideration can shape the question

before technical abundance determines the design.

Caution 7.16 (Methodological camp capture). A research programme can become methodologically narrow when the representational affordances of a preferred tradition repeatedly determine which objects and questions receive attention, especially where alternative forms of access could materially change the claim.

The caution concerns repeated selection effects that can accompany specialized expertise. Deep specialization remains valuable. The methodological issue arises when specialization becomes an unexamined filter on research orientation.

7.2.8 Limits of a Binary Methodological Division

The familiar qualitative–quantitative distinction captures a real historical and institutional division in social science. King, Keohane, and Verba offered an influential attempt to bridge that divide through a common logic of descriptive and causal inference (King et al. 1994). Mixed-methods research subsequently developed explicit designs for coordinating qualitative and quantitative components (Creswell and Plano Clark 2018). These developments remain important, yet a binary division can obscure several forms of methodological heterogeneity that matter for relational inquiry.

First, historical-interpretive inquiry and qualitative field research overlap without being identical. Archival sequence reconstruction, hermeneutic interpretation, ethnography, interviewing, documentary analysis, and comparative historical work can involve different evidence relations and standards of warrant. Second, quantitative inquiry contains heterogeneous logics, including description, prediction, measurement, causal identification, spatial analysis, temporal analysis, and network statistics. Third, formal and computational research can use numerical procedures while answering questions different from those of conventional statistical estimation. A simulation may explore mechanism possibility while a statistical design estimates a population parameter. A theorem may clarify structural implication without using empirical data directly.

The binary also becomes unstable inside particular projects. Qualitative coding can produce counts. Quantitative variables require interpretive decisions. Historical databases can combine archival judgment with statistical analysis. Network data can be numerically represented while edge semantics depend on qualitative reconstruction. Machine-learning systems can process textual or visual materials while producing outputs whose interpretation remains context dependent. The material format of data therefore provides only part of the information needed to classify the epistemic mode of inquiry.

For GRE, a more useful map begins from epistemic functions. Researchers may need methods for discovering relations, reconstructing meaning, identifying historical sequence, measuring magnitude, estimating uncertainty, testing causal contrasts, representing topology, simulating mechanisms, comparing cases, interpreting institutions, or validating claims across manifestations. The same project can move among several functions as the research object becomes more precise.

Proposition 7.17 (Function-prior methodological classification). *For relational inquiry, methodological classification is often more informative when it identifies the epistemic function performed by a method in a specific research configuration than when it assigns the method exclusively to a qualitative or quantitative camp.*

Proposition 7.17 provides the bridge to the remainder of Chapter 7. The next sections move from traditions toward the concrete construction of relational inquiry: specification of the research object, boundary, scale, relation identification, characterization, persistence, configuration reconstruction, and the evidential practices through which those tasks are pursued. The methodological traditions surveyed here remain available as resources. Their contribution will be assessed locally through the relations they help disclose, the manifestations they make usable as evidence, and the remainders their representations leave for further inquiry.

7.3 Specification of the Research Object

Sections 7.1 and 7.2 established two conditions for relational methodology. Method selection should remain answerable to the research question and to the ontological, epistemological, and practical conditions of inquiry; methodological traditions provide partially distinct modes of access whose adequacy depends on the object and claim under examination. The present section develops the first concrete operation that follows from those conditions: specification of the research object. Its role is to clarify how an inquiry provisionally individuates entities, candidate relations, higher-order relations, configurations, fields, institutions, symbolic objects, and historical objects before later sections develop boundary construction, scale selection, relation identification, and validation in greater detail. The objective is methodological rather than metaphysical. Object specification provides a disciplined and revisable analytical interface through which inquiry can proceed while preserving the ontological suspension of Chapter 4 and the mediated, partial, historically situated epistemology of Chapter 5.

Research commonly begins with nouns that appear already available: a person, organization, market, institution, platform, policy, community, class, network, field, or historical period. Relational inquiry treats such terms as starting points whose analytical content may require reconstruction. A familiar name can conceal uncertainty about individuation, membership, constitutive relations, temporal persistence, scale, and manifestation. A “firm,” for example, can be specified as a legal entity, an ownership structure, a contractual nexus, an organizational hierarchy, a technological infrastructure, a set of routines, or a historically changing configuration combining several of these features. Each specification can support useful inquiry while foregrounding different relations and leaving different remainders.

The three-register architecture developed in Section 91 gives this problem a precise form. An analytical research object can refer to a relational reality, to one or more manifestational forms, or to a representation through which those manifestations are recorded and interpreted. The object used by a method therefore need not coincide with the ultimate ontology of what is being studied. Section 92 permits inquiry to proceed under ontological suspension, while Sections 113–116 show why movement from manifestation to relational knowledge can remain non-invertible and representation-dependent. Research-object specification sits at this interface: it stabilizes a target sufficiently for investigation while recording the inferential and representational choices through which that stability was achieved.

Definition 7.18 (Research-object specification). A *research-object specification* is a provisional and explicit account of what an inquiry treats as its analytical object, in-

cluding the criteria of individuation relevant to the question, the candidate relations or structures through which the object is characterized, the manifestations through which it can be accessed, the temporal and scalar conditions relevant to its identity, and the conditions under which the specification would be revised.

Definition 7.18 gives object specification epistemic content. The specification is more than a naming convention. It affects what evidence is collected, which contrasts become meaningful, which relations appear internal or external, how persistence is judged, and which alternative explanations remain visible. It can also change during inquiry. An object initially approached as an organization can later require analysis as an institutional field; a dyadic relation can become intelligible only inside a higher-order configuration; a seemingly stable category can become a historical object whose changing meaning is part of the explanation.

Table 7.2 summarizes the principal object forms developed in this section. The categories are analytical resources whose boundaries can overlap. A single project may use several linked specifications when the research question spans different registers or levels of organization.

The table also anticipates a recurrent principle of Chapter 7: a research object is specified through a relation among question, manifestation, representation, and inferential purpose. The sections that follow will refine boundary, scale, and identification procedures. The present section establishes the object forms on which those procedures operate.

7.3.1 Provisional Entities

Relational inquiry often requires entities. Persons, households, firms, agencies, schools, platforms, states, datasets, documents, and technologies can provide analytically useful units. Relational analysis therefore does not require dissolution of entityhood. It asks how an entity is being individuated for the research purpose and which relations are relevant to that individuation.

An entity can be provisionally specified through several criteria. Legal recognition can establish one form of continuity. Organizational membership can establish another. Bodily continuity, control over resources, account identity, spatial location, functional role, or shared institutional treatment can each support entity specification under different questions. The choice influences the inquiry. A household defined administratively can differ from a household reconstructed through care, co-residence, financial transfer, or self-identification. A platform account can represent a person, organization, automated agent, shared role, or strategically managed interface. A state can be treated as a legal actor in one inquiry and as a heterogeneous configuration of agencies, offices, infrastructures, and authority relations in another.

Definition 7.19 (Provisional entity). A *provisional entity* is an analytically individuated unit whose identity and continuity are specified sufficiently for the research question while remaining open to decomposition, aggregation, or reclassification when consequential internal or external relations become visible.

This definition preserves a practical middle position. Entity categories can support measurement, comparison, interviewing, archival organization, or formal modeling. Their use gains methodological strength when the criteria of individuation are visible. A researcher studying organizational inequality, for example, may initially treat a university as one entity for comparison across institutions. Inquiry into internal

Table 7.2: Research-object forms and characteristic specification questions

Object form	Provisional specification	Characteristic evidential interface	Possible revision trigger
Entity	Criteria of individuation, continuity, membership, and relevant internal relations	Legal, administrative, observational, testimonial, material, or computational traces	Internal heterogeneity becomes consequential to the claim
Relation	Relata, relation semantics, directionality, temporality, and mode of realization	Interaction, record, testimony, rule, transfer, co-presence, or inferred pattern	Manifestations support competing relational interpretations
Higher-order relation	Relations or configurations functioning as relata or conditioning structures	Multi-source relational records, nested observation, comparative or formal reconstruction	Relation types or levels are conflated by the initial representation
Configuration	Patterned arrangement among multiple entities and relations	Network, institutional, ethnographic, documentary, statistical, or formal representation	Local relations fail to explain configuration-level regularities
Field	Distributed conditions, positions, gradients, or constraints across a relational domain	Recurrent cross-case patterns, positional differences, institutional traces, spatial or temporal distributions	Pairwise or organizational explanation proves sufficient, or field attribution lacks distinctive support
Institution	Stabilized rules, roles, practices, authority, infrastructures, and expectations	Legal texts, administrative records, routines, testimony, observation, enforcement and resource flows	Formal rules and enacted relations diverge materially
Symbolic object	Category, representation, narrative, model, sign, or classificatory form with relational effects	Textual, legal, administrative, statistical, media, or computational representation	Meaning, uptake, or performative effects change across settings or time
Historical object	Event, trajectory, period, category, or process individuated through temporal relations	Archives, longitudinal traces, oral history, material records, retrospective reconstruction	Periodization, category meaning, or continuity criteria become unstable

allocation may later require decomposition into departments, laboratories, administrative offices, funding streams, and employment categories. The earlier specification can remain useful for one claim while becoming too coarse for another.

The epistemology of manifestation also matters here. Administrative entities can acquire apparent solidity because records are organized around them. A database may provide one row per household or organization, encouraging the analyst to treat that unit as naturally given. Section 116 showed that representation can organize what becomes epistemically available, while Section 117 showed that classifications

can become performative. Entity specification should therefore record whether the unit originates from the research question, from institutional practice, from a data system, from participant self-understanding, or from a later analytical reconstruction.

A provisional entity can also have porous membership. Collaborative teams, communities, informal organizations, migratory households, online collectives, and research networks may have participants with different degrees or durations of inclusion. Binary membership can then obscure the relation through which membership is enacted. Later sections on boundary construction and scale selection will provide more detailed procedures for these cases. At the present stage, the object specification should make uncertainty about membership visible rather than converting it prematurely into a fixed boundary.

Caution 7.20 (Entity reification). An entity specification can become misleading when the analytical unit is treated as internally homogeneous or historically continuous beyond the evidence required for the claim. Relational inquiry should preserve a route for decomposing or reclassifying the entity when internal differentiation becomes consequential.

Caution 7.20 connects directly to ontological restraint. Analytical convenience can justify a provisional unit without establishing that the unit is fundamental, homogeneous, or invariant.

7.3.2 Candidate Relations

Once provisional entities or other relata have been identified, relational inquiry specifies candidate relations. A candidate relation is a proposed form of connection, dependence, differentiation, coordination, constraint, recognition, transfer, obligation, influence, exchange, co-constitution, or other structured linkage whose evidential status remains to be investigated. The adjective *candidate* is important because the relation should not enter the analysis as established merely because a dataset contains an edge, an institution uses a category, or participants employ a familiar term.

Candidate-relation specification begins with semantics. The researcher should state what kind of relation is being proposed. “Connected to,” “associated with,” “works with,” “depends on,” “trusts,” “governs,” and “exchanges with” carry different relational meanings. A formal representation that reduces them to a common edge type can be useful for a limited purpose, yet the reduction should remain visible. The same pair of entities can participate simultaneously in contractual, affective, legal, informational, financial, spatial, and hierarchical relations whose interaction matters to the research question.

The specification can also record directionality, reciprocity, sign or valence where meaningful, intensity, temporality, and conditions of activation. An obligation can exist before enforcement. A trust relation can persist through intervals with little observable interaction. A contractual relation can be formally symmetrical while operating through asymmetric dependence. A transfer relation can be directional even when the wider relationship contains reciprocal exchange. These features need not be quantified at the specification stage; they should be conceptually available so later methods can determine which features require evidence.

The inverse problem of manifestation is especially consequential for candidate relations. A recorded interaction can support several relational interpretations. Re-

peated messages can indicate collaboration, supervision, conflict, dependency, or routine administration. Co-location can support opportunity for interaction without establishing a meaningful relation. A legal contract can establish formal obligations while leaving enacted practice partly unresolved. Testimony can directly reveal experienced meaning while remaining situated in a relational and historical context. Candidate-relation specification therefore benefits from stating the evidential pathway through which manifestations are expected to bear on the relation.

Definition 7.21 (Candidate relation). A *candidate relation* is a provisionally specified relational form whose relata, semantic content, relevant temporal conditions, and expected evidential manifestations are stated sufficiently to permit identification, comparison, or attempted falsification in later inquiry.

The definition treats candidate relations as objects of investigation. Section 172 will address identification standards in detail. At the specification stage, the researcher is preparing those standards by making the relation explicit enough that evidence can count for or against it.

Contingent encounter can enter at this point. A candidate relation may originate from an unexpected phrase in an interview, an archival juxtaposition, a spatial pattern, a surprising residual, an institutional inconsistency, or an aesthetic recognition of structural similarity across domains. Such origins can be epistemically productive without settling the relation's validity. The move from encounter to specification converts an initial salience judgment into an inspectable proposal whose evidence, alternatives, and boundaries can later be examined.

7.3.3 Higher-Order Relations

Some research questions concern relations whose relata are themselves relations, configurations, roles, or structured interactions. Section 121 developed the epistemology of higher-order relational knowledge; the methodological problem here is how to specify such objects before choosing techniques for reconstructing them.

A higher-order relation can appear when one relation conditions another. A funding relation can alter the relation between a laboratory and its research agenda. A legal relation can structure the bargaining relation between employer and worker. A kinship relation can affect the meaning of a financial transfer. A platform's moderation relation with users can reshape relations among users. In each case, the object of inquiry may exceed a collection of pairwise ties because the relation among relations is substantively consequential.

Higher-order specification requires care with levels. A researcher can distinguish a relation among relations from a relation among entities represented in several layers. A multilayer network may contain friendship, advice, authority, and resource-transfer ties among the same actors. A higher-order claim goes further when the inquiry proposes that the configuration or state of one relation changes the operation, meaning, or possibility of another. The methodological burden therefore includes stating the conditioning relation rather than relying solely on visual or formal complexity.

Definition 7.22 (Higher-order relational object). A *higher-order relational object* is a provisionally specified relation or configuration in which one or more relata are themselves relations, relational positions, or relational configurations, or in which the interaction among relation types is part of the substantive claim.

Evidence for such an object can be distributed across sources. Legal documents may establish one relation, interviews another, transaction records a third, and temporal comparison the conditioning pathway among them. This makes provenance particularly important. The researcher should be able to reconstruct which evidence supports each lower-order relation and which additional evidence supports the higher-order linkage.

The specification should also preserve inherited uncertainty. If the existence or meaning of a lower-order relation remains uncertain, confidence in the higher-order object can be affected. A mathematically elegant representation does not remove that dependence. Formalization can clarify how relations combine; empirical and interpretive work determines whether the represented relations and conditioning pathways have adequate support in the target field.

7.3.4 Relational Configurations

Relational configurations become relevant when the arrangement among several entities and relations carries analytical significance beyond isolated dyads. A configuration can include clusters, chains, hierarchies, cycles, nested structures, brokerage positions, overlapping memberships, institutional arrangements, or other patterned organizations of relation. The configuration is specified as an object when the research question concerns how these relations coexist, constrain one another, or produce a recognizable structure.

The distinction between configuration and relation is one of analytical resolution. An employment relation can be studied dyadically. The organization in which employment occurs may also be represented as a configuration involving authority, ownership, division of labor, information, evaluation, technology, and resource allocation. A household transfer can be examined as one directional relation, while the wider configuration may include care, inheritance, co-residence, obligation, migration, and recognition. Configuration specification becomes informative when the arrangement changes what individual relations mean or what possibilities they support.

Definition 7.23 (Relational configuration). A *relational configuration* is a provisionally bounded arrangement of multiple entities, relations, positions, or higher-order relations whose organization is analytically relevant to the research question.

Configuration specification should identify the organizing features that matter. A network representation can emphasize topology. An institutional analysis can emphasize roles and rules. Ethnographic reconstruction can emphasize enacted practice and meaning. A formal model can emphasize interaction rules or state transitions. Several representations can refer to the same empirical setting while specifying different configuration objects. Section 7.2 therefore matters directly: methodological traditions provide distinct access relations to configurations and can correct one another where representations diverge.

A configuration should also retain historical indexation. Apparent structural similarity across two moments can conceal changes in relation semantics, membership, technology, or institutional context. Conversely, visible changes in membership can coexist with persistent organizational relations. Section 120 distinguished relational identity from immobility; configuration specification carries that distinction forward by making the criteria of continuity available for later analysis.

Proposition 7.24 (Configuration-sensitive specification). *Where the meaning, persis-*

tence, or consequence of a candidate relation depends materially on surrounding relations, the research object gains adequacy from specifying the relevant configuration rather than treating the focal relation as context-free.

The proposition is conditional. Some questions can be answered with a focused relation. Configuration-level specification becomes valuable when surrounding relations alter the claim or evidential interpretation.

7.3.5 Fields

A field specification is useful when the inquiry concerns distributed conditions that organize possibilities across a relational domain without being adequately represented as a finite set of directly observed pairwise relations. Section 122 distinguished field reconstruction from dense-network description. The methodological task is to state what kind of distributed condition is being proposed and what observations could make that proposal informative.

Fields can be specified through positions, gradients, constraints, opportunities, symbolic valuations, resource distributions, institutional pressures, or recurrent directional tendencies across a domain. The field concept can therefore help describe cases in which similarly positioned actors encounter comparable pressures despite lacking direct ties, or in which local interactions repeatedly display patterned orientation toward a wider structure.

The term should remain analytically disciplined. A field label can become a placeholder for unexplained context if the distributed condition is not specified. Calling an environment a “political field,” “economic field,” “cultural field,” or “epistemic field” provides limited methodological leverage until the inquiry identifies the positions, resources, rules, gradients, evaluative structures, or other relations through which field effects are expected to appear.

Definition 7.25 (Provisional field object). A *provisional field object* is a specified relational domain in which distributed positions, constraints, gradients, resources, or evaluative conditions are hypothesized to organize local possibilities or interactions across more than one directly observed relation.

Field specification therefore includes a distinctive evidential question: what pattern would be difficult to account for through the observed local relations alone and would become more intelligible under the proposed distributed condition? The answer can involve recurrent positional differences, parallel adaptations across disconnected actors, spatial gradients, institutional convergence, symbolic hierarchies, or other patterned manifestations. Later field-based relational analysis in Section 191 will develop the relevant methods.

Ontological suspension remains especially useful here. A field representation can organize evidence without requiring the researcher to claim that the social world literally possesses a field in the same ontological sense as a physical field. The methodological value rests on explanatory and evidential adequacy within the specified domain, together with explicit limits on the analogy.

7.3.6 Institutions

Institutions often appear as ready-made research objects because legal systems, administrative classifications, organizational charts, and public discourse already name them. Relational specification asks what configuration of rules, roles, practices, expectations, authority, infrastructures, resources, and symbolic recognition makes the institution effective in the research setting.

The distinction between formal institution and enacted institution is methodologically significant. A rule can exist in law or policy while being weakly enforced, unevenly interpreted, or displaced by informal practice. Conversely, stable practices can acquire institutional force before complete formal codification. An institution can therefore be studied through several linked objects: its formal representation, the relations through which it is enacted, the actors and infrastructures that sustain it, and the manifestations through which participants encounter it.

Definition 7.26 (Institutional research object). An *institutional research object* is a provisionally specified configuration of rules, roles, practices, authority relations, expectations, infrastructures, and symbolic or material supports through which a recurrent pattern of coordinated or constrained action is stabilized over a relevant domain and interval.

This specification does not require each listed component to be present with equal strength. Its purpose is to prevent the institutional label from substituting for relational reconstruction. A court, market, university, ministry, welfare regime, research field, or platform-governance arrangement can each involve distinct combinations whose empirical realization should be specified locally.

Institutional objects also illustrate performative representation. Legal classifications, rankings, administrative categories, eligibility rules, and algorithmic classifications can describe institutional relations while also contributing to their reproduction or transformation. Sections 117 and 131 showed why representation and reflexive observation can enter the object itself. A research design that studies such institutions may therefore need to distinguish the institution before a representation, the representation as manifestation, and the later institution partly reorganized through that representation.

Institutional specification also creates a bridge to later ethical analysis. Which relations count as institutional can affect responsibility, visibility, and the allocation of causal or normative attention. A narrow specification may place responsibility on individual actors while leaving infrastructural or rule-based constraints outside the frame. A broader specification may illuminate those constraints while reducing detail about local agency. Boundary and scale choices therefore remain explicit rather than being settled by the institutional name alone.

7.3.7 Symbolic Objects

Relational inquiry frequently encounters objects whose efficacy depends partly on symbolization: categories, narratives, classifications, legal concepts, models, metrics, rankings, images, identities, doctrines, currencies, reputational signs, and other represented forms. Chapter 4 distinguished manifestational reality from relational reality, and Sections 116–117 examined symbolization and performative representation. Methodologically, symbolic objects require specification at the junction of meaning,

representation, uptake, and relational consequence.

A symbolic object can be studied as a representation with semantic content. It can also be studied as a relationally real object when repeated uptake gives it persistence and efficacy within a system. A credit rating, credential, legal status, organizational label, or monetary denomination can affect access, expectations, authority, or resource flows because actors and institutions orient their conduct around the symbolized form. The relevant research object may therefore include both the symbolic representation and the relations through which that representation becomes consequential.

Definition 7.27 (Symbolic research object). A *symbolic research object* is a provisionally specified sign, category, representation, narrative, model, or classificatory form whose meaning, circulation, uptake, or relational effects are relevant to the research question.

Symbolic specification should distinguish several questions. What does the object mean in the relevant setting? Who can produce, authorize, interpret, contest, or modify it? Through which media and institutions does it circulate? Which manifestations indicate uptake? Which relations does it describe, stabilize, obscure, or transform? These questions prevent the analysis from equating symbolic presence with shared meaning or causal efficacy.

Machine-mediated inquiry adds further complexity. A computational category can operate symbolically for human participants while also functioning operationally inside an automated system. A risk score, recommendation category, similarity metric, or model-generated label may affect later decisions even when its internal meaning is opaque to those classified. Section 130 treated such cases as machine-mediated relational knowledge. Object specification should preserve the relation among training or source data, model representation, operational classification, institutional uptake, and experienced consequence when those layers matter to the inquiry.

Symbolic objects also illustrate why aesthetic judgment and epistemic judgment should remain distinct. A researcher can be drawn to a metaphor, category, image, or formal pattern because it appears unusually elegant or generative. That salience can open a productive research trajectory. The symbolic object's analytical role still requires evidence concerning meaning, circulation, relation, and effect. Aesthetic recognition can orient the encounter while methodological specification prepares the object for epistemic examination.

7.3.8 Historical Objects

Historical inquiry requires objects whose identity unfolds through time. Events, periods, institutional formations, categories, trajectories, crises, reforms, movements, technological transitions, and long-run relational configurations can function as historical objects. Their specification differs from a static snapshot because temporal boundary, sequence, continuity, transformation, and retrospective reconstruction become constitutive parts of the research problem.

Section 125 developed trajectories and historical knowledge, while Section 120 addressed relational identity and persistence. Those epistemic commitments imply that a historical object should state the criterion under which temporally separated manifestations are being treated as parts of the same trajectory or formation. A category whose name persists can change in meaning. An institution can retain legal conti-

nuity while its enacted relations transform. A movement can change membership and organization while preserving a recognizable problem orientation. A crisis can be bounded narrowly around a visible rupture or more broadly around the relations that prepared and prolonged it.

Definition 7.28 (Historical research object). A *historical research object* is a provisionally individuated event, trajectory, period, category, institution, or relational configuration whose identity depends materially on temporal sequence, continuity, transformation, or historically situated interpretation.

Historical specification should therefore record periodization and category semantics. The beginning and end of an object can depend on the research question. A policy reform may begin with legislation, with implementation, with anticipatory behavior, or with earlier institutional preparation. Its effects can persist after formal repeal. Several periodizations can remain analytically useful if their purposes are explicit. The same discipline applies to historical categories. Researchers can preserve the language of historical actors while also constructing analytical categories for comparison; the relation between these two vocabularies should remain visible.

Historical objects also depend on archives and preserved traces whose survival is uneven. The available record can overrepresent institutions with durable documentation and underrepresent relations expressed through oral practice, informal exchange, marginalized communities, destroyed records, or transient digital infrastructures. The specification should therefore include the conditions under which the historical object becomes knowable. Absence from the record can reflect disappearance of the relation, weak manifestation, archival loss, exclusion, or inaccessible evidence. These possibilities carry different implications.

Contingent encounter can be especially productive in historical specification. A previously ignored document, marginal notation, visual artifact, dataset, testimony, or juxtaposition between periods can make a latent relation salient. The initial encounter can change the proposed object: a seemingly bounded event becomes a longer trajectory; a familiar institution becomes a history of category change; a peripheral actor becomes central to the relational reconstruction. Such revisions illustrate why historical object specification benefits from preserving provenance and alternative periodizations rather than converging too early on one canonical narrative.

7.3.9 Revisable Object Specification

The preceding subsections treat research objects as provisional achievements of inquiry. Revisability brings those forms together into a methodological discipline. Object specification should be stable enough to support evidence collection, comparison, modeling, interpretation, and communication while remaining responsive to evidence that the initial individuation obscures consequential relations.

Several kinds of evidence can trigger revision. New data can reveal hidden internal heterogeneity. Participant testimony can challenge the meaning assigned to an institutional category. Historical evidence can show that a supposedly stable entity changed its criteria of membership. Formal analysis can reveal that a dyadic representation omits a higher-order dependency required by the mechanism. Cross-scale comparison can show that the relation changes under aggregation. Computational inference can identify a pattern that requires qualitative interpretation before it can

support a relational claim. An intervention can also change the object itself, especially where measurement, classification, or publication becomes performative.

Definition 7.29 (Object-specification revision). An *object-specification revision* is a documented change in the individuation, type, constituents, relational semantics, temporal identity, or representational mapping of a research object in response to evidence that the earlier specification materially limits the inquiry's intended claim.

Revision can take several forms. An entity can be decomposed into a configuration. A relation can be differentiated into several relation types. A configuration can be reframed as a field when distributed conditions matter. A formal institution can be linked to enacted practice. A symbolic object can be treated as performative after evidence of uptake. A snapshot can become a historical object when temporal dependence becomes explanatory. The reverse movements can also occur. Detailed relational reconstruction may show that a simpler entity-level object is adequate for a particular comparison. Field language can be set aside when local relations account sufficiently for the observed pattern. Revisability therefore supports both greater complexity and justified simplification.

A revision record should preserve the earlier specification, the evidence motivating change, the new specification, and the consequences for earlier findings. This follows the revisability architecture of Section 131 and the cumulative research practice developed in Section 164. Preserving versions allows later readers to determine whether a change in results arose from new evidence, altered object definition, boundary revision, scale change, or transformation in the field itself.

Proposition 7.30 (Object-specification discipline). *Relational inquiry gains methodological clarity when the research object is treated as an explicit, question-relative, evidence-sensitive, and versionable specification whose criteria of individuation can be examined separately from claims about the object's ultimate ontology.*

Proposition 7.30 summarizes the section's bridge from ontology and epistemology into method. Ontological suspension permits the analyst to work with provisional objects without converting analytical individuation into metaphysical closure. Relational and manifestational distinctions require the researcher to state how evidence provides access to the proposed object. Historical and scale sensitivity keep object identity open to transformation. Research praxis adds responsibility for how categories and representations affect participants, institutions, and later inquiry.

The same discipline also clarifies the role of contingent encounter and aesthetic judgment. An inquiry may begin because a relation, category, configuration, or historical juxtaposition appears unexpectedly significant before the researcher possesses a complete evidential account. Object specification gives that recognition a researchable form. It records what has become salient, how the proposed object is being individuated, which manifestations could bear on it, and what evidence could require its revision. In an environment where AI can rapidly generate candidate concepts, classifications, models, and relational interpretations, this conversion from salience to accountable specification may become increasingly consequential.

Research-object specification therefore prepares the next methodological problem. Once an object has been provisionally individuated, the inquiry needs to determine what lies within the analytical domain, which relations cross or constitute its edge, and how permeability or uncertainty at that edge should be represented. Section 170 develops this problem through boundary construction.

7.4 Boundary Construction

Section 7.3 treated the research object as a provisional and revisable epistemic specification. The present section develops the next methodological operation: construction of the boundary within which that object is investigated. Its role is to make inclusion, exclusion, interface, and cross-boundary relations explicit parts of research design. The objective is to specify how analytical, spatial, temporal, institutional, and relational boundaries can delimit a tractable domain without converting that delimitation into an unwarranted claim that relational reality itself terminates at the same edge. The section therefore examines analytical boundaries, spatial and temporal delimitation, institutional edges, relational neighborhoods, permeability, sensitivity to alternative boundaries, and procedures for revision.

The epistemological foundation for this operation was established in Section 119, which defined an epistemic boundary as a stated rule of inclusion and exclusion and argued that the warrant of relational knowledge can depend on the boundary under which evidence has been assembled. Chapter 7 translates that conclusion into research practice. Boundary construction determines which entities, relations, events, traces, intervals, and environments enter the immediate analysis; which are provisionally treated as external conditions; and which interfaces remain visible because they may transmit effects across the analytical edge. In this sense, a boundary forms part of the inferential architecture of a study; its role exceeds that of a neutral container placed around an already completed object.

Several intellectual traditions already provide resources for this problem. Simon's account of near-decomposable organization shows why relatively bounded subsystems can sometimes support useful analysis while remaining connected to wider structures (Simon 1962). Network analysis similarly directs attention to clusters, positions, ties, and relational neighborhoods whose analytical boundaries need not coincide with conventional group categories (Wellman 1983). Multiscale analysis emphasizes that organization visible at one scale can differ from organization visible at another (Bar-Yam 2004), while social-ecological systems research provides a practical example of boundary construction across linked resource, governance, user, and interaction domains (Ostrom 2009). The methodological lesson drawn here is limited: useful boundaries can correspond to durable structures in the world, to institutional classifications, or to question-specific analytical decisions, and their adequacy should be evaluated through the claims they are intended to support.

Definition 7.31 (Methodological boundary construction). *Methodological boundary construction* is the explicit, question-relative specification of the entities, relations, events, traces, intervals, environments, and interfaces included within the immediate analytical domain of an inquiry, together with the criteria of exclusion, the treatment of cross-boundary relations, and the conditions under which the boundary would be revised.

Definition 7.31 emphasizes construction without implying arbitrariness. Some boundaries are legally instituted, physically consequential, organizationally enforced, ecologically structured, or historically stabilized. Others are introduced by the researcher to make observation or representation manageable. In either case, the methodological task is to state what the boundary does for the inquiry and which consequences follow from treating particular relations as internal, external, or boundary-crossing.

Table 7.3: Boundary dimensions and characteristic methodological questions

Boundary dimension	Primary delimitation	Characteristic boundary-crossing issue	Possible revision trigger
Analytical	Question-relative inclusion of relevant entities, relations, and conditions	Omitted relation materially alters the intended claim	Residual pattern, alternative explanation, or participant evidence reveals consequential exclusion
Spatial	Territory, distance, ecological region, infrastructure, or location	Mobility, remote interaction, resource flow, or jurisdiction crosses the perimeter	Effects cluster outside the selected area or depend on spatially distant relations
Temporal	Observation window, episode, period, lag, or historical interval	Antecedent conditions, anticipation, delayed effects, or persistence exceed the window	Changing results under plausible start, end, or lag specifications
Institutional	Membership, jurisdiction, authority, ownership, rule system, or organizational responsibility	Outsourcing, inter-organizational dependence, informal practice, or overlapping authority	Formal and enacted boundaries diverge materially
Relational neighborhood	Relation type, path length, interaction frequency, dependency, or functional connection	Relevant actors or relations lie beyond the initial relational horizon	Expanding the neighborhood changes interpretation or mechanism
Permeability and interface	Conditions governing passage across an analytical or instituted edge	Selective flows of persons, resources, information, value, symbols, or authority	Boundary-crossing processes become constitutive of the object or outcome

Table 7.3 summarizes the boundary dimensions developed below. The dimensions can overlap. A single project may use a territorial boundary for sampling, an institutional boundary for authority, a temporal boundary for exposure, and a relational neighborhood for tracing effects. Their combination should remain inspectable because different combinations can generate different research objects and different inferential reach.

The table also anticipates a central discipline of this section. Boundary construction should preserve the difference between delimiting an inquiry and declaring an ontological edge. A legally incorporated firm can have a clear juridical boundary while its productive capacities depend on suppliers, households, infrastructures, financial institutions, software platforms, and regulatory systems. A school can have a formal membership boundary while learning relations extend through families, online communities, examinations, and labor markets. The methodological question concerns which of these relations need to remain inside the immediate explanatory frame for a specified claim.

7.4.1 Analytical Boundaries

An analytical boundary specifies the immediate domain within which a research claim is constructed. It identifies which parts of a relational configuration are treated as focal, which are represented as contextual conditions, and which remain outside the present inquiry. The boundary therefore operationalizes a theory of

relevance. It helps make inquiry tractable while also shaping what can appear as cause, context, mechanism, consequence, or remainder.

Analytical boundaries often arise before data collection. A project can delimit itself to employees within one organization, transactions within a platform, policies within a jurisdiction, or relations among organizations participating in a programme. Such decisions determine sampling frames, documentary searches, interview recruitment, measurement, model structure, and later generalization. They can also arise during inquiry. A study that begins with a bounded organization may discover that a procurement rule, financing relation, family arrangement, or external platform materially structures the relations observed inside the organization. The boundary then becomes an empirical question whose adequacy can be investigated directly.

The distinction between internal and external relations is consequently boundary-relative. A relation classified as external for one purpose can become internal for another. Credit relations may remain external to a narrow study of workplace communication while becoming internal to an inquiry into organizational survival. A household transfer can remain outside a firm-level productivity model while becoming central to a study of labor reproduction. The classification carries methodological meaning only when the research question and boundary are stated together.

Claim 7.32 (Boundary-relative inferential reach). *When relations excluded by an analytical boundary plausibly contribute to the formation, persistence, interpretation, or transformation of the target object, the inferential reach of the study depends partly on how those relations are represented, tested, or acknowledged.*

Claim 7.32 supports deliberately scoped inquiry with conclusions calibrated to that scope. A study can remain deliberately narrow when its conclusion is correspondingly narrow. The practical problem arises when the analytical reach of the conclusion exceeds the relational reach of the evidence. A localized study may support strong claims about a specified process while leaving broader institutional, ecological, or historical implications open.

Boundary provenance helps maintain this alignment. A research record can state whether a boundary follows law, administrative data, physical access, institutional membership, a theoretical mechanism, sampling feasibility, ethical constraint, or a preliminary relational reconstruction. These origins matter because a boundary inherited from a dataset can appear more natural than it is. Administrative records frequently define the universe of visible entities in advance; platform data can privilege interactions that leave machine-readable traces; legal categories can determine which organizations or persons appear as formally recognized actors. Methodological transparency requires the researcher to distinguish convenience of access from evidence that the same boundary is analytically adequate.

Analytical boundaries also have an ethical dimension. Exclusion from the immediate analytical frame can reduce visibility of actors or consequences that are already weakly represented in the available evidence. A bounded study can remain appropriate while some affected relations lie outside its scope. Boundary decisions deserve greater scrutiny when they systematically remove groups, forms of labor, informal practice, ecological dependence, or downstream consequences that are relevant to the claim. Epistemic humility therefore begins partly with stating what the analysis has left outside.

7.4.2 Spatial Boundaries

Spatial boundaries delimit inquiry through location, territory, distance, ecological region, built environment, administrative geography, or infrastructural reach. They can be highly consequential because many forms of social and economic organization are spatially structured. Residence, transport, property, jurisdiction, resource access, environmental exposure, and face-to-face interaction can depend on spatial position. At the same time, spatial proximity and relational inclusion need not coincide.

A city boundary, district, watershed, campus, workplace, market area, or service region can provide a useful sampling or analytical frame. Its adequacy depends on the process under study. A municipal boundary may be appropriate for a question about local administrative authority while proving too narrow for commuting, housing finance, food supply, air pollution, digital communication, or care networks. A workplace perimeter can capture co-presence while omitting remote coordination and household conditions. A national border can have major legal force while transnational finance, supply chains, migration, media, and knowledge flows remain analytically consequential.

Spatial boundary construction should therefore distinguish at least three relations: location of the focal object, spatial reach of the relevant mechanism, and spatial organization of the evidence. These can differ. Researchers may observe participants in one location, reconstruct a mechanism extending across several locations, and rely on data aggregated according to a third geography. Making these mappings explicit reduces the risk that the geometry of the dataset becomes the assumed geometry of the process.

Boundary zones can also deserve attention. Effects may be concentrated near an edge because institutions, prices, regulations, infrastructures, or ecological conditions change across it. In such cases, the boundary is part of the phenomenon. Comparisons across jurisdictional borders, service catchments, school districts, ecological transition zones, or platform access regimes can use boundary discontinuity as evidence, although the interpretation still depends on whether other relations change at the same edge.

Spatial boundaries can move. Administrative borders are redrawn, organizations relocate, infrastructures expand, ecosystems shift, and digital systems alter the relevance of physical distance. A longitudinal inquiry should therefore avoid assuming that a geographic unit retains identical relational meaning throughout the study period. The persistence of a name on a map may conceal transformation in mobility, connectivity, jurisdiction, or material dependence.

A useful spatial boundary record can consequently include the selected geography, the reason for its use, relevant cross-boundary flows, known edge effects, and plausible alternative delimitations. The practical objective is to preserve enough information to determine whether the claim depends on a spatial perimeter that the underlying relational process regularly exceeds.

7.4.3 Temporal Boundaries

Temporal boundaries specify when the analytical object is observed and which prior or subsequent relations enter the explanatory frame. Section 7.3.8 showed that historical objects require explicit periodization. Boundary construction extends this disci-

pline to research that may not present itself as historical. Cross-sectional, experimental, organizational, computational, and policy studies also rely on temporal windows whose placement can influence the relations that become visible.

A temporal boundary can follow a calendar interval, policy period, organizational lifecycle, event sequence, exposure window, cohort, technological regime, or period of relatively stable institutional conditions. Each choice can foreground different mechanisms. A study beginning on the date a policy is formally implemented may miss anticipatory behavior. An inquiry ending when a programme formally closes may miss persistence, displacement, or delayed effects. A crisis bounded by its most visible rupture may omit the slower relational changes that prepared it or the institutional adaptations that followed it.

Temporal delimitation also affects relation identity. A tie observed once can represent a transient interaction, an episode within a durable relation, or the first manifestation of a newly forming relation. Repeated observations can reveal persistence, rhythm, intermittency, or transformation. The evidential meaning of absence can likewise depend on the window: a relation can be inactive during the observation period while remaining institutionally available or historically consequential.

Temporal boundaries should therefore be aligned with the characteristic timescale of the research question where that timescale can be estimated. Rapid interactions, organizational routines, policy adaptation, institutional change, ecological transformation, and intergenerational processes can unfold at different rates. A single observation window may capture some dynamics while compressing others into apparently stable background conditions. Section 171 will treat scale selection directly; the present point is that temporal boundaries already encode a provisional view of which durations matter.

Sensitivity to start and end points can be informative. If a conclusion changes materially when the observation window is extended modestly, the result may indicate anticipation, lag, seasonality, path dependence, structural break, or unstable object specification. Such variation does not automatically invalidate the original analysis. It identifies a temporal condition of the claim that should remain visible.

Temporal boundaries also interact with archival survival. Earlier periods may be represented by sparse institutional records, while recent periods produce dense digital traces. Apparent historical increases in interaction, reporting, or category prevalence can therefore reflect changing manifestation and record production. A boundary-conscious analysis asks whether the temporal change belongs to the relation, the evidential interface, or some combination of both.

7.4.4 Institutional Boundaries

Institutional boundaries are produced through membership rules, jurisdiction, ownership, authority, legal status, administrative responsibility, professional competence, organizational role, and stabilized expectations. They are often especially visible because institutions generate documents that name their own edges: charters, statutes, organizational charts, contracts, eligibility rules, territorial jurisdictions, account permissions, and reporting structures. These manifestations can provide strong evidence while still leaving a distinction between formal and enacted boundaries.

A formal institutional boundary identifies who or what is recognized as belonging

to an organization, programme, jurisdiction, or rule system. An enacted boundary concerns where authority, coordination, responsibility, dependence, or expectation operates in practice. The two can coincide closely. They can also diverge. Contractors may perform core organizational functions while remaining formally external. A platform can shape transactions among nominally independent firms. Informal actors can influence decisions without holding recognized office. Standards issued by one institution can structure behavior far beyond its formal jurisdiction.

Relational methodology therefore benefits from preserving both representations when the distinction matters. A study of legal responsibility may appropriately privilege formal jurisdiction. A study of operational dependence may need to include outsourced or infrastructural relations. A study of institutional legitimacy may require both formal authority and experienced recognition. Treating one boundary as universally decisive would obscure these different research purposes.

Institutional boundaries can also overlap. A person can simultaneously participate in household, workplace, professional, legal, educational, financial, and digital institutions whose demands interact. Organizations can belong to regulatory regimes, markets, supply networks, professional associations, funding systems, and technical standards. Research focused on one institutional domain can therefore encounter cross-institutional relations that alter the meaning of behavior observed within it.

Boundary construction can become part of the object itself when institutional membership is contested. Disputes over jurisdiction, eligibility, citizenship, employment status, authorship, professional recognition, organizational responsibility, or platform participation often concern where an institution's edge should be drawn. In such cases, the researcher should avoid resolving the dispute merely by adopting one administrative representation as the analytical truth. Competing boundary claims can themselves be evidence about power, recognition, responsibility, and institutional transformation.

This issue has direct epistemic-justice implications. Institutional records can make formally recognized actors highly visible while rendering informal, excluded, precarious, or externally classified participants less visible. A boundary-aware methodology can preserve the official institutional boundary while also documenting relationally consequential actors who remain outside it. The aim is analytical transparency concerning the difference between institutional recognition and relational participation.

7.4.5 Relational Neighborhoods

A relational neighborhood delimits inquiry primarily through connection, allowing territory or formal membership to remain secondary where the research question requires it. The neighborhood can be organized around a focal entity, relation, event, institution, or configuration and can include other objects connected through specified relation types, path lengths, intensities, dependencies, temporal recencies, or functional roles. Network analysis offers a familiar representation of such neighborhoods, although relational methodology need not reduce them to graph distance alone (Wellman 1983).

Definition 7.33 (Relational neighborhood). A *relational neighborhood* is a question-relative set of entities, relations, configurations, or conditions included because they satisfy a stated criterion of relational proximity, dependence, interaction, transmission, similarity of position, or functional connection to a focal research object.

The definition permits several constructions. A first-order neighborhood can include direct contractual partners. A wider neighborhood can include suppliers of suppliers, linked institutions, or actors connected through repeated interaction. A functional neighborhood can include relations needed for a process to operate even when graph distance is large. A multiplex neighborhood can include several relation types whose combination matters to the question. A temporal neighborhood can privilege recent or recurrent relations over historically remote ones.

The selected neighborhood determines what appears local. A person's immediate communication network can differ from the network through which employment opportunities, care, political information, or financial support are obtained. An organization's contractual neighborhood can differ from its technological dependency neighborhood. A research community's citation neighborhood can differ from its collaboration, training, or institutional-funding neighborhood. The relation semantics established in Section 7.3.2 therefore need to precede or accompany neighborhood construction.

Relational neighborhoods can also reveal why conventional group boundaries are inadequate. Actors classified into different organizations, regions, sectors, or demographic categories can occupy closely connected positions in a process. Conversely, members of the same formal group can have weak or highly asymmetric relations. A relational neighborhood can therefore supplement, refine, or occasionally replace a categorical boundary when the research question concerns transmission, dependency, influence, coordination, support, or exposure.

Cutoffs should remain inspectable. Path length, interaction frequency, tie intensity, similarity threshold, or inclusion of particular relation types can change the neighborhood substantially. The methodological task is to state why the selected cutoff is relevant and to examine plausible alternatives when the conclusion depends on it. A neighborhood that expands until it includes the entire field loses its discriminating purpose; a neighborhood drawn too tightly can remove the relations through which the focal process is sustained.

Relational neighborhoods can change during inquiry. New evidence may show that a seemingly peripheral actor occupies a bridging position, that an indirect dependency is stronger than a direct tie, or that the focal relation is embedded in a higher-order configuration. Such findings provide a natural bridge to boundary revision and later to the relation-identification procedures of Section 172.

7.4.6 Permeable Boundaries

Many analytically useful boundaries are permeable. Persons, resources, information, authority, technologies, norms, environmental effects, symbols, and value can cross them selectively. Permeability can be symmetric or asymmetric, routine or exceptional, legally regulated or informal, stable or historically changing. Treating a boundary as permeable makes cross-boundary relations part of the research design without requiring the immediate domain to expand indefinitely.

Definition 7.34 (Boundary permeability). *Boundary permeability* is the specified capacity of a methodological or instituted boundary to permit, channel, transform, restrict, or differentially expose cross-boundary relations relevant to the research object and claim.

This definition emphasizes interfaces. A boundary may operate as a selective filter

as well as a separation. A border can permit some forms of movement while restricting others. An organization can receive capital, data, standards, and technologies while limiting membership or decision authority. A household can exchange care, labor, money, information, and obligations through different interfaces. A scientific field can admit methods or concepts from neighboring disciplines while maintaining distinct standards of evidence or professional identity.

Permeability can itself be structured by power. Access conditions, fees, credentials, legal status, language, technical standards, platform permissions, infrastructure, or social recognition can determine who crosses a boundary and under what terms. An analysis concerned with distribution, vulnerability, or generative capacity may therefore need to treat the interface as part of the research object and examine its operation directly. The same boundary can be open for one actor and restrictive for another.

Cross-boundary relations can also be constitutive. A firm whose production depends on external suppliers, credit, software infrastructure, and household labor reproduction may remain legally bounded while its operational persistence is generated through recurrent exchange across that boundary. A social-ecological system can depend on interactions among resource, governance, and user components that do not share one simple perimeter (Ostrom 2009). Simon's near-decomposability provides one formal intuition: relative autonomy can coexist with non-negligible coupling across subsystem boundaries (Simon 1962). These examples support a methodological distinction between boundary existence and boundary closure.

Permeability also has an epistemic dimension. Evidence can cross the boundary differently from the relation itself. Researchers may observe internal records while lacking access to external negotiations; they may possess transaction data without information about informal coordination; they may observe outcomes inside a jurisdiction while the decision process occurred elsewhere. The boundary of observation can therefore differ from the boundary of the process. This difference should be recorded when it bears on inference.

Digital and AI-mediated research makes the issue especially visible. A dataset may appear bounded because an API, archive, platform, or model exposes only a defined universe of records. The computational interface can then become an unnoticed epistemic boundary. Expanding technical access can enlarge the record while still leaving unrecorded relations, private infrastructures, or missing historical contexts outside the representation. Computational abundance reduces some access costs, but it does not by itself settle where the relevant relational boundary lies.

7.4.7 Boundary Sensitivity

Boundary sensitivity asks whether a result, interpretation, or inferred mechanism changes under plausible alternative delimitations. The procedure is analogous to sensitivity analysis in other methodological settings, but its object is the construction of the analytical domain. It can involve expanding or contracting a spatial region, moving a temporal start or end point, changing a relational cutoff, comparing formal and enacted institutional membership, including or excluding a cross-boundary interface, or testing nested versions of the research object.

Definition 7.35 (Boundary sensitivity analysis). A *boundary sensitivity analysis* is a structured comparison of an inquiry's conclusions under substantively plausible alternative boundary specifications, undertaken to identify which claims remain stable,

which depend on a particular delimitation, and which omitted relations require further investigation.

Boundary sensitivity does not require exhaustive enumeration of possible boundaries. The space of conceivable delimitations can be very large. The researcher can prioritize alternatives supported by theory, participant knowledge, institutional structure, historical evidence, model diagnostics, prior findings, or observed cross-boundary flows. The purpose is to test materially plausible alternatives and avoid artificial robustness produced by arbitrary perturbation.

Several outcomes are informative. A claim can remain relatively stable across tested boundaries, increasing confidence that the result persists beyond one narrow delimitation. A claim can weaken gradually as the boundary expands, suggesting a localized process. It can reverse under a different institutional or temporal frame, indicating substantial boundary dependence. A mechanism can remain stable while effect magnitude changes. Different boundary choices can also reveal distinct processes that coexist within the same broader field.

Stability under tested boundaries should be interpreted with care. Boundary robustness supports a limited conclusion about the alternatives examined; it does not establish universal invariance. Likewise, boundary sensitivity need not be treated as a defect. If a process is genuinely jurisdiction-dependent, spatially localized, historically bounded, or conditional on a relational neighborhood, sensitivity can be an accurate description of the phenomenon. The methodological contribution lies in identifying the dependency and making its conditions visible.

Boundary sensitivity can also operate qualitatively. Interviewees may identify actors or institutions the formal design omitted. Archival evidence can show that a jurisdictional line had different practical meaning in an earlier period. Ethnographic observation can reveal routine crossings of a boundary that administrative records present as firm. Formal modeling can show that a conclusion requires treating an external parameter as fixed. These forms of evidence can motivate targeted boundary alternatives even when the study does not employ numerical robustness analysis.

Remark 7.36 (Boundary remainder). A *boundary remainder* is a relation, condition, actor, or consequence placed outside the immediate analytical domain whose exclusion remains potentially relevant to interpretation. Recording such remainders helps later inquiry distinguish deliberate scope limitation from unnoticed omission.

The remark gives a practical form to epistemic humility. A research design can acknowledge a relevant remainder while leaving its resolution to later inquiry. This is especially useful in cumulative research, because later work can revisit the omitted relation with new evidence, methods, or scales while retaining a clear record of the original boundary decision.

7.4.8 Boundary Revision

Boundary revision occurs when evidence indicates that the existing analytical edge has become insufficient for the intended claim. Revision can expand, contract, relocate, split, nest, or change the permeability assigned to a boundary. It can also alter the relation between several boundaries: a spatial frame can remain fixed while an institutional boundary expands; a temporal window can widen while a relational neighborhood becomes more selective; a formal jurisdiction can remain one analytic layer while an enacted authority network is added as another.

Several forms of evidence can motivate revision. Unexpected residual patterns can cluster outside the original region. Participants can identify external actors who shape an apparently internal process. Archival evidence can show that a relevant relation began earlier than the selected period. A formal model can require an external dependency that the initial specification treated as exogenous. Cross-scale analysis can show that aggregation conceals a boundary-crossing mechanism. An intervention can change the permeability of the boundary itself. A newly available dataset can reveal relations that earlier evidence could not represent.

Contingent encounter can also play a role. A researcher may encounter an unexpected document, conversation, spatial pattern, institutional inconsistency, or model residual that makes a cross-boundary relation suddenly salient. Aesthetic judgment can contribute to the initial recognition that the anomaly is worth following. Methodological revision begins when that recognition is translated into a testable question about the boundary: whether the newly noticed relation is recurrent, causally consequential, interpretively necessary, or structurally constitutive of the object. The encounter can therefore open the boundary without by itself establishing the revised account.

Definition 7.37 (Boundary revision). A *boundary revision* is a documented alteration of the inclusion, exclusion, interface, or permeability rules of a research design in response to evidence that the earlier boundary materially constrains the adequacy of the intended claim.

A revision record should preserve the prior boundary, the evidence motivating change, the revised specification, and the consequences for earlier findings. This mirrors the versioning discipline developed for research objects in Section 7.3.9. It also supports cumulative inquiry: later researchers can determine whether disagreement arose from new evidence, changed relation semantics, different scale, or a different boundary around the same nominal object.

Boundary revision can also justify simplification. An expanded exploratory design may reveal that several external relations have little bearing on the target claim, allowing a more compact boundary to be defended. A highly porous institutional representation can be narrowed when evidence shows that only one interface materially conditions the outcome. Revisability therefore supports both expansion and disciplined contraction.

Proposition 7.38 (Boundary-construction discipline). *Relational inquiry gains methodological clarity when boundaries are treated as explicit, question-relative, evidence-sensitive, and versionable specifications whose analytical usefulness can be distinguished from claims about the ultimate extent of the relational reality under study.*

Proposition 7.38 completes the movement from object specification to domain construction. The research object of Section 7.3 gives the inquiry a provisional target. Boundary construction specifies the immediate relational domain through which that target will be examined. The two operations remain distinct: an object can retain its analytical identity while the boundary around its relevant environment expands, contracts, or becomes more permeable.

The distinction also prepares the next methodological problem. Boundary answers which relations, entities, intervals, and environments are included in the immediate domain. Scale addresses the level and resolution at which organization within and across that domain is described. A boundary can therefore remain fixed while

the analysis moves from individual to dyadic, organizational, institutional, field, or multiscale representation. Section 171 develops this problem through scale selection, cross-scale relations, and scale-induced distortion.

7.5 Scale Selection

Section 7.4 distinguished the analytical boundary of an inquiry from the wider relational reality in which the research object is situated. The present section develops a second and distinct design choice: the scale at which organization within and across that boundary is represented. Its role is to make analytical resolution explicit before the identification and characterization of particular relations. The objective is to show how individual, dyadic, organizational, community, institutional, and field scales disclose different relational structures; how relations can connect processes across scales; how aggregation or excessive decomposition can distort inference; and how multiscale inquiry can coordinate several resolutions without assuming that one scale provides a privileged description of the whole.

This methodological problem follows directly from the ontology and epistemology developed earlier in the book. Section 106 treated entityhood and relationality as scale-relative: a firm can operate as a contracting entity at one resolution while appearing as a heterogeneous configuration of governance, labor, assets, technologies, routines, and expectations at another. Section 119 then treated scale as an epistemic condition of relational knowledge, because changing resolution can alter which entities, relations, regularities, and discontinuities become visible. Chapter 7 translates those commitments into research design. Scale selection therefore concerns the resolution at which a question is asked, evidence is assembled, relations are distinguished, and claims are stated. It does not imply that the analyst creates the relevant reality by choosing a scale, and it does not imply that finer-grained descriptions are inherently more adequate. The selected scale remains answerable to the organization and causal differences that the inquiry seeks to reconstruct.

Several established approaches provide useful resources for this problem. Simon's analysis of complex organization emphasizes nested and near-decomposable structures whose internal and cross-component interactions can differ in strength and frequency (Simon 1962). Multiscale analysis similarly emphasizes that patterns visible at one resolution can differ from those visible at another (Bar-Yam 2004). Network analysis shows how individual attributes, dyadic ties, neighborhoods, positions, and larger relational configurations can support different descriptions of the same empirical domain (Wellman 1983). Work on social-ecological systems provides another example in which users, governance arrangements, resource systems, and interactions are studied through several connected levels rather than through one scale alone (Ostrom 2009). These traditions support a limited methodological conclusion: scale can be treated as a substantive feature of representation whose adequacy depends on the research question, the evidential interface, and the organization of the phenomenon.

Definition 7.39 (Methodological scale selection). *Methodological scale selection* is the explicit specification of the analytical resolution at which entities, relations, processes, constraints, and differences are treated as distinguishable for a stated research question, together with the treatment of relations that connect or transform organization across other relevant scales.

Table 7.4: Analytical scales and characteristic methodological concerns

Scale	Primary analytical focus	Relations made especially visible	Characteristic distortion risk
Individual	Situated actor, subject, or unit	Capacity, interpretation, exposure, trajectory, agency	Relational and institutional conditions appear as background attributes
Dyadic	Relation between two specified relata	Reciprocity, asymmetry, dependence, exchange, recognition, conflict	Third-party, network, and institutional mediation is suppressed
Organizational	Coordinated configuration with roles and routines	Governance, division of labor, internal authority, resource coordination	Internal heterogeneity is compressed into organizational averages or decisions
Community	Shared practice, membership, memory, or locality	Informal norms, belonging, mutual support, collective interpretation	Porous membership and internal differentiation are underrepresented
Institutional	Rule, category, authority, and expectation structures	Authorization, classification, obligation, legitimacy, patterned constraint	Institutions are treated as unitary actors or reduced to formal rules
Field	Distributed relational environment	Position, differential access, competition, constraint, symbolic and material conditions	Local mechanisms and actor-level heterogeneity become difficult to recover
Multiscale	Relations among several resolutions	Mediation, emergence, feedback, translation, cross-scale constraint	Correspondence across scales is mistaken for a demonstrated pathway

Definition 7.39 distinguishes scale from boundary. Boundary specifies which entities, relations, intervals, and environments enter the immediate analytical domain. Scale specifies the resolution at which organization inside and across that domain is described. A study can therefore hold its boundary fixed while moving between individual, dyadic, organizational, institutional, and field representations. Conversely, two studies can work at a similar scale while drawing different boundaries around the domain of inquiry.

Scale is also multidimensional. Spatial extent, temporal resolution, organizational level, institutional position, functional granularity, informational resolution, and relational distance can vary separately. A national dataset can contain individual-level observations. A short ethnographic encounter can reveal a long-standing institutional relation. A field-level constraint can operate through dyadic interactions. A household can be treated as an organizational unit in one inquiry and as a configuration of interpersonal relations in another. The methodological task is therefore to specify which dimension of scale is being varied and which differences are intended to remain visible.

Table 7.4 summarizes the principal scales developed in this section. The rows should be read as analytical orientations rather than mutually exclusive ontological levels. A single research object can support several of them, and the relations among these orientations become part of multiscale inquiry.

7.5.1 Individual Scale

The individual scale treats a person, household member, worker, student, decision maker, organization member, or other specified subject as the principal unit at which relevant differences are observed. This scale is often indispensable when the inquiry concerns heterogeneous capacities, interpretations, exposures, preferences, trajectories, or forms of agency. It can preserve variation that disappears when observations are aggregated into groups, organizations, or institutions.

An individual-scale design can reconstruct how a person encounters a relation rather than merely whether a relation is formally present. Two workers occupying the same nominal occupational category can experience different supervisory relations, different access to information, different dependence on income, and different capacities to contest decisions. Two students enrolled in the same institution can occupy distinct relational positions through language, prior knowledge, disability, family resources, peer networks, or interactions with teachers. Individual-scale evidence can therefore reveal heterogeneity that a higher-level average compresses.

Relational methodology, however, treats the individual as a provisional analytical object rather than an isolated explanatory origin. Attributes recorded at the individual scale can themselves summarize relational histories. Educational attainment can reflect family, institutional, peer, and policy relations. Income can reflect labor-market position, ownership, bargaining relations, legal status, and household arrangements. A reported preference can be shaped through prior encounters, norms, expectations, and available alternatives. The individual scale therefore supports detailed analysis of situated subjects while retaining the possibility that some apparently individual variables are manifestations of wider relational processes.

The epistemological implication is that individual-level evidence does not automatically identify the scale at which a mechanism operates. A repeated association among individuals can arise from dyadic interaction, organizational sorting, institutional classification, neighborhood structure, or field-level conditions. Likewise, a subjective account can provide important access to meaning and experience while leaving parts of the surrounding configuration weakly observed. Individual-scale inquiry gains strength when the relation between the individual's evidence and the broader relational environment is stated explicitly.

Remark 7.40 (Individual-scale remainder). An individual-scale description can preserve actor-level heterogeneity while leaving relational, organizational, institutional, or field conditions as a remainder. Recording that remainder helps prevent individual variation from being interpreted automatically as individually generated variation.

This remark is particularly important for GRE because later economic analysis will often examine capacities and opportunities. A person's capacity may be individually manifested while being relationally produced, maintained, constrained, or depleted. The scale of manifestation and the scale of generation can therefore differ.

7.5.2 Dyadic Scale

The dyadic scale treats a relation between two specified relata as the focal analytical unit. This scale is especially useful when the research question concerns reciprocity, dependence, exchange, recognition, authority, conflict, trust, communication, con-

tractual relation, or another process whose meaning is difficult to reconstruct from actor attributes alone. The dyad makes the relation itself visible as an object of inquiry.

Dyadic analysis can examine direction and asymmetry. A resource transfer from *A* to *B* need not have the same meaning as a transfer from *B* to *A*. Advice can be sought in one direction and authority exercised in another. Trust can be mutual, asymmetric, domain-specific, or temporally unstable. A contractual tie can combine reciprocal obligations with unequal exit options. Treating the dyad explicitly therefore helps distinguish relational characteristics from properties attributed separately to the participants.

The dyadic scale also allows relational history to enter analysis. The meaning of an interaction at time *t* can depend on prior cooperation, conflict, promises, breaches, or accumulated expectations between the same participants. A short exchange can carry a long relational history. Conversely, repeated contact does not necessarily imply a stable relation if the underlying meaning or institutional basis changes substantially. Dyadic inquiry therefore benefits from temporal indexing and from the persistence criteria developed later in this chapter.

A dyad can nevertheless be analytically incomplete. Relations are frequently mediated by third parties, shared infrastructures, organizations, legal rules, norms, markets, and network positions. A lender–borrower relation depends on monetary, contractual, regulatory, and informational structures. A teacher–student relation is shaped by curriculum, institutional authority, assessment systems, peer environments, and family expectations. A buyer–seller relation can be mediated by a platform whose ranking, payment, data, and dispute systems alter both parties' options. Dyadic analysis should therefore preserve relevant mediating relations rather than treating the pair as a closed world.

Definition 7.41 (Dyadic analytical scale). A *dyadic analytical scale* treats a specified relation between two relata as the focal unit of description while retaining the possibility that the relation is conditioned by third parties, institutions, infrastructures, histories, or wider relational configurations.

This definition keeps the dyad analytically central without making it ontologically self-sufficient. Section 172 will later distinguish directly observed, inferred, latent, symbolized, institutional, historical, negative, and absent relations. The present task is prior: to establish when the relation itself, rather than either participant separately, is the resolution at which the research question becomes most intelligible.

7.5.3 Organizational Scale

The organizational scale treats a coordinated configuration—such as a firm, public agency, university, laboratory, association, hospital, platform operator, or project—as a relatively persistent analytical unit. This scale becomes useful when roles, routines, governance procedures, resource allocations, internal divisions of labor, and collective outputs possess enough stability to influence outcomes beyond the momentary actions of particular members. Simon's analysis of complex organization provides one influential account of how relatively stable subsystems can support higher-level analysis without eliminating lower-level heterogeneity (Simon 1962).

Organizational analysis can therefore ask questions that are poorly represented at the individual or dyadic scale. How is authority distributed across roles? Which

routines coordinate dispersed tasks? How are decisions transformed as they pass through units? Which resources are pooled? How are errors detected and corrected? Which internal interfaces create bottlenecks? How does membership turnover coexist with organizational continuity? These questions concern a relational configuration whose persistence can exceed that of many individual participants.

The scale-relative ontology developed in Section 106 is particularly important here. A firm can be treated as an entity when it contracts, owns assets, incurs liabilities, or enters a market. The same firm can be decomposed into teams, governance structures, technologies, documents, routines, labor relations, and external dependencies when those differences matter to the question. The methodological choice between these resolutions should therefore follow the intended inference. Treating the organization as a single actor can be adequate for one claim and seriously distort another.

Organizational aggregation can hide unequal internal positions. An average wage, average productivity measure, institutional decision, or organizational preference can suppress disagreement, hierarchy, informal work, subcontracting, or differential exposure to risk. A formal organizational boundary can also conceal cross-boundary relations with suppliers, households, contractors, funders, regulators, and infrastructures. Section 7.4 therefore remains active: organizational scale does not settle organizational boundary.

A useful design strategy is to identify which properties are being attributed to the organization and which lower-level relations are required to warrant those attributions. If the claim concerns an organization's formal commitment, documentary evidence and authorized decisions may be central. If it concerns organizational practice, repeated behavior across units and roles may be more informative. If it concerns learning or adaptation, the inquiry may need relations among individuals, routines, memory systems, and external feedback. Scale selection thus affects the evidence required for an organizational claim.

7.5.4 Community Scale

The community scale concerns configurations organized through shared locality, practice, identity, memory, mutual recognition, common resources, recurrent interaction, or some combination of these relations. Communities can overlap formal organizations but need not coincide with them. Their boundaries can be porous, contested, or historically changing, and their coordination can depend more strongly on informal norms and repeated interaction than on centralized authority.

Community-scale inquiry is useful when the research question concerns collective interpretation, mutual support, informal sanction, belonging, shared knowledge, customary practice, local stewardship, or collective memory. A community can sustain expectations that remain weakly visible in individual questionnaires or formal institutional records. It can also preserve historical knowledge through practices, stories, routines, spatial arrangements, and relationships whose significance becomes visible only when the collective configuration is examined.

The community scale should not imply homogeneity. Internal differences in status, wealth, gender, expertise, age, legal standing, or access to decision making can be substantial. A community-level statement can therefore become misleading when it converts a dominant position into a collective position or when it treats participation as evenly distributed. The methodological task is to specify which shared re-

lations warrant the community-scale object and which internal differences remain consequential for the claim.

Community analysis also interacts closely with boundary construction. Membership may be formal in one setting and relationally inferred in another. People can participate intermittently, occupy peripheral positions, belong to several communities, or be affected by community decisions without being recognized as members. Cross-boundary relations can provide resources, information, political leverage, or external constraints. The community scale therefore often benefits from layered membership and neighborhood representations rather than a single binary inclusion rule.

A community can also operate at several temporal scales. Short-lived communities can form around emergencies, campaigns, collaborative projects, or online events, while other communities reproduce relations across generations. The relevant scale should therefore be indexed to the persistence and causal interval of the process under study. Community-scale reality is compatible with substantial turnover when enough relational organization, memory, or practice persists to sustain the focal phenomenon.

7.5.5 Institutional Scale

The institutional scale focuses on relatively durable systems of rules, categories, authority, obligation, legitimacy, expectation, and patterned practice. An institution can be realized through organizations while remaining analytically distinct from them. A legal rule can organize many organizations; a market convention can coordinate actors without a single governing body; a professional standard can operate across workplaces; a citizenship category can structure rights and obligations across multiple administrative sites. Scale selection should therefore avoid treating “institution” and “organization” as interchangeable units.

Institutional-scale inquiry asks how categories and rules organize relations across cases. It can examine who is authorized to decide, which classifications create access or exclusion, how obligations are assigned, how sanctions operate, how norms become expected, and how formal rules relate to enacted practice. The relevant evidence can include legal texts, administrative procedures, organizational routines, records of enforcement, participant interpretation, and historical change. Institutional analysis often requires several evidential interfaces because the formal representation of an institution may differ from its practical realization.

This scale is especially important for generative-relational inquiry because institutions can condition the space of possible relations before a particular interaction occurs. Property rules affect the relations through which assets can be controlled or transferred. Educational institutions classify credentials and pathways. Financial rules condition access to credit and settlement. Research institutions distribute authority, recognition, resources, and standards of evidence. These effects can be manifested through individual or dyadic events while depending on a wider institutional architecture.

Institutional-scale claims should preserve variation in implementation. A rule can be formally common while being enacted differently across offices, organizations, regions, or historical periods. An aggregate institutional description can therefore conceal local discretion, informal workaround, selective enforcement, or unequal access. A multiscale design may be needed when the question concerns how institutional

rules are translated into organizational procedures and individual experiences.

Remark 7.42 (Institutional manifestation across scales). An institutional relation can be manifested at individual, dyadic, organizational, and field scales without being exhausted by one manifestation. Evidence gathered at one scale can therefore support only the component of the institutional claim that its access relation can warrant.

The remark extends the epistemological distinction between manifestation and relational object. A denial recorded in one administrative encounter can be evidence about institutional enactment without by itself establishing the distribution of institutional practice across the wider system. Conversely, a formal rule can establish an authorized institutional relation while leaving its practical realization uncertain.

7.5.6 Field Scale

The field scale treats the focal phenomenon as situated within a distributed relational environment in which positions, opportunities, constraints, resources, norms, expectations, and symbolic classifications are patterned across a wider configuration. Field analysis becomes useful when local interactions appear to depend on conditions that are not adequately represented as properties of one actor, one dyad, or one organization.

A field can be represented in several ways depending on the research question. It can emphasize network position, institutional location, distributions of resources, symbolic classifications, competitive structures, technological infrastructures, legal conditions, or recurrent patterns of dependence. Network analysis provides one family of representations for distributed relational position (Wellman 1983); other field representations can be qualitative, historical, spatial, institutional, or formal. The methodological commitment is therefore to distributed conditioning rather than to one specific mathematical form.

Field-scale inquiry can reveal why similar local relations produce different outcomes in different environments. The same contractual form can operate differently under distinct labor-market conditions. The same educational intervention can have different consequences when institutional access, peer structures, family resources, and credential regimes differ. A local innovation can diffuse in one technological field and remain isolated in another. These differences can be difficult to explain if field conditions are treated merely as background variables.

The field scale also poses a risk of abstraction. A broad relational environment can be represented so generally that the mechanisms connecting field conditions to local manifestations become obscure. A field-level pattern can correspond to several distinct local processes. Section 119 therefore required bridge evidence for cross-scale claims, and the same discipline applies here. The researcher should identify how field conditions become operative through institutions, organizations, dyads, or situated actors rather than infer local mechanism from field-level correspondence alone.

Field analysis is also sensitive to boundary choice. A professional field, market field, policy field, cultural field, or technological field may extend beyond one jurisdiction or organization. Its edges can be porous and relation-specific. The boundary remainder introduced in Section 7.4 can therefore be useful when potentially relevant field relations are known but remain outside the tractable scope of a study.

7.5.7 Cross-Scale Relations

Cross-scale inquiry begins when the research question concerns how organization at one resolution conditions, emerges from, translates, or transforms organization at another. The language of “micro,” “meso,” and “macro” can be convenient, but it is too coarse for many relational problems because scale is not defined only by physical size or population count. Individual, dyadic, organizational, institutional, temporal, spatial, and informational resolutions can cross one another in different ways.

A cross-scale relation therefore requires a specified pathway. Individual actions can accumulate into an organizational routine, but the pathway can depend on authority, repetition, documentation, incentives, or technological embedding. An institutional rule can condition individual behavior, but its effect can be mediated by organizational interpretation, enforcement, social meaning, and available alternatives. A community norm can shape dyadic trust through repeated observation and sanction. A field-level technological change can alter organizational possibilities by changing cost structures, standards, or infrastructures. These are cross-scale hypotheses because the explanatory pathway connects organization represented at different resolutions.

The epistemological requirement is stronger than simple pattern correspondence. If an aggregate outcome changes after many individual changes, the co-occurrence does not by itself establish how the levels are connected. If a national policy is followed by a local outcome, temporal sequence does not by itself identify the mediating relation. If an institutional classification correlates with individual behavior, the classification can operate through several pathways. Section 119 therefore introduced a cross-scale bridge requirement: evidence should concern the pathway that links scale-specific processes. Chapter 7 turns that requirement into design practice.

Definition 7.43 (Cross-scale bridge). A *cross-scale bridge* is an empirically or theoretically specified pathway through which a relation, constraint, resource, representation, or transformation at one analytical scale becomes consequential for organization represented at another scale.

A cross-scale bridge can be material, informational, institutional, symbolic, organizational, spatial, or temporal. Examples include an administrative rule implemented through caseworker decisions, household resources translated into educational opportunities through school access, organizational routines sedimented from repeated local practices, or market-wide price changes transmitted through contracts and budgets. The bridge need not imply one-directional causation. Feedback can connect the scales recursively.

Cross-scale divergence can itself be informative. Aggregate access can increase while access for a subgroup decreases. An organization can remain formally stable while local practices change rapidly. A network can become more connected globally while some neighborhoods become more isolated. A policy can improve an average outcome while increasing variance. Such divergences suggest that scale is part of the phenomenon rather than a technical nuisance to be averaged away.

7.5.8 Scale-Induced Distortion

Scale-induced distortion occurs when the selected resolution suppresses, merges, separates, or reclassifies differences in ways that materially alter the intended inference.

Distortion can arise from aggregation, excessive decomposition, inappropriate temporal resolution, or treating a scale-specific manifestation as though it represented the same object across scales.

Aggregation is one familiar source. Group averages can hide bimodal distributions, subgroup reversals, unequal exposure, or distinct relational positions. Organizational indicators can conceal internal hierarchy. National indicators can suppress regional differences. Network summaries can conceal local bottlenecks or brokerage. Historical periodization can smooth over rapid transitions. Aggregation is methodologically defensible when the differences it suppresses are irrelevant to the target claim; it becomes problematic when those differences are part of the mechanism or normative question.

Excessive decomposition produces a complementary distortion. A highly granular description can dissolve organizational routines, institutional authority, community memory, or field structure into local observations without preserving the higher-level organization through which those observations become coordinated. Finer resolution can therefore reduce explanatory adequacy when persistence, constraint, or causal efficacy appears only at a coarser scale. The scale-relative ontology of Section 106 was introduced partly to avoid this assumption that decomposition automatically approaches a more fundamental social explanation.

Temporal scale can generate similar problems. A short window can make a slowly evolving institution appear fixed. A long window can blur a critical transition. High-frequency observations can create an impression of volatility while missing stable long-run relations; low-frequency observations can miss rapid feedback and temporary but consequential states. The relevant temporal resolution should correspond to the causal and interpretive timescales of the research question.

Definition 7.44 (Scale-induced distortion). *Scale-induced distortion* is a material alteration of a relational inference produced when the analytical resolution suppresses, merges, separates, or reclassifies differences that are consequential for the research question.

Scale-induced distortion can be investigated through sensitivity across plausible resolutions. The researcher can disaggregate a group, aggregate a network neighborhood, compare organizational units, change temporal windows, or reconstruct a field-level condition. A change in conclusion does not automatically indicate methodological failure. It can reveal that the phenomenon is genuinely scale-dependent. The task is to report which components of the claim remain stable and which depend on resolution.

A useful companion to the boundary remainder is a *scale remainder*: organization known or plausibly expected to exist at another scale but not represented in the focal analysis. Recording such a remainder helps preserve the difference between deliberate resolution and unnoticed omission. It can also guide later inquiry when evidence becomes available at another scale.

Remark 7.45 (Scale remainder). A *scale remainder* is a relation, process, heterogeneity, or organized condition that lies outside the resolution of the focal representation but remains potentially consequential for interpretation, mechanism, or transfer of the resulting claim.

The remark supports epistemic humility. A study can make a strong claim at one scale while preserving explicit uncertainty about organization outside that resolution.

It also supports cumulative research because later work can target the recorded remainder rather than reconstruct the original omission from scratch.

7.5.9 Multiscale Inquiry

Multiscale inquiry coordinates two or more analytical resolutions when the research question depends on relations that are difficult to reconstruct adequately at one scale alone. Its purpose is not to maximize the number of levels represented. Additional scales introduce data requirements, translation problems, computational burden, interpretive complexity, and new opportunities for mismatch. A multiscale design is warranted when the relation among scales contributes materially to the claim.

Multiscale analysis can proceed through nested, parallel, sequential, or bridge-centered designs. A nested design examines individuals within organizations and organizations within institutions. A parallel design analyzes the same phenomenon separately at several scales and compares the resulting structures. A sequential design begins at one scale and shifts resolution when anomalies or unanswered questions emerge. A bridge-centered design starts from a hypothesized cross-scale pathway and gathers evidence at the scales required to evaluate each part of the pathway. Social-ecological systems research provides a familiar example of analysis that links users, governance arrangements, resources, and interactions across several connected components (Ostrom 2009); multiscale complex-systems approaches similarly emphasize that patterns and constraints can vary with resolution (Bar-Yam 2004).

Translation between scales should remain visible. Aggregating individual observations into an organizational indicator is a transformation. Inferring a community norm from interviews is a transformation. Treating local decisions as evidence of institutional enactment is a transformation. Mapping field conditions into actor-level exposures is a transformation. Each operation preserves some information and suppresses other information. The translation-remainder principle developed earlier in the book therefore applies to scale changes as well as to changes of method or representation.

Multiscale inquiry also benefits from versioned scale selection. A project can begin at the individual and dyadic scales because those are the most accessible manifestations, then add organizational or institutional analysis when repeated patterns indicate shared conditioning. Conversely, a field-level project can move toward local scales when broad regularities conceal heterogeneous mechanisms. Contingent encounter can motivate such movement: an archival document, interview statement, model residual, spatial pattern, or organizational inconsistency can make another scale suddenly salient. Aesthetic judgment can contribute to recognizing that the pattern is worth following, while later inquiry determines whether the additional scale materially improves explanation.

AI-assisted research can lower some costs of multiscale exploration by linking documents, extracting entities, reconstructing networks, comparing representations, or simulating systems across resolutions. These capacities do not settle which scale is substantively appropriate. Abundant automatically generated representations can increase the importance of scale judgment: the researcher still has to determine which distinctions correspond to the question, which transformations preserve relevant meaning, and which apparent cross-scale regularities survive independent

evidential scrutiny.

Proposition 7.46 (Scale-selection discipline). *Relational inquiry gains methodological clarity when analytical scale is stated explicitly, justified by the organization relevant to the research question, tested against plausible alternative resolutions where material, and accompanied by evidence for pathways invoked in cross-scale claims.*

Proposition 7.46 completes the movement from object specification and boundary construction to analytical resolution. Section 7.3 specified what kind of object the inquiry provisionally studies. Section 7.4 specified the domain within which relevant relations are sought. The present section specifies the resolution at which those relations and objects are distinguished. These three operations are separable but recursive: changing the scale can reveal that an object should be respecified or that a boundary should be revised, while a new boundary can expose organization that requires a different scale.

The next methodological problem concerns identification. Once object, boundary, and scale are explicit, the researcher can ask what evidence warrants the claim that a relation is present, inferred, latent, symbolized, institutional, historical, negative, or absent. Section 172 therefore turns from the resolution of relational inquiry to the identification of relations under mediated and incomplete epistemic access.

7.6 Identification of Relations

Sections 7.3–7.5 specified the provisional research object, the analytical boundary, and the scale at which relational differences are represented. The present section addresses the next methodological problem: what warrants the claim that a relation is present, absent, latent, symbolically mediated, institutionally sustained, historically reconstructed, or negatively structured within that specification. Its role is to translate the ontology and epistemology of Chapters 4–5 into criteria for relational identification before the later tasks of characterization, persistence analysis, and configuration reconstruction. The section distinguishes several modes of identification, examines the evidential relations appropriate to each, and ends with a multidimensional account of relation uncertainty. The method is deliberately plural. Observation, documents, archives, interviews, institutional rules, statistical regularities, formal models, computational traces, and historical reconstruction can each contribute to identification when the inferential bridge between manifestation and target relation is made explicit.

Identification should be distinguished from characterization. A study can possess strong evidence that a relation exists while remaining uncertain about its intensity, reciprocity, duration, asymmetry, or meaning. Conversely, a dataset can attach a numerical weight to an edge whose underlying relational interpretation remains weakly warranted. Section 173 will address characteristics of identified relations. The present task is prior: determining what kind of evidential and inferential support permits the relation to enter the research object in the first place.

The distinction between relational and manifestational reality is decisive here. A recorded transfer, signed contract, observed conversation, administrative code, spatial co-presence, or statistical association is a manifestation or trace available to inquiry. Depending on the target claim, the manifestation can constitute part of the relation, provide evidence for it, or merely correlate with it. The inverse problem devel-

oped in Section 113 therefore remains active. Relation identification proceeds from manifestations under stated conditions toward a bounded claim about relational reality; the apparent visibility of the manifestation should not be confused with transparent access to the complete relation.

Definition 7.47 (Relation identification). *Relation identification* is the warranted assignment of a specified relational status to a candidate relation among stated relata, within a stated boundary, scale, and temporal domain, on the basis of manifestations, traces, institutional conditions, historical evidence, inferential assumptions, or combinations of these sources.

Definition 7.47 makes identification indexed rather than absolute. A relation can be strongly identified at one institutional or temporal scale and remain uncertain at another. The same observed interaction can support identification of communication while providing only weak evidence of trust. A legal record can strongly identify a formal obligation while leaving actual compliance uncertain. An absence claim can be credible within a carefully observed channel while remaining open outside that channel. Relation identification is therefore claim-relative and should state the type of relation being identified rather than relying on an unqualified statement that two entities are “related.”

Table 7.5 summarizes the modes developed below. They are neither mutually exclusive nor exhaustive ontological kinds. A historical institutional relation can be symbolized, negatively structured, and partly latent at the same time. The classification concerns routes of epistemic access and the burdens attached to them. It is therefore compatible with the ontological suspension of Chapter 4: the inquiry can identify a relational status sufficiently for its research purpose without claiming a final metaphysical classification of the relation.

7.6.1 Directly Observed Relations

A directly observed relation is identified through a manifestation that closely corresponds to the operational target of inquiry. Examples include a recorded monetary transfer when the target is a transfer relation, a witnessed exchange of messages when the target is communication, a jointly signed agreement when the target is formal contractual linkage, or repeated co-presence when the target is co-location. The term *directly observed* therefore describes the relation between observation and the specified target; it does not imply unmediated access to relational reality in a broader ontological sense.

This distinction is important because observation is produced through instruments, categories, positions, and recording practices. A platform log records actions that the platform is technically capable of registering. An ethnographer observes from a particular location and under particular access conditions. A financial ledger records transactions according to accounting categories. A legal file records the relation that the legal system recognizes and preserves. The epistemology of manifestation developed in Sections 114–116 therefore applies even where the observed event appears straightforward.

Direct observation can provide strong identification when the target relation is defined at the level of the manifested act. If the research question concerns whether a payment occurred, a verified transaction record can be highly informative. If the question concerns whether the payment expressed solidarity, coercion, obligation,

Table 7.5: Principal modes of relation identification and characteristic evidential burdens.

Identification mode		Primary evidential access	Characteristic remainder or risk
Directly served	ob-	Recorded interaction, transaction, co-action, communication, or other manifestation closely matching the target relation	Observation remains selective; the observed act may underdetermine relational meaning or persistence
Inferred		Multiple manifestations connected to the target through an explicit inferential bridge	Dependence on auxiliary assumptions, model structure, and alternative explanations
Latent		Convergent traces, dispositional evidence, patterned consequences, or model-supported hidden structure	Reification of a convenient latent construct or overinterpretation of indirect evidence
Symbolized		Language, signs, declarations, classifications, narratives, images, or symbolic performances	Symbolic representation may diverge from enacted relation while also contributing to its formation
Institutional		Rules, statuses, rights, duties, authority, procedures, and patterned enactment	Formal relation may differ from practical realization across settings
Historical		Archived traces, sequences, retrospective records, material residues, and reconstructed trajectories	Preservation bias, changing categories, missing records, and uncertain continuity
Negative		Evidence of prohibition, exclusion, avoidance, antagonism, blocking, or structured non-cooperation	Risk of confusing structured opposition with simple non-occurrence
Absent		Sustained non-detection under conditions in which the target relation would plausibly have become detectable	Absence of evidence can be mistaken for evidence of absence when detection conditions are weak

reciprocity, or strategic compliance, the same record provides only part of the required evidence. The inferential burden grows as the target relation includes meanings, dispositions, histories, or institutional consequences that exceed the observed act.

A useful practice is to state the observational granularity. “A message was sent” differs from “a communication relation existed” when delivery, reception, interpretation, and response are relevant. “Two actors met” differs from “they coordinated” when joint planning is the target. “A transfer occurred” differs from “a dependency relation existed” when the broader pattern of resource access matters. Such distinctions protect direct evidence from being asked to carry a stronger relational claim than its manifest content supports.

Direct observation can also be distributed across time. A single observed interac-

tion may identify an event relation without warranting a durable relation. Repeated interactions can support stronger continuity claims when the criteria for persistence are specified. Section 174 will examine that problem directly. For present purposes, the key discipline is to keep the unit of identification aligned with what the observation makes available.

Claim 7.48 (Observation-relative directness). *A relation can be treated as directly observed when the recorded manifestation closely matches the specified relational target at the relevant scale and time, while additional relational meaning, persistence, or generative significance remains subject to separate inference.*

Claim 7.48 prevents “direct” from becoming a rhetorical marker of privileged access. Directness is useful precisely when its scope is narrow enough to be inspectable.

7.6.2 Inferred Relations

Many relations of substantive interest are identified inferentially. Trust, dependence, influence, informal authority, exclusion, coordination, institutional constraint, shared expectation, and field position can become visible through patterns of behavior, testimony, records, outcomes, and comparative evidence without appearing as single directly observable acts. In these cases, relation identification requires an explicit bridge from manifestations to the proposed relation.

The compatibility-set logic of Section 113 is useful. A manifestation can remain compatible with several relational explanations. Repeated consultation of one actor before decisions can indicate expertise, hierarchy, trust, procedural requirement, or strategic deference. Similar transaction patterns can arise from preference, constraint, common exposure, or institutional routing. Identification improves when additional evidence removes alternatives or identifies relational properties shared by the serious reconstructions that remain.

Inference can rely on several forms of support. Process evidence can show how one actor’s decision enters another’s choice. Cross-context comparison can reveal whether the proposed relation persists under changing conditions. Intervention or natural variation can test whether altering one relational condition changes the expected manifestation. Interviews can clarify meanings that behavioral traces leave ambiguous. Formal or statistical models can estimate relations that are difficult to observe directly, provided that model-imposed structure remains distinguishable from evidential constraint. Giere’s purposive account of scientific representation is relevant because a model represents selected aspects of a target under stated purposes and respects of similarity rather than reproducing the target without remainder (Giere 2004).

The background assumptions of the inference should therefore be visible. Longino’s account of evidential relevance emphasizes that observations acquire evidential force through background assumptions and critical scrutiny (Longino 1990). Within the present framework, those assumptions can concern boundary, scale, comparability, classification, detection, temporal ordering, or the manifestation relation itself. An inferred relation becomes methodologically stronger when plausible alternatives and the assumptions that distinguish them are stated rather than left implicit.

Definition 7.49 (Inferential bridge). *An inferential bridge is the stated set of evidential relations, assumptions, mechanisms, comparison rules, or model structures through*

which one or more manifestations are taken to support identification of a specified relation.

The definition makes inferred relations auditable. Different traditions can construct different bridges: process tracing, statistical estimation, ethnographic interpretation, archival reconstruction, formal deduction, network inference, legal analysis, or mixed-method triangulation. The relevant standard is not uniformity of technique but adequacy of the bridge to the target claim.

7.6.3 Latent Relations

A latent relation is proposed when the target relation is not directly manifest in the available evidential field yet appears necessary or useful for explaining a structured pattern of traces, dispositions, or consequences. Latency here is broader than the technical use of latent variables in statistical modeling. It refers to relational organization whose epistemic access is indirect and whose manifestations can be dispersed across observations.

Examples include a durable dependency that becomes visible only when alternative resource channels disappear, an informal hierarchy inferred from recurrent deference across settings, a trust relation revealed through willingness to accept vulnerability, or a coordination structure reconstructed from synchronized action without an observable command. The relation can be relationally consequential before it receives explicit symbolic articulation, consistent with Chapter 4's claim that relational reality need not await perception or naming.

Latent identification requires particular care because explanatory convenience can be mistaken for relational evidence. A hidden relation should not be introduced merely because it permits a model to fit observed outcomes. Competing explanations can include common causes, measurement artifacts, selection processes, aggregation effects, or omitted institutional rules. Convergent manifestations from different sources are therefore especially useful. A proposed latent relation becomes more credible when behavioral, documentary, historical, and positional evidence point toward a compatible structure while making materially different errors.

The distinction between a latent relation and an unobserved relation is also important. A relation can be unobserved simply because data are unavailable. Latency adds a stronger methodological claim: the relation is partly hidden from direct manifestation in the current evidential regime, yet its presence is supported through indirect traces or structural consequences. The researcher should therefore specify what would count as evidence against the latent interpretation as well as what currently supports it.

Proposition 7.50 (Latent-relation discipline). *Identification of a latent relation is strengthened when the proposed relation explains a specified pattern across heterogeneous manifestations, survives plausible alternative reconstructions, and generates further discriminating observations or historical expectations.*

This proposition keeps latency revisable. A relation initially treated as latent can later become more directly observable when access, instruments, archives, or institutional records change. The reverse can also occur when a previously visible relation moves into informal or opaque channels.

7.6.4 Symbolized Relations

Symbolized relations become epistemically accessible through language, signs, declarations, classifications, narratives, images, ritual forms, legal texts, interfaces, or other symbolic media. A person may call another a colleague, debtor, citizen, mentor, rival, dependent, partner, or stranger; an institution may classify a person as eligible, liable, authorized, resident, employee, or beneficiary. Such symbols can reveal relational interpretation while also participating in the production and stabilization of the relation itself.

The performative dimension developed in Chapter 5 is therefore central. Symbolization can be descriptive, constitutive, strategic, contested, aspirational, or retrospective. A declaration of friendship can express an existing relation, attempt to establish one, or mask a deteriorating one. A legal classification can identify an institutional status while simultaneously activating rights and duties. A statistical category can render a population administratively visible while shaping later allocation and policy. Historical work on quantification and classification shows how representational infrastructures can become institutionally consequential rather than remaining neutral mirrors (Porter 1995; Desrosières 1998).

Relation identification should therefore preserve at least two questions. First, what relation does the symbol claim, imply, or make legible? Second, what relation does the act of symbolization help generate, sustain, transform, or contest? These questions can have different answers. Symbolic recognition may be weakly enacted in practice; practical coordination may precede a shared vocabulary; competing symbols can organize the same relation differently across groups.

Symbolized relations are also sensitive to translation. A term used in one historical or cultural setting can lack a precise equivalent in another. Administrative translation can compress relational distinctions; computational extraction can normalize several terms into one edge type. The methodological response is to preserve provenance and, where material, the original symbolic form together with the analytical translation applied to it.

Remark 7.51 (Symbolization and identification). Symbolization can supply evidence about a relation and can participate in constituting that relation. Relational inquiry should distinguish these epistemic and generative roles where their separation affects interpretation.

This distinction prepares later analysis of relational meaning in Section 173 while avoiding the assumption that symbolic naming is either sufficient or irrelevant to relational existence.

7.6.5 Institutional Relations

Institutional relations arise through systems of rules, statuses, authority, obligations, procedures, expectations, and patterned enforcement. Examples include ownership, citizenship, employment, trusteeship, regulatory authority, contractual liability, professional jurisdiction, fiduciary duty, entitlement, and organizational office. Such relations can persist despite turnover in particular actors because their continuity is carried through institutional arrangements.

Identification of an institutional relation can begin from formal sources: statutes, contracts, charters, organizational rules, registries, judicial decisions, administrative

classifications, or authorized records. Institutional analysis, however, also requires attention to enactment. A formally granted right can remain practically inaccessible; an official hierarchy can coexist with informal authority; a contractual relation can be reconfigured through dependence on infrastructures or intermediaries. North's account of institutions as constraints structuring interaction and Searle's analysis of status functions and institutional facts provide different resources for understanding how rule-governed relations acquire persistence and practical consequence (North 1990; Searle 1995).

The methodological problem is therefore two-layered. The first layer identifies the formal institutional relation. The second asks whether and how that relation is enacted, recognized, enforced, circumvented, or transformed in practice. A study concerned with legal status may legitimately stop at the first layer if its target is narrowly specified. A study concerned with effective access, power, dependence, or generative consequence usually requires the second.

Institutional identification can also involve distributed evidence. Authority may be documented in one institution, operationalized through another, and experienced through a third. Rights and duties can be layered across jurisdictional scales. A person's relation to a welfare system, for example, can involve statute, administrative category, caseworker discretion, digital eligibility systems, and appeal procedures. The relation can therefore be institutionally real while manifesting differently across interfaces.

This is one point where the scale analysis of Section 7.5 becomes important. An institutional relation identified at a field or legal scale can be unevenly enacted at organizational or interpersonal scales. Cross-scale divergence does not by itself invalidate the institutional identification; it reveals that formal status and practical realization should be represented separately.

7.6.6 Historical Relations

Historical relations are identified through evidence whose meaning depends on temporal sequence, preservation, changing categories, and criteria of continuity. Some relations are no longer directly observable because the actors, institutions, or practices have disappeared. Others persist into the present but can be understood only by reconstructing how they formed, stabilized, changed, or acquired their current meaning.

Historical identification therefore works through traces: archives, correspondence, contracts, statistics, maps, material remains, oral histories, institutional records, prior classifications, legal documents, publications, and later reconstructions. These traces were produced under historically specific manifestation relations. Their survival is also selective. Records can be destroyed, may not have been created, can be unevenly preserved, or can be concentrated among actors with greater institutional capacity to document their activities.

A silence in the record is consequently ambiguous. It can indicate that a relation was absent, that it was not institutionally legible, that relevant actors lacked record-producing capacity, that evidence was suppressed, or that surviving archives are incomplete. Section 7.6.8 will return to absence directly. For historical inquiry, the central discipline is to reconstruct the conditions under which a relation could have left a trace and the conditions under which that trace could survive.

Historical categories also change. Hacking's work on historical ontology and Abbott's emphasis on temporality and events support attention to the historically changing objects through which inquiry is organized (Hacking 2002; Abbott 2001). A recorded category can retain the same label while its institutional meaning changes, or different labels can refer to relations with substantial continuity. Identification should therefore rely on historically appropriate relational criteria rather than lexical sameness alone.

Sequence can provide evidence that a static observation does not provide on its own. A relation may become identifiable through repeated dependence, progressive closure of alternatives, cumulative institutionalization, or path-dependent stabilization. Pierson's work on increasing returns illustrates how timing and sequence can become consequential in institutional development (Pierson 2000). Historical identification can therefore involve reconstruction of trajectories through which a relation becomes durable enough to warrant a claim of continuity.

Definition 7.52 (Historically reconstructed relation). A *historically reconstructed relation* is a relation whose identification depends materially on temporally ordered traces and on an account of the historical conditions governing their production, preservation, interpretation, and continuity.

Definition 7.52 keeps historical identification compatible with later revision. New archives, improved digitization, newly accessible testimony, or a changed conceptual vocabulary can alter the evidential field without implying that prior reconstruction lacked methodological seriousness.

7.6.7 Negative Relations

Relational inquiry should distinguish a negative relation from the absence of relation. A negative relation is present when actors, institutions, or positions are connected through structured opposition, prohibition, exclusion, avoidance, blocking, sanction, incompatibility, or another relational form whose content constrains or prevents a class of interactions. The term *negative* describes relational organization, not moral evaluation.

Examples include a legal prohibition, an institutional veto, a blacklist relation, enforced separation, strategic avoidance, a boycott, exclusion from an access channel, or an antagonistic relation that predictably reorganizes conduct. In such cases, the non-occurrence of a positive interaction can be generated by an active relation. Two actors who do not exchange resources because one is institutionally barred from the channel are relationally different from two actors who simply have no relevant connection.

Identification therefore requires evidence of structured non-connection or opposition. Relevant manifestations can include explicit prohibitions, repeated blocking behavior, sanctions, avoidance patterns under conditions of opportunity, testimony concerning anticipated consequences, or counterfactual changes when the negative relation is removed. The evidential burden should remain sensitive to alternative explanations. Repeated non-interaction can arise from distance, irrelevance, lack of opportunity, measurement gaps, or preference without constituting a stable negative relation.

Negative relations can also operate at several scales. An interpersonal conflict can remain local. An organizational rule can generalize exclusion across many dyads. A

field-level stigma can shape interaction even when a particular pair has not encountered one another. Multiscale inquiry can therefore ask whether the negative relation is carried through local action, institutional status, symbolic classification, infrastructural design, or a combination of these mechanisms.

Definition 7.53 (Negative relation). A *negative relation* is an identified relational structure in which opposition, prohibition, exclusion, avoidance, blocking, sanction, or comparable constraint organizes the possible interaction among specified relata within a stated domain.

The definition helps later economic analysis because restricted access, gatekeeping, exclusion from markets, denial of institutional recognition, and blocked conversion pathways can be relationally consequential even when the most visible manifestation is non-participation.

7.6.8 Absent Relations

An absent relation is a claim that a specified relation is not present within the stated boundary, scale, temporal window, and detection regime. Such claims are methodologically demanding because non-detection has several possible explanations. The relation can be absent, weak, intermittent, hidden, outside the observation window, expressed through an unmeasured channel, or obscured by a manifestation process that the inquiry does not understand well.

The phrase “absence of evidence is not evidence of absence” captures a useful caution but can itself become too strong when treated without qualification. Sustained non-detection can provide evidence of absence when the inquiry has credible reasons to expect the relation to generate detectable manifestations under the conditions observed. The relevant question is therefore whether the detection regime had adequate opportunity and sensitivity to register the target relation.

Consider communication. Failure to observe messages in one platform does little to establish absence if actors can use other channels. Failure to observe a legally required filing can be stronger evidence when the institutional procedure makes filing necessary and records are complete. Repeated inability to detect a predicted pathway across several independent data sources can weaken a relational hypothesis substantially. Historical absence is more difficult when record production and preservation are uncertain.

A useful absence claim therefore states the target relation, the observation opportunities, the expected manifestations, the sensitivity of the detection procedure, and the remaining alternative channels. It can also state a confidence horizon: absence during a specified interval does not imply absence before or after that interval.

Definition 7.54 (Evidentially supported relational absence). *Evidentially supported relational absence* is a bounded claim that a specified relation is not present within a stated domain when repeated or appropriately sensitive observation under credible detection conditions fails to reveal manifestations expected if that relation were present, and materially plausible alternative channels have been considered.

This definition preserves the difference between absence, missingness, and invisibility. Section 193 will later address missingness in relational data as a methodological object in its own right. The present section concerns the narrower inferential question of when absence itself can be identified.

7.6.9 Relation Uncertainty

Relation uncertainty concerns the degree and form of unresolvedness attached to identification. It should be represented more precisely than a binary present/absent flag. A candidate relation can be well supported as present while its type remains uncertain; its existence can be secure at one scale and doubtful at another; its historical continuity can be uncertain even when present manifestations are clear; its institutional status can be documented while practical enactment remains variable.

At least several dimensions can matter. *Existence uncertainty* concerns whether the relation is present. *Type uncertainty* concerns which relational category best fits the evidence. *Relata uncertainty* concerns who or what occupies the positions connected by the relation. *Manifestation uncertainty* concerns how reliably available traces reveal the relation. *Boundary uncertainty* concerns whether omitted actors or domains alter identification. *Scale uncertainty* concerns whether the relation persists under alternative resolutions. *Temporal uncertainty* concerns onset, duration, intermittency, and continuity. *Historical uncertainty* concerns reconstruction under incomplete or changing records. *Model uncertainty* concerns dependence on statistical, computational, formal, or conceptual representations.

These dimensions need not move together. A legal ownership relation can have low existence uncertainty and high uncertainty about practical control. A latent trust relation can have moderate existence uncertainty and substantial uncertainty about relational meaning. A historical dependency can have strong evidence for its existence during one period while its exact onset remains unclear. A network edge inferred from communication data can have low uncertainty within the platform and high boundary uncertainty if important communication occurs elsewhere.

The multidimensional confidence approach of Section 128 therefore carries directly into methodology. A single numerical confidence score can be useful in some designs, yet it can also compress distinctions needed for interpretation. Relational inquiry can use probabilities, intervals, sensitivity ranges, competing reconstruction sets, qualitative confidence categories, or structured uncertainty statements according to the evidential form and research purpose.

Definition 7.55 (Relation-identification profile). A *relation-identification profile* is a structured statement of the evidential status of a candidate relation across the dimensions material to its identification, including the available manifestations, inferential bridge, boundary and scale, temporal scope, plausible alternatives, and remaining uncertainties.

The profile is especially useful when several methods contribute different pieces of evidence. An interview can clarify meaning while transaction data establish frequency; institutional records can establish formal status while ethnography reveals enacted variation; archival materials can establish historical continuity while quantitative data estimate current distribution. The profile allows these contributions to accumulate without forcing them into one epistemic metric.

Contingent encounter can also alter relation identification. An unexpected archival juxtaposition, anomalous residual, phrase in an interview, spatial pattern, or institutional inconsistency can make a previously unconsidered relation salient. Aesthetic judgment may contribute to the initial recognition that the pattern is structurally interesting or generatively promising. Methodological identification begins when that salience is converted into a candidate relation with explicit relata, manifestations, al-

ternatives, and revision conditions. This distinction remains important in AI-assisted research: automated systems can generate large numbers of candidate edges or latent structures, while the evidential status of those candidates still depends on the manifestation regime, model assumptions, independent evidence, and accountable judgment.

Proposition 7.56 (Identification discipline). *Relational inquiry becomes more accountable when the status of a candidate relation is stated together with the manifestations or traces that support it, the inferential bridge connecting those manifestations to the target, the boundary, scale, and temporal domain of the claim, the principal alternatives considered, and the uncertainties that remain material to interpretation.*

Proposition 7.56 completes the sequence begun in Sections 7.3–7.5. Object specification states what kind of relational object is provisionally under study. Boundary construction states the domain within which relevance is assessed. Scale selection states the resolution at which differences are represented. Relation identification states what evidence warrants entry of a candidate relation into that object. These operations remain recursive: an identification failure can motivate boundary revision, a latent relation can require a new scale, and historical evidence can alter the object specification itself.

The next section turns from the evidential status of relation presence to the properties through which identified relations differ. Section 173 develops direction, intensity, duration, reciprocity, dependence, constraint, enablement, asymmetry, multiplexity, and relational meaning. Keeping identification and characterization separate allows the later analysis to ask not only whether a relation is present, but what kind of relation it has become and which of its properties are sufficiently warranted for further inquiry.

7.7 Characterization of Relations

Section 7.6 addressed the prior question of when available evidence warrants treating a candidate relation as present, absent, latent, institutional, historical, symbolically mediated, or otherwise identifiable within a specified research configuration. The present section moves from identification to characterization. Its role is to specify the properties through which an identified relation can differ from another relation and through which the same relation can change across time, scale, domain, and mode of manifestation. The discussion develops direction, intensity, duration, reciprocity, dependence, constraint, enablement, asymmetry, multiplexity, and relational meaning. These dimensions are treated as analytically distinguishable and potentially interdependent. Their characterization should remain indexed to the evidence through which the relation was identified, the boundary and scale selected in Sections 170–171, and the uncertainty retained in the relation-identification profile.

Characterization is therefore neither a decorative description added after relation identification nor an assumption that can be read directly from the presence of a tie. A relation can be well identified while several of its properties remain weakly known. A formal employment relation can be documented with high confidence while practical dependence, intensity of supervision, reciprocity of obligation, or relational meaning vary substantially across workers and periods. A communication edge can be directly observed while the direction of influence remains uncertain. A durable institutional

relation can contain intermittent interaction. A symmetric exchange frequency can coexist with asymmetric dependence. Methodological adequacy requires these distinctions to remain visible.

Definition 7.57 (Relational characterization profile). A *relational characterization profile* is a question-relative and revisable specification of the warranted properties of an identified relation, including the evidential basis, temporal scope, scale, boundary, relevant dimensions, and remaining uncertainty associated with those properties.

Definition 7.57 gives the section a practical unit of analysis. A characterization profile need not be complete across the dimensions developed below. Some inquiries require careful reconstruction of direction and dependence while intensity is secondary. Others focus on duration, multiplexity, or meaning. The relevant discipline is to distinguish properties that have been investigated from properties that remain unspecified, rather than silently filling unknown dimensions with assumptions inherited from a dataset, formal representation, or institutional category.

Table 7.6 summarizes the dimensions developed in this section. The table should be read as a methodological map rather than a claim that relations possess a fixed universal coordinate system. The dimensions can overlap in empirical manifestation, and some research traditions may operationalize them differently. Their value lies in making explicit which relational properties are being claimed and what kinds of evidential error are especially plausible.

7.7.1 Direction

Direction concerns the ordered orientation of a relation. The relevant ordering can involve movement of resources, information, commands, recognition, obligations, influence, care, risk, or other relationally specified contents. Direction should therefore be defined with respect to the relation under study rather than assumed from the order in which two entities appear in a dataset. A directed edge can record who sent a message, while the analytically relevant direction may concern who initiated coordination, who exercised authority, who became dependent on the information, or whose conduct changed afterward.

Several directions can coexist between the same relata. An employee may receive instructions from a supervisor while providing information upward, producing value for the organization, depending on the organization for income, and possessing specialized knowledge on which the supervisor relies. A lender can transfer capital toward a borrower while obligations of repayment run in the opposite direction. A teacher can transmit instruction toward a student while feedback, questions, and performance data modify the teacher's subsequent practice. Characterization should therefore state *which relational content is directed*.

Temporal order can help identify direction while remaining insufficient by itself for some claims. A precedes B does not establish that A caused B. Likewise, a payment from A to B does not establish that influence, dependence, or obligation runs in the same direction. Direction of manifestation, direction of causal effect, direction of normative obligation, and direction of dependence are analytically distinguishable. A study can characterize one of these while leaving another unresolved.

Direction can also vary across scale. A local dyad may show repeated influence from one actor toward another while organizational rules governing both actors originate elsewhere. At the institutional scale, the relation may therefore appear to be

Table 7.6: Dimensions of relational characterization and characteristic inferential risks

Dimension	Characterization question	Illustrative evidence	Characteristic inferential risk
Direction	In what direction does a flow, obligation, effect, recognition, or authority relation operate?	Ordered transfers, commands, replies, obligations, temporal sequence	Observed order is mistaken for causal or normative direction
Intensity	How strongly is the relation enacted or consequential within the stated domain?	Frequency, magnitude, salience, exposure, resource volume, reported importance	Frequency or volume is treated as intensity without relational interpretation
Duration	How long does the relation persist, recur, or remain institutionally available?	Longitudinal records, repeated interaction, contracts, archival continuity	Calendar continuity is confused with unchanged relational content
Reciprocity	To what extent do relevant relational acts or obligations return across relata?	Mutual exchange, acknowledgment, response, reciprocal obligation	Reciprocity is equated with equality or symmetry
Dependence	How much does one relatum rely on another for valued resources, capacities, recognition, access, or alternatives?	Exit options, substitutability, resource access, switching costs, counterfactual loss	Association or repeated use is interpreted as dependence
Constraint	Which possibilities are limited, conditioned, delayed, or made costly through the relation?	Rules, sanctions, bottlenecks, vetoes, opportunity restrictions	Constraint is inferred from unfavorable outcomes without a relational pathway
Enablement	Which capacities, options, access routes, or forms of action become available through the relation?	Access, coordination, knowledge transfer, recognition, infrastructure, support	Availability is treated as realized benefit or equal capability
Asymmetry	Which relational properties differ across positions or directions?	Unequal authority, dependence, information, exit capacity, exposure, conversion power	Difference is automatically interpreted as injustice or domination
Multiplexity	Which distinct relational channels connect the same or overlapping relata?	Work, kinship, finance, communication, authority, care, symbolic recognition	Several channels are collapsed into one undifferentiated tie
Meaning	How is the relation interpreted, classified, experienced, and institutionally recognized?	Interviews, texts, symbols, practices, legal categories, situated interpretation	One actor's account or one formal label is treated as exhaustive meaning

conditioned by a third source. Conversely, a distributed institutional pattern can be sustained through many local directional interactions. Multiscale analysis should preserve the distinction between a direction observed within a focal scale and a direction inferred across scales.

Definition 7.58 (Relational direction). *Relational direction* is the warranted ordering of a specified relational content among identified relata within a stated temporal, spatial, institutional, and analytical domain.

Definition 7.58 makes direction content-specific and bounded. It also prepares later work on causal and generative inquiry, where claims about directional production or

transformation will require stronger evidence than claims about ordered interaction alone.

7.7.2 Intensity

Intensity concerns the degree to which an identified relation is enacted, salient, resource-bearing, behaviorally consequential, or otherwise strong with respect to a stated analytical criterion. This formulation is intentionally plural because intensity has no single empirical manifestation across relational domains. Ten messages can constitute a weak routine contact, while one legal decision can reorganize a relation profoundly. A small financial transfer can have substantial consequences under severe scarcity, whereas a larger transfer can be marginal for an actor with abundant alternatives. Frequency and magnitude are therefore possible indicators of intensity rather than definitions of it.

Characterizing intensity requires specifying the dimension along which strength is assessed. Relevant dimensions can include frequency of interaction, volume of transferred resources, duration of exposure, salience to participants, institutional enforceability, behavioral consequence, degree of commitment, opportunity cost, or the magnitude of change associated with the relation. These measures can diverge. A rarely activated emergency guarantee can be institutionally strong despite low frequency. A frequent digital interaction can be socially shallow. A formally weak advisory relation can become practically influential when alternative expertise is scarce.

Intensity is also relative to baseline conditions. The same transfer can represent a small share of one actor's resources and a large share of another's. The same supervisory intervention can be consequential in a tightly controlled organization and routine in another setting. A characterization profile should therefore record the denominator or comparison condition where intensity is quantified. When intensity is interpreted qualitatively, the criteria supporting labels such as strong, weak, consequential, or peripheral should remain recoverable.

Measurement can itself alter perceived intensity. Platform logs privilege interactions that leave digital traces. Administrative records can capture formal transactions while informal support remains weakly recorded. Interview accounts can foreground experiences that participants consider salient while routine relations become less narratively visible. Triangulation across manifestations can therefore be especially valuable when intensity is theoretically important.

Remark 7.59 (Intensity is multidimensional). A relation can be intense along one dimension and weak along another. High interaction frequency can coexist with low dependence, while low-frequency relations can carry strong legal, symbolic, or material consequences. Characterization should preserve the dimension on which intensity is claimed.

This remark matters for later economic analysis. Market frequency, monetary volume, bargaining dependence, institutional enforceability, and generative consequence can move differently. Collapsing them into a single edge weight can obscure the relational mechanism that the inquiry is trying to explain.

7.7.3 Duration

Duration concerns the temporal extension, recurrence, persistence, intermittency, and availability of an identified relation. A relation can exist continuously, recur periodically, remain dormant while institutionally available, or be reconstructed as a sequence of related but changing relational episodes. Characterizing duration therefore requires more than recording the interval between first and last observations.

A contractual relation can persist during periods with little visible interaction because obligations and expectations remain active. A friendship can involve long periods without communication while retaining a meaningful capacity for renewed interaction. An institutional affiliation can remain formally continuous while practical participation changes sharply. Conversely, repeated transactions between the same actors do not necessarily constitute one durable relation if the basis, meaning, or governing conditions of the interaction change materially.

Several temporal properties should be distinguished where relevant. *Onset* concerns when the relation becomes sufficiently constituted to identify. *Persistence* concerns the extent to which it remains recognizable through time. *Intermittency* concerns gaps in manifestation without necessarily implying dissolution. *Recurrence* concerns repeated reactivation. *Termination* concerns the point at which the relation ceases to satisfy the criteria under which it was identified. *Latency* concerns periods in which a relation remains consequential or institutionally available despite weak observable enactment.

Historical inquiry adds the problem of changing relational content. A relation can preserve a name while its obligations, authority, material basis, or symbolic meaning evolve. Duration should therefore be distinguished from identity through time. Section 174 will address relational identity and persistence directly. For present purposes, a duration claim should state whether it concerns persistence of formal status, continuity of interaction, continuity of effect, continuity of meaning, or another specified property.

Definition 7.60 (Relational duration). *Relational duration* is the temporally bounded characterization of the persistence, recurrence, intermittency, dormancy, or termination of an identified relation under stated criteria of continuity.

The definition keeps duration connected to evidential conditions. A missing observation in a longitudinal dataset can indicate inactivity, unobserved interaction, data loss, or dissolution. Duration claims therefore inherit the missingness and detection problems developed in Section 172 and later revisited in the chapter's treatment of relational data.

7.7.4 Reciprocity

Reciprocity concerns the extent to which relational acts, obligations, recognition, resources, or responses move across positions in ways that are meaningfully returned or mutually constituted. Reciprocity should be distinguished from symmetry. A relation can be reciprocal while remaining highly asymmetric in magnitude, timing, authority, dependence, or meaning. Parent and child, teacher and student, lender and borrower, state and citizen, employer and employee, or clinician and patient can occupy reciprocal relations without occupying interchangeable positions.

The form of return also matters. A resource transfer can be reciprocated by money,

labor, care, recognition, information, future obligation, institutional compliance, or another form of response. If analysis defines reciprocity only as exchange of the same measurable object, it can miss heterogeneous return relations. This is particularly important for GRE, where later chapters will examine heterogeneous value forms and conversions that may resist a common metric.

Reciprocity can be immediate or temporally extended. A response may occur within seconds, after a contractual period, across a career, or across generations. Short observation windows can therefore make reciprocal structures appear unilateral. At the same time, indefinite expectations of future return should not be used to infer reciprocity without evidence. A characterization profile can record the expected form and temporal horizon of return together with uncertainty about whether reciprocal realization has occurred.

Institutional rules can organize reciprocity even when local interactions look one-directional. Taxation and public provision, membership obligations and institutional benefits, or credentialing and professional duties can involve distributed forms of reciprocity that do not map neatly onto one dyad. Conversely, formally reciprocal obligations can be enacted asymmetrically when one party possesses greater enforcement capacity or exit options.

Remark 7.61 (Reciprocity and symmetry). Reciprocity concerns relational return or mutual constitution. Symmetry concerns similarity across specified relational properties. A relation can therefore be reciprocal while remaining asymmetric in authority, dependence, intensity, timing, exposure, or capacity to exit.

Preserving this distinction prevents a common methodological shortcut in which mutual exchange is taken as evidence of relational equality. Later analysis of power and justice will require more detailed attention to which properties remain asymmetric within apparently reciprocal relations.

7.7.5 Dependence

Dependence concerns the extent to which a relatum's valued options, capacities, resources, recognition, security, or ability to continue a course of action rely on a specified relation. Dependence is therefore relational and counterfactual: it concerns what becomes difficult, costly, unavailable, or substantially altered if access through the relation changes. Repeated interaction alone provides limited evidence of dependence when substitutes are readily available and exit is inexpensive.

Several conditions can contribute to dependence. These include scarcity of alternatives, switching costs, legal restrictions, sunk investments, informational specialization, social attachment, infrastructural concentration, geographic immobility, credential requirements, or control over conversion interfaces. The same observed relation can therefore generate different levels of dependence for different participants. A worker with several comparable employment options can occupy the same formal employment relation as a worker whose legal status or geographic location makes exit difficult, yet their dependence profiles differ.

Dependence can also be domain-specific. An organization can depend on a supplier for one specialized input while retaining broad autonomy elsewhere. A researcher can depend on an institution for laboratory access without depending on it for intellectual identity. A community can depend on a platform for visibility while maintaining offline support networks. Characterization should state the valued domain in which

dependence is claimed.

Counterfactual reasoning is useful but should remain calibrated. Removing a relation can create losses because the relation was beneficial, because alternatives were suppressed, because transition costs are high, or because surrounding institutions were built around that relation. These mechanisms imply different forms of dependence. Evidence can include observed exit behavior, substitution patterns, participant accounts, institutional rules, resource concentration, natural experiments, historical disruptions, or comparative cases with different alternatives.

Definition 7.62 (Relational dependence). *Relational dependence* is the degree to which a relatum's specified valued capacities, options, resources, recognition, or continuity of action rely on maintaining access through an identified relation under the alternatives available within the stated domain.

Dependence should not be treated automatically as domination or injustice. Some dependencies are voluntarily cultivated, mutually beneficial, or constitutive of valuable forms of cooperation. Their normative evaluation depends on properties such as reversibility, alternatives, voice, distribution of benefits and burdens, vulnerability to unilateral change, and broader institutional context.

7.7.6 Constraint

Constraint concerns the ways in which an identified relation conditions, narrows, delays, redirects, penalizes, or raises the cost of possible actions or trajectories. Constraint can be explicit, as in a legal prohibition, contractual restriction, technical access control, or organizational veto. It can also be distributed through expectations, resource dependencies, classification systems, infrastructures, or relational configurations that make some actions difficult without a single actor issuing a command.

A constraint claim should identify the constrained possibility and the relational pathway through which the limitation is produced. An unfavorable outcome alone is weak evidence that a relation constrained the actor. The actor may have lacked resources for unrelated reasons, preferred another option, misperceived available alternatives, or faced a broader environmental limitation. Relational inquiry therefore asks how the identified relation changed the feasible or practically accessible set of actions relative to plausible alternatives.

Constraints can be enabling for coordination at another level. Traffic rules restrict possible movements while supporting predictable collective mobility. Research ethics procedures can delay some forms of inquiry while protecting participants and sustaining institutional legitimacy. Contractual obligations can limit immediate discretion while stabilizing expectations needed for cooperation. The analytical task is therefore to characterize what is constrained, for whom, at what scale, over what horizon, and with what consequences, rather than assigning a globally constraining identity to the relation.

Constraint can also be latent. An actor may not encounter a sanction because anticipated enforcement already shapes conduct. A platform rule can influence behavior even when no account is removed. A professional norm can limit publicly imaginable options through expected reputational consequences. Evidence for such constraints may require participant accounts, institutional documents, comparative cases, observed behavior around rule changes, or counterfactual variation.

Definition 7.63 (Relational constraint). A *relational constraint* is a warranted condition through which an identified relation limits, conditions, delays, redirects, or raises the cost of a specified class of possible actions or trajectories for one or more relations within a stated domain.

This definition treats constraint as possibility- and domain-specific. It also leaves room for constraints that operate through several scales, such as institutional rules enacted through organizational routines and experienced in local interactions.

7.7.7 Enablement

Enablement concerns the capacities, access routes, resources, coordination possibilities, forms of recognition, or actionable options that become available or more feasible through an identified relation. As with constraint, enablement should be characterized relative to a specified possibility and evidential pathway. The mere presence of a resource or institutional entitlement does not establish that a person can effectively convert it into capability or action.

Relations can enable through several mechanisms. They can transmit knowledge, provide material resources, coordinate complementary activity, authorize participation, confer recognition, reduce uncertainty, share risk, provide infrastructure, create trust, or connect actors to further relations. The same relation can enable one class of action while constraining another. Organizational membership can provide resources and professional identity while imposing role obligations. A financial relation can provide liquidity while creating repayment dependence. A legal status can confer protection while subjecting activity to specified procedures.

Enablement can also depend on complementary relations. Access to a scholarship may have limited practical effect if housing, language support, transportation, or legal permission remain unavailable. Digital access may not become informational capacity without literacy, time, or trusted interpretive support. A research collaboration can offer data access while leaving participants without authority to shape the questions asked. Characterization therefore benefits from distinguishing nominal availability from effective convertibility.

This distinction will later matter for GRE's analysis of generativity. An enabling relation can expand present options without necessarily producing durable generative capacity. Conversely, a modest immediate resource can become highly generative if it enters a relational configuration that supports learning, coordination, or repeated conversion. The present section remains at the level of relation characterization; Chapter 8 will address stronger claims about generation and subsequent transformation.

Definition 7.64 (Relational enablement). *Relational enablement* is a warranted condition through which an identified relation expands, supports, authorizes, coordinates, or lowers the cost of a specified class of capacities, access routes, or possible actions within a stated domain.

Constraint and enablement should therefore be characterized separately rather than treated as logical opposites. A relation can do both, and the balance can vary across actors, timescales, and scales.

7.7.8 Asymmetry

Asymmetry concerns differences in relational properties across positions, directions, or relata. These differences can involve authority, dependence, information, intensity, exposure, risk, mobility, recognition, resource contribution, conversion capacity, exit options, or capacity to define the meaning of the relation itself. Asymmetry is therefore a comparative property of a relation rather than a synonym for hierarchy.

Some asymmetries are built into differentiated roles. A surgeon and patient, judge and litigant, teacher and student, or pilot and passenger occupy positions with different responsibilities and competencies. Other asymmetries can emerge historically through resource accumulation, institutional privilege, infrastructural control, or differential alternatives. The methodological task is to identify the dimension of difference and its consequences before making a normative judgment.

Asymmetry can also be concealed by symmetric data representations. A network dataset can record an undirected connection between two organizations while one controls most of the relevant resources. A contract can list mutual obligations while enforcement capacity differs sharply. Two actors can exchange similar monetary amounts while one faces much higher opportunity cost. Characterization therefore requires attention to the property that is being compared rather than assuming that a symmetric edge implies a symmetric relation.

The reverse problem also occurs. A visibly asymmetric relation may be normatively justified or practically necessary within a specified domain, especially when responsibilities, expertise, risk, or consent differ. Empirical asymmetry should therefore be kept distinct from conclusions about domination, exploitation, injustice, or legitimacy. Those conclusions require additional normative and causal analysis.

Definition 7.65 (Relational asymmetry). *Relational asymmetry* is a warranted difference across positions or directions in one or more specified properties of an identified relation, such as authority, dependence, information, intensity, exposure, alternatives, or capacity to alter the relation.

This definition will support later economic analysis of bargaining power, ownership, value capture, access, and generativity return without assuming that each form of relational difference has the same normative significance.

7.7.9 Multiplexity

Multiplexity concerns the coexistence of several relational channels among the same or overlapping relata. Two people can simultaneously be colleagues, friends, coauthors, creditors, neighbors, and members of the same institution. Two organizations can compete in one market while collaborating on standards, sharing infrastructure, exchanging personnel, and depending on the same regulator. A state can relate to an organization through taxation, licensing, procurement, regulation, subsidy, data exchange, and legal adjudication. Collapsing these channels into one undifferentiated tie can obscure how relational properties interact.

The channels need not be independent. One relation can alter the meaning or consequence of another. Friendship can change how professional criticism is interpreted. Financial dependence can affect bargaining in a contractual relation. Shared institutional membership can make communication possible. A symbolic relation can legitimize a material transfer. Multiplexity therefore concerns more than counting tie

types; it concerns the configuration through which several relation types coexist, reinforce, compensate for, or conflict with one another.

Methodologically, multiplexity raises identification and measurement problems. A survey question about “support” can combine emotional, informational, financial, and practical assistance. Administrative records can capture contractual ties while informal advice remains invisible. Network layers can be available at different temporal resolutions. A researcher can therefore construct artificial multiplexity or artificial simplicity depending on how categories are defined and data sources are combined.

Scale also matters. At a dyadic scale, multiplexity concerns several channels between two relata. At an organizational or field scale, it can concern overlapping systems of finance, authority, information, recognition, infrastructure, and regulation. Cross-scale relations can themselves be multiplex: an institution can influence local conduct through law, funding, classification, professional norms, and technical standards at the same time.

Definition 7.66 (Relational multiplexity). *Relational multiplexity* is the coexistence of analytically distinguishable relational channels among the same or overlapping relata, together with the possibility that those channels condition one another’s operation, meaning, or consequence.

The definition prepares later network, higher-order, and field-based analysis. It also matters for economic praxis because material exchange, authority, trust, symbolic recognition, knowledge, and institutional access can circulate through partially overlapping relational infrastructures.

7.7.10 Relational Meaning

Relational meaning concerns how an identified relation is interpreted, classified, experienced, expected, narrated, symbolized, and institutionally recognized by participants and relevant surrounding actors. Meaning is analytically important because materially similar interactions can occupy different relational structures when participants understand their obligations, permissions, identities, or expectations differently. A monetary transfer can be a wage, gift, loan, tax, bribe, reimbursement, inheritance, donation, or ritual contribution. The physical movement of money does not by itself establish the relation being enacted.

Meaning can be accessed through language, interviews, ethnographic observation, documents, legal categories, symbols, rituals, practices, institutional classifications, and comparative context. These sources provide partially different forms of evidence. A participant’s account can reveal lived interpretation without exhausting the institutional meaning of the relation. A legal category can establish formal status while practical meaning differs in everyday enactment. An external researcher can identify structural dependence that participants do not describe in those terms. Relational meaning is therefore reconstructed through situated evidence rather than assigned exclusively by one source of authority.

Meaning can also be contested within a relation. An organization can describe a work arrangement as flexible collaboration while workers experience it as dependence. A state can classify a transfer as assistance while recipients interpret it as entitlement, compensation, or surveillance. A family relation can carry different expectations across generations. Contested meaning is itself a relational fact when the

disagreement shapes conduct, legitimacy, trust, or conflict.

Historical change further complicates meaning. The same institutional category can acquire different associations, rights, obligations, and symbolic valence over time. A relation can also be reclassified deliberately, as when an informal practice becomes legally recognized, a market exchange becomes regulated as employment, or a customary entitlement is reframed as a discretionary benefit. Such reclassification can change behavior because symbolic and institutional meanings enter the relation's consequences.

Meaning interacts with the other dimensions developed in this section. Direction can be interpreted as authority, advice, care, or coercion. Reciprocity can be understood as exchange, obligation, solidarity, or indebtedness. Dependence can be experienced as security, vulnerability, commitment, or constraint. Asymmetry can be accepted as legitimate specialization in one context and contested as domination in another. Multiplexity can make these meanings coexist and sometimes conflict.

Definition 7.67 (Relational meaning). *Relational meaning* is the historically and contextually situated interpretation, classification, expectation, and symbolic significance through which an identified relation is understood and enacted by relevant participants, institutions, or interpretive communities.

Definition 7.67 avoids treating meaning as either purely subjective or fully fixed by formal classification. Meaning is relationally produced and can remain contested. Its reconstruction therefore benefits from methodological pluralism, especially when participant accounts, documentary categories, observed practices, quantitative patterns, and institutional rules diverge.

The ten dimensions developed in this section should be treated as a characterization architecture rather than a mandatory checklist. Their relevance depends on the research question and the relation identified. A careful study can leave some dimensions unspecified while stating why they are outside its scope. What matters is that unexamined properties are not silently assumed. Characterization also remains revisable: new evidence can change an estimate of dependence, reveal previously hidden multiplexity, alter the inferred direction of influence, or show that the meaning of a relation changed across periods.

This revisability is especially important under contingent encounter. A relation initially characterized as weak can become analytically important when an unexpected event reveals high dependence. A formally reciprocal relation can appear differently after an archival record exposes asymmetric enforcement. A relation represented as purely material can acquire a symbolic dimension through an interview, ritual, or institutional dispute. Aesthetic judgment can make such discrepancies salient before their epistemic significance is established; subsequent inquiry should determine whether the discrepancy warrants revision of the characterization profile.

AI-assisted analysis can increase the number of relational properties that can be extracted, compared, and modeled across large bodies of text, administrative records, networks, and longitudinal data. This expands methodological possibility while increasing the importance of semantic discipline. Automatically generated edge weights, sentiment labels, inferred roles, or relational categories remain representations whose meaning depends on training data, operational definitions, context, and validation. Abundance of characterized relations therefore does not remove the need to ask what each characteristic means and how it was warranted.

The next section turns from characterization at a given analytical moment to a harder temporal question. Section 174 examines relational identity and persistence: under what conditions can a changing relation be treated as the same relation through time, when does transformation become reconstitution, and how can continuity be reconstructed without assuming that persistence requires invariance.

7.8 Relational Identity and Persistence

Section 7.7 characterized identified relations through dimensions such as direction, intensity, duration, reciprocity, dependence, constraint, enablement, asymmetry, multiplexity, and meaning. The present section addresses the temporal problem that follows from such characterization: when observations separated in time may be treated as phases of one continuing relation, when change warrants reclassification, and when a relation has dissolved while some of its effects remain. Its role is methodological rather than primarily ontological or epistemological. Chapters 4 and 5 established that relational reality can persist through changing realization and that relational identity claims require explicit continuity criteria. Here those commitments are converted into a research procedure for reconstructing formation, continuity, transformation, dissolution, symbolic continuity, discontinuity, historical identity, persistence criteria, and uncertainty of identity.

The problem arises because persistence is compatible with change. An employment relation can continue through changes in wages, tasks, supervisors, contractual instruments, and working arrangements. A credit relation can continue through refinancing or restructuring. An institutional relation can retain legal continuity while its practical authority changes. A professional, kinship, or diplomatic relation can remain available during long intervals of sparse interaction. Conversely, continuity of a name, account identifier, organization, office, or legal form can conceal substantial relational reconstitution. Temporal inquiry therefore requires more than matching labels across observations. It requires a defensible account of what carries continuity and which changes matter for the research question.

A further complication follows from Sections 7.4–7.7. Identity judgments inherit the boundary, scale, identification, and characterization choices through which the relation was specified. A relation can appear continuous at an institutional scale while undergoing repeated local reconstitution. It can remain formally stable while dependence, meaning, or reciprocity changes. It can be intermittent in observable enactment while persisting through recognized obligations, memory, infrastructure, or latent capacity. Relational identity is therefore best treated as a structured temporal judgment whose evidential basis remains recoverable.

Definition 7.68 (Relational identity profile). A *relational identity profile* is a question-relative and revisable record that specifies the relation being tracked, its identity-bearing dimensions, continuity carriers, relevant temporal and spatial scope, evidence of formation and persistence, transformations, possible discontinuities, dissolution conditions, and remaining uncertainty.

Definition 7.68 provides the practical unit for this section. The profile does not require the researcher to declare a relation permanently identical or permanently different across an entire history. It can represent continuity in some dimensions together with transformation in others, periods of dormancy, contested transitions,

Table 7.7: Temporal operations in relational identity analysis

Operation	Methodological question	Illustrative continuity evidence	Characteristic inferential risk
Formation	When does the target relation become sufficiently organized to enter the inquiry as a relation of the specified kind?	First enforceable obligation, repeated coordinated practice, stabilized expectation, recognized status, recurrent exchange	First observation is mistaken for first formation
Continuity	Which identity-bearing dimensions remain connected across time?	Recurring obligations, records, memory, infrastructure, role succession, repeated interaction	Surface similarity is treated as sufficient continuity
Transformation	Which changes materially alter the relation while preserving some lineage or continuity?	Changed rules, dependence, authority, meaning, realization, or reproduction mechanism	Change is either ignored or treated as complete replacement too quickly
Dissolution	When do the relevant persistence conditions cease to hold?	Termination, loss of obligation, disappearance of coordination, ineffective authority, replacement of carrying mechanisms	Non-observation is treated as dissolution despite latency or missing evidence
Symbolic continuity	How do names, categories, records, narratives, and symbols preserve or reshape relational continuity?	Persistent designation, credential, archive, ritual, legal category, public memory	Symbolic persistence is equated with substantive relational persistence
Discontinuity	Which identity-bearing dimensions exhibit a consequential break?	Rupture of obligations, replacement of mechanism, institutional break, changed participants or capacities	A single event is treated as total discontinuity across scales and dimensions
Historical identity	How are later relations connected to earlier relations through lineage, succession, inheritance, or path dependence?	Succession records, inherited assets, rules, infrastructures, obligations, institutional memory	Historical descent is equated with unchanged identity
Persistence criterion	Which dimensions and tolerances define continuity for the research target?	Explicit criterion, continuity carrier, temporal resolution, failure condition	The criterion is selected after seeing the desired conclusion
Identity uncertainty	Which competing continuity accounts remain plausible?	Alternative timelines, missing intervals, conflicting records, contested interpretations	Ambiguity is hidden through forced binary classification

or alternative identity hypotheses. This is especially useful for longitudinal work in which later evidence changes the interpretation of earlier observations.

Table 7.7 summarizes the main temporal operations developed below. The categories are analytical aids rather than mutually exclusive states. Formation can be gradual, continuity can contain transformation, dissolution can leave residues, and symbolic continuity can coexist with practical discontinuity.

7.8.1 Relation Formation

Relation formation concerns the entry of a candidate relation into a sufficiently organized state for the specified inquiry. Formation should be distinguished from first observation. The earliest surviving record can postdate the practical emergence of a relation, while a formal creation date can precede the point at which the relation becomes enacted. A contract may be signed before work begins. A legal office may be created before authority becomes practically effective. Trust can develop through repeated encounters without a unique inaugural event. A market relation can become economically consequential before a durable statistical category exists for recording it.

Methodological reconstruction therefore benefits from a *formation window* when the evidence does not support a singular date. The window can contain precursor interactions, negotiations, symbolic acts, institutional decisions, initial exchanges, repeated coordination, or other processes through which the relation becomes recognizable under the identity criterion. A narrow legal inquiry can legitimately use a formal date when legal status is the target. A study of practical dependence may require a different formation threshold. A historical inquiry may distinguish several stages, such as precursor conditions, initial enactment, stabilization, and public recognition.

Definition 7.69 (Relation formation record). A *relation formation record* is a temporally ordered account of the manifestations, precursor conditions, entry criteria, and evidential uncertainties through which a relation is judged to have formed for a specified analytical target.

A formation record helps prevent retrospective compression. Once a relation is well established, earlier events can appear to have led inevitably toward it. The record should preserve uncertainty about alternatives that were available during formation when those alternatives affect interpretation. Failed negotiations, competing institutional forms, unrealized expectations, and contingent encounters can reveal that the later relation was one historical resolution among several possibilities.

Formation can also occur at different times across scales. A dyadic exchange relation may form before a wider organizational routine stabilizes around it. An institutional relation can be formally established before local actors adopt the corresponding practices. A transnational arrangement can exist legally while implementation remains uneven across jurisdictions. The relational identity profile should therefore state the scale at which formation is being claimed and avoid treating one formation date as automatically applicable across nested relations.

The role of manifestation also requires care. A declaration, classification, public ceremony, price, credential, or platform status can mark formation when the relation is partly constituted through symbolic recognition. In other cases, the manifestation records a relation that had already become practically operative. The evidential task is to determine whether the manifestation is a constitutive event, a public indicator, a delayed record, or a later reinterpretation of formation.

7.8.2 Relation Continuity

Relation continuity concerns the connection between temporally separated states of a relation under a stated identity criterion. Continuity can be carried through repeated interaction, legal succession, memory, records, obligations, routines, infrastructure,

positional structure, shared expectations, or other mechanisms that connect earlier and later states. The relevant carrier depends on the relation under study. A continuing debt can persist through an account balance and enforceable obligation even when borrower and lender have little interaction. A professional relation can persist through institutional position and recognized responsibility. A friendship can persist through memory and expectation during a long period of sparse communication.

The methodological problem is therefore to identify a *continuity carrier* rather than infer persistence from duration alone. Calendar time does not explain how a relation remains connected across change. A database can show that an identifier appears for ten years while leaving open whether the underlying authority, dependence, or meaning changed. Conversely, turnover of personnel or technology can coexist with strong continuity when roles, obligations, institutional memory, or infrastructure reproduce the relation.

Definition 7.70 (Continuity carrier). A *continuity carrier* is a relation, record, practice, obligation, memory, infrastructure, recognized status, or other empirically traceable mechanism through which identity-bearing features of a relation remain connected across a specified temporal interval.

Continuity carriers can be multiple and partially substitutable. An organization may preserve a relation through legal succession, standardized routines, archived records, and role inheritance. If one carrier weakens, others may sustain continuity. This plurality can also create disagreement. Legal continuity may remain strong while interactional continuity becomes weak; practical dependence may persist after the formal relation changes; symbolic recognition may outlive material exchange. The relational identity profile should preserve these divergences rather than compress them into one binary continuity variable.

Intermittence deserves separate treatment. An inactive period does not necessarily terminate a relation. Dormant credit, seasonal employment, recurrent ritual obligations, kinship responsibilities, emergency powers, or long-distance professional ties can retain recognized possibility and expectation during periods with few observable events. Evidence of latency can include continuing entitlements, retained access, standing obligations, preserved infrastructure, or credible expectations of resumption. Where such carriers are absent, an inactivity interval places stronger pressure on a persistence claim.

Continuity also remains scale-sensitive. A supply relation between organizations can appear continuous at the organizational scale while its operational pathways, personnel, and technologies change repeatedly. A community relation can persist while individual participants enter and leave. A field-level dependency can remain stable while particular dyadic links are replaced. Methodological reporting should state the scale at which continuity is claimed and preserve lower- or higher-scale changes that materially affect interpretation.

7.8.3 Relation Transformation

Relation transformation concerns change that materially alters one or more identity-bearing dimensions while preserving enough continuity or lineage to make comparison with the earlier relation analytically meaningful. The concept is needed because persistence and replacement do not exhaust the temporal possibilities of relational change. A relation can remain historically connected to its earlier form while chang-

ing in authority, dependence, reciprocity, medium, institutional basis, meaning, or mode of reproduction.

The characterization dimensions from Section 7.7 provide one route for diagnosing transformation. A long-standing exchange relation can remain continuous while dependence becomes more asymmetric. An institutional relation can preserve formal authority while practical compliance weakens. A care relation can persist while its material and emotional organization changes. A platform relation can retain the same account identifiers while algorithmic mediation changes access, visibility, and bargaining conditions. The question is whether the change is sufficiently consequential for the target inquiry that an unqualified statement of continuity would conceal an important difference.

Transformation thresholds can be qualitative, quantitative, institutional, or mixed. A quantitative study may specify a threshold in network position or exchange volume. A legal inquiry may treat amendment, novation, merger, or formal reconstitution as a decisive change. Historical inquiry may identify a transition through converging evidence that the relation now operates through different mechanisms. Ethnographic or interview-based inquiry may reveal a change in meaning or obligation that remains invisible in administrative records. Methodological pluralism is therefore useful because different forms of evidence can reveal transformation in different dimensions.

A productive reporting form is *continuity with transformation*. This formulation preserves both facts when the evidence supports them: the later relation belongs to the same historical lineage under one or more continuity criteria, while a specified set of relational properties has changed enough to require explicit qualification. Such reporting is often more informative than forcing the case into either complete sameness or complete replacement.

Transformation can also propagate across scale. Changes in an institutional rule may alter organizational implementation, dyadic interaction, and individual dependence at different rates. Conversely, accumulated changes in local practices may eventually reconstitute an institutional relation. The temporal profile should therefore preserve the sequence and cross-scale pathways through which transformation occurs rather than treating the transition as simultaneous across the system.

7.8.4 Relation Dissolution

Relation dissolution concerns the failure of the persistence conditions relevant to the specified relation. It can be formal, practical, gradual, abrupt, partial, or contested. A contract can terminate on a stated date while informal obligations persist. A relation of trust can erode gradually before participants acknowledge the change. A regulatory authority can remain formally assigned while becoming practically ineffective. A market relation can cease through the disappearance of transactions, expectations, and enabling infrastructure even without a formal termination event.

The evidential problem resembles the problem of absent relations in Section 7.6. Non-observation provides stronger evidence of dissolution when the observation regime would probably have detected continuing enactment and when the relevant continuity carriers have also disappeared or become ineffective. Sparse data, hidden activity, altered recording practices, latency, or migration to another medium weaken the inference from silence. A dissolution judgment should therefore record both the cessation evidence and the detection conditions under which continued

relation would have been observable.

Formal dissolution can carry substantial weight when formal status constitutes the target relation. Cancellation of a contract, abolition of an office, revocation of a license, or legal dissolution of an organization can immediately alter recognized rights and obligations. Yet residual consequences can remain. Debts, records, reputations, infrastructures, learned routines, classifications, symbolic meanings, and distributions produced during the relation's persistence can continue to condition later configurations.

Proposition 7.71 (Persistence and residual efficacy). *For a specified relational identity criterion, evidence that a relation has dissolved can coexist with evidence that products or residues generated during its persistence remain causally or interpretively consequential in later configurations.*

Proposition 7.71 prevents the end of a relation from being confused with erasure of its history. The proposition is especially important for economic and institutional inquiry, where past relations can remain encoded in property distributions, debt, infrastructure, credentials, legal precedent, organizational memory, or reputational structure.

Dissolution can also be scale-specific. A dyadic relation can end while a wider organizational dependency remains. An organization can dissolve while interpersonal networks formed within it continue. A legal regime can terminate while administrative routines survive. Reporting should therefore specify the relational object that is judged to have dissolved and identify relevant residual relations that remain outside that identity claim.

7.8.5 Symbolic Continuity

Symbolic continuity concerns persistence of names, categories, narratives, records, representations, rituals, credentials, public identities, or other symbolic forms associated with a relation. Such continuity deserves separate analysis because symbolic persistence can relate to relational persistence in several ways. It can record continuity, help reproduce continuity, conceal transformation, or survive after practical dissolution.

A name can remain stable while the relation it denotes changes substantially. An institution can preserve its title while authority, membership, financing, or purpose is reorganized. A currency name can continue across changes in monetary architecture. A professional category can retain legal recognition while the practices and dependencies associated with it change. In these cases symbolic continuity provides evidence of a historical or institutional connection while offering limited support for continuity of the full relational profile.

Symbolic forms can also act as continuity carriers. A credential can preserve access across organizations. A legal title can sustain rights and expectations through personnel turnover. A family designation can organize obligations across physical separation. An organizational narrative can coordinate action by connecting present participants to a remembered institutional history. The methodological question is therefore whether a symbol merely indicates continuity or participates in reproducing it.

Definition 7.72 (Symbolic continuity role). *A symbolic continuity role specifies*

whether a persistent symbolic form functions primarily as an indicator of relational continuity, a mechanism that helps reproduce continuity, a historical trace, a contested claim of continuity, or a residual form after substantive transformation or dissolution.

This distinction becomes especially important in archival and AI-assisted research. Name matching, entity resolution, and record linkage can produce apparently continuous longitudinal series from repeated labels. Such procedures are useful for discovery while remaining vulnerable to both false continuity and false discontinuity. A renamed organization can remain relationally continuous; an unchanged identifier can contain major reconstitution. Automated linkage should therefore preserve the provenance and basis of identity matches rather than silently converting lexical similarity into historical identity.

Symbolic discontinuity can likewise occur without substantive dissolution. New terminology, rebranding, language change, legal recodification, or altered classification can modify manifestation while practical relations remain substantially continuous. Researchers should therefore compare symbolic and substantive temporal profiles rather than treating them as interchangeable.

7.8.6 Relational Discontinuity

Relational discontinuity concerns a consequential break in one or more identity-bearing dimensions of a relation. Discontinuity can be abrupt, cumulative, partial, multidimensional, or scale-specific. A political event can rapidly alter recognized authority. A technological transition can progressively displace a communication relation. A merger can terminate corporate identities while preserving employment routines. A migration can interrupt local interaction while leaving obligations and emotional relations active. The method should identify which dimension has broken and over what interval.

A discontinuity judgment benefits from comparison with the continuity carriers identified earlier. Evidence becomes stronger when previously operative carriers cease, are replaced, or lose efficacy. A relation organized through repeated face-to-face practice may be interrupted by physical separation yet reconstituted through digital communication. In that case discontinuity of medium need not equal discontinuity of relation. If the relevant obligations, expectations, and interaction cease as well, the case for a stronger discontinuity judgment increases.

Discontinuity can also take branching or merging forms. One institutional relation can split into several successor relations. Several local relations can be consolidated under a new organizational form. A transformed relation can retain partial lineage with more than one predecessor. These cases are poorly represented by a single continuous line. A branching temporal representation, event history, relational genealogy, or versioned record may be methodologically more adequate.

Periodization should therefore remain relation-specific. A major historical event can supply a useful temporal boundary while different relations cross that boundary in different ways. Some may rupture immediately, some may transform gradually, and others may remain comparatively stable. The event can still be causally significant without functioning as a universal breakpoint for the entire relational field.

Contingent encounter is relevant here because discontinuity is sometimes first noticed through an anomalous trace: a missing obligation, changed phrase, altered cat-

egory, unusual transaction pattern, newly absent actor, or unexpected archival juxtaposition. Aesthetic judgment can make the discontinuity salient by registering that the pattern no longer fits the expected continuity. That salience motivates inquiry; the discontinuity claim itself requires later evidence about the identity-bearing dimensions and continuity carriers involved.

7.8.7 Historical Identity

Historical identity concerns the relation between persistence and lineage. A later relation can inherit assets, obligations, categories, infrastructures, records, participants, or institutional memory from an earlier relation while changing enough that unqualified identity becomes analytically misleading. Conversely, substantial changes in realization can occur while continuity remains strong at the scale and target relevant to the inquiry. Historical identity therefore benefits from recording lineage and sameness separately.

Lineage asks where a relation comes from and which earlier configurations participate in its formation. Identity asks whether earlier and later configurations should be treated as phases of one relation for a specified research purpose. The two questions often overlap while remaining distinguishable. A successor organization can inherit records and obligations from a predecessor without satisfying each plausible criterion of organizational continuity. A new monetary arrangement can descend from an earlier system while changing the mechanisms through which claims are settled. A transformed institutional relation can preserve precedent and personnel while reallocating authority.

Historical identity can consequently be multidimensional. Continuity of legal status, practical function, participant expectations, infrastructure, symbolic recognition, and generative effects can diverge. A historical account can report strong institutional lineage, moderate functional continuity, and weak interactional continuity without contradiction. Such a profile is often more informative than a single label of sameness or difference.

Historical identity also depends on temporal resolution. At a short interval, a relation can appear stable; over decades, several phases become visible. A long horizon can reveal that what appears to be one continuous relation contains recurring dissolution and reconstitution. Conversely, a high-frequency record can exaggerate temporary fluctuation and obscure durable organization. The scale discipline developed in Section 7.5 therefore applies temporally as well as structurally.

Path dependence can contribute to historical identity when earlier relational states alter later options, costs, expectations, or institutional possibilities. Yet inherited constraint alone does not establish persistence of the original relation. A dissolved relation can condition later arrangements through its residues, as Proposition 7.71 emphasizes. Historical explanation should therefore distinguish persistence of the relation from persistence of effects generated by the relation.

7.8.8 Criteria of Persistence

Criteria of persistence make the preceding judgments auditable. A persistence criterion specifies which dimensions carry identity, what degree of variation is compatible with continuity, how gaps are treated, which evidence is required, and what obser-

vations would place sufficient pressure on the continuity claim to trigger revision. The criterion follows the inferential target rather than being selected solely for convenience of available data.

Several forms of persistence criterion can be useful. A *legal-institutional criterion* can emphasize recognized status, succession, rights, and obligations. An *interactional criterion* can emphasize recurring coordination or exchange. A *functional criterion* can track continuity of a specified relational capacity. A *dependency criterion* can focus on continuing reliance, substitutability, and exposure. A *symbolic criterion* can examine recognized identity, classification, or narrative continuity. An *infrastructural criterion* can track the material or technical arrangements through which a relation remains available. A *historical-lineage criterion* can emphasize succession and inherited organization. Several criteria can be combined when the research question genuinely requires them.

Proposition 7.73 (Target-relative persistence criterion). *A persistence claim becomes methodologically stronger when the identity-bearing dimensions, continuity carriers, tolerated variation, temporal resolution, and revision conditions are specified in relation to the research target before the final continuity judgment is made.*

The timing in Proposition 7.73 matters because criteria selected after the outcome is known can be adjusted opportunistically to preserve or dissolve identity. Pre-specification is especially useful in confirmatory quantitative work. Historical and exploratory inquiry often develops criteria iteratively, in which case the revisions should remain documented so that readers can see how the identity judgment changed with evidence.

Sensitivity analysis can strengthen the account. A study can ask whether its substantive conclusion changes under another plausible identity criterion. Suppose a corporate relation is continuous legally but discontinuous in ownership and authority. If an economic conclusion depends entirely on legal continuity, that dependence should be visible. If several reasonable criteria support the same continuity judgment, confidence increases. If criteria diverge, the divergence can itself reveal the multidimensional organization of the relation.

Persistence criteria should also remain compatible with the boundary and scale choices developed earlier in the chapter. A criterion can work well for an organization while being inappropriate for a community or field. It can be adequate over a five-year interval and too coarse for daily interaction. It can preserve lineage across personnel turnover while failing to capture a change in local meaning. Methodological adequacy therefore lies in alignment among research question, object, boundary, scale, evidence, and identity criterion.

7.8.9 Uncertainty of Relational Identity

Uncertainty of relational identity arises when the available evidence leaves more than one continuity account plausible or when key components of the identity profile remain weakly known. Sources include uncertain formation dates, missing observation intervals, ambiguous participant linkage, changing categories, contested meanings, multiple possible continuity carriers, unknown transformation thresholds, and incomplete evidence of dissolution. Uncertainty can also result from genuine multidimensional divergence, such as legal continuity combined with practical reconstitution.

A binary variable for “same relation” can therefore conceal several different uncertainties. Researchers can distinguish uncertainty about whether the relation formed, whether two records refer to the same relational object, whether a continuity carrier remained operative, whether a transformation crossed the chosen threshold, whether an inactive interval represents latency or dissolution, and whether symbolic continuity corresponds to substantive continuity. These uncertainties need not receive the same confidence assessment.

Definition 7.74 (Relational identity uncertainty profile). A *relational identity uncertainty profile* records the principal competing continuity interpretations, the evidence bearing on each interpretation, the temporal intervals and dimensions in which ambiguity remains, and the consequences of alternative classifications for the substantive analysis.

Definition 7.74 favors preserved ambiguity over forced certainty when the evidence remains genuinely underdetermined. A study can report a formation interval rather than an exact date, represent two plausible succession paths, classify a period as uncertain dormancy, or provide results under alternative identity codings. Such practices preserve information for later reanalysis and reduce the risk that an early coding decision becomes invisible in subsequent cumulative research.

AI-assisted longitudinal analysis increases both opportunity and risk in this area. Automated record linkage, text comparison, sequence detection, and entity resolution can help reconstruct long histories at scales previously difficult to inspect manually. The same systems can overmerge relations that share names, infer continuity from recurring language, smooth over missing periods, or create an appearance of coherent lineage from heterogeneous records. An auditable workflow should therefore retain source-level provenance, confidence in linkages, alternative matches where material, and the human or institutional judgments through which an identity profile was accepted or revised.

Contingent evidence can also reopen an apparently settled identity judgment. A newly digitized archive, testimony, recovered contract, unusual transaction, or previously inaccessible institutional record can reveal an earlier formation date, hidden interruption, alternative successor, or different continuity carrier. Aesthetic judgment can contribute to noticing such anomalies, especially when a trace appears strangely inconsistent with the accepted history. Epistemic warrant still depends on reconstruction of the relevant evidence and alternatives.

The methodological sequence of Sections 7.6–7.8 can now be stated more clearly. Relation identification asks whether a relation is sufficiently warranted to enter the inquiry. Relational characterization specifies what properties are warranted at relevant times and scales. Relational identity analysis reconstructs which temporally separated states belong to one continuing history, where transformation occurs, and where discontinuity or dissolution becomes the better-supported account. The next section extends this temporal discipline to configurations containing several relations. Section 175 turns to reconstruction of relational configurations, where the identity, interaction, and higher-order organization of multiple relations become the object of inquiry.

7.9 Reconstruction of Relational Configurations

Sections 7.6–7.8 established procedures for identifying relations, characterizing their properties, and reconstructing their persistence through time. The present section moves from the analysis of a relation considered in relative isolation toward the reconstruction of configurations in which several relations are organized together. Its role is to specify when a set of relations warrants treatment as a configuration, how dyadic and triadic structures differ from higher-order organization, how nesting and relations among relations can be represented, how recurring motifs and topology can be used without reducing relational inquiry to graph theory, and how uncertainty should be preserved when the configuration remains only partially observed. The discussion proceeds from small configurations toward progressively broader relational organization while retaining the boundary, scale, and epistemic disciplines established earlier in the chapter.

A relational configuration is not simply a list of ties. The arrangement among relations can condition what individual relations mean, which capacities they enable, which constraints they impose, and how they change through time. A transfer between two organizations can have one significance when it occurs within a competitive field and another when the same organizations share governance, ownership, or regulatory dependence. A dyadic relation of trust can change when a third actor becomes an interpreter, guarantor, broker, witness, or rival. A formally similar institutional relation can generate different consequences depending on the surrounding configuration of law, finance, infrastructure, symbolic recognition, and organizational practice. The methodological problem is therefore to reconstruct enough of the configuration to support the target inference without presuming that a complete representation of the surrounding relational world is either available or necessary.

Definition 7.75 (Relational configuration). A *relational configuration* is a question-relative and revisable specification of several identified relations together with the organization among them that is relevant to interpretation, constraint, enablement, dependence, persistence, or subsequent transformation within a stated boundary, scale, and temporal interval.

Definition 7.75 places organization, rather than mere multiplicity, at the center of configuration reconstruction. The same set of relata can support several configurations depending on which relations are included, how relation types are distinguished, what scale is selected, and which historical interval is examined. Configuration reconstruction therefore remains an epistemic operation under ontological suspension. A graph, hypergraph, institutional map, legal relation matrix, ethnographic diagram, process map, or narrative reconstruction can each represent part of a configuration without being treated as the configuration's final ontology.

Table 7.8 summarizes the principal configuration forms developed below. The table should be read as a methodological map. The categories can overlap, and a research object can move among them as evidence and analytical purpose change.

7.9.1 Dyadic Configurations

Dyadic configurations provide the smallest relational unit in which two positions can be analyzed together. They remain methodologically important because many consequential relations are organized through bilateral exchange, obligation, authority,

Table 7.8: Forms of relational configuration and characteristic reconstruction problems

Configuration form	Analytical focus	Illustrative evidence or representation	Characteristic reconstruction risk
Dyadic	Organization within a focal two-position relation	Interaction records, contracts, exchange histories, interviews, bilateral obligations	Surrounding relations are treated as irrelevant merely because the focal relation is dyadic
Triadic	Effects introduced by a third position or relation	Brokerage records, guarantees, mediation, coalition, witness, referral, triadic interaction	The third actor is treated as an additive variable rather than a structural change in the configuration
Higher-order	Joint relations involving several relata or irreducible group organization	Group decisions, committees, team production, joint obligations, hyperedges, simplicial or group-level representations	Group structure is projected onto pairwise ties that fail to preserve the relevant joint condition
Nested	Relations embedded within broader relations or institutional layers	Teams within organizations, organizations within regimes, local units within transnational structures	Nesting is confused with simple hierarchy or assumed to be perfectly aligned across levels
Relations among relations	One relation conditions, authorizes, interprets, guarantees, or transforms another	Legal authorization, collateral, referral, meta-governance, interdependence among contracts or institutions	Relations are flattened into independent edges and higher-order dependence is lost
Motif	Recurrent local relational form across cases or locations	Repeated triads, brokerage patterns, role configurations, recurring institutional forms	Recurrence is interpreted as common mechanism without historical or contextual verification
Topology	Broader organization of connectivity, separation, clustering, reachability, and positional structure	Network maps, blockmodels, institutional architecture, qualitative relational maps	Formal topology is reified or mistaken for substantive meaning by itself
Uncertain configuration	Competing or incomplete reconstructions of relational organization	Alternative maps, confidence-weighted ties, missing records, contradictory testimony	One convenient reconstruction is treated as settled configuration

communication, care, credit, contract, recognition, or dependence. A dyadic configuration can therefore support close analysis of direction, reciprocity, asymmetry, dependence, meaning, and persistence using the characterization dimensions developed in Section 7.7.

A dyad should nevertheless be distinguished from a dyadic representation. Two actors can be selected as the focal relata while their relation depends substantially on surrounding institutions, infrastructures, third parties, or field conditions. A borrower–lender relation can depend on collateral law, payment infrastructure, credit scoring, guarantors, and monetary policy. A patient–clinician relation can depend on professional regulation, insurance, institutional routines, diagnostic categories, and technical systems. The focal relation can therefore be dyadic for

analytical purposes while remaining embedded in a broader configuration. The boundary remainder introduced in Section 170 and the scale remainder introduced in Section 171 provide ways to preserve these omitted conditions without forcing them into the focal representation.

Dyadic reconstruction begins by specifying the two positions, the relation type or types connecting them, and the temporal interval over which the dyad is treated as the focal configuration. Multiplexity deserves particular attention. Two organizations may simultaneously exchange information, money, labor, data, legitimacy, and regulatory obligations. A dyadic representation that compresses these channels into one edge can conceal relations that differ in direction, intensity, dependence, or normative standing. Where the channels condition one another, the dyad is already a small multiplex configuration rather than a single tie.

Dyadic evidence can also be asymmetric. One participant may leave extensive records while the other leaves few. Institutional data can register transfers but omit interpretation. Interviews can reveal meaning while providing limited evidence about frequency or historical sequence. Relation reconstruction should therefore keep the evidential basis of each dyadic property visible rather than treating the dyad as uniformly observed.

Remark 7.76 (Dyadic focality). A dyadic focal configuration can be methodologically adequate even when broader relations matter, provided that the omitted relations are either substantively negligible for the target claim or preserved as explicit contextual, boundary, or scale remainders.

Remark 7.76 prevents relational inquiry from becoming methodologically unbounded. The aim is selective inclusion guided by the target claim, with the conditions of focalization kept explicit and revisable.

7.9.2 Triadic Configurations

Triadic configurations introduce a third position into the relational architecture. This addition can change the form of the configuration rather than merely increasing its size. Classical relational thought has long recognized the distinctive analytical possibilities introduced by triadic organization, including mediation, brokerage, coalition, exclusion, secrecy, and forms of interaction that depend on the presence of a third position Peirce 1960; Simmel 1971. The methodological significance lies in the possibility that a relation between two positions acquires different properties because of how a third position connects to one or both of them.

A third actor can serve as guarantor, interpreter, broker, witness, monitor, gatekeeper, competitor, coalition partner, or audience. Consider a bilateral exchange in which a third institution guarantees payment. The observable transfer remains between the original two parties, yet the guarantee can alter trust, bargaining power, risk, and willingness to transact. In another case, a broker can connect otherwise separated actors and gain positional advantage from controlling access. A regulator can shape a relation without participating directly in the focal exchange. A public audience can transform a private interaction by changing reputational stakes. These examples show why the third position should be reconstructed according to its relational role rather than treated as a generic additional variable.

Triadic closure and triadic separation can also matter. If A is connected to B and B to C, the presence or absence of a direct A–C relation can alter information flow,

verification, coalition possibilities, and dependence on B. Yet the implications depend on relation type and context. Closure in friendship, credit, professional collaboration, or regulatory oversight can carry different meanings. Methodology should therefore avoid treating a formally similar triangle as a substantively identical configuration across domains.

Triadic analysis can be qualitative, historical, legal, quantitative, or formal. Archival evidence can reconstruct how an intermediary entered a relation. Ethnography can show how a third party changes meaning and conduct in situated interaction. Legal analysis can specify guarantee or agency relations. Quantitative network analysis can identify brokerage or closure patterns. Formal models can examine how triadic organization changes incentives or information. The forms of access differ, and the configuration claim should remain linked to the evidence supporting the role assigned to the third position.

Definition 7.77 (Triadic reconfiguration). A *triadic reconfiguration* occurs when the introduction, removal, or repositioning of a third relatum or relation materially changes the interpretation, constraints, enablements, dependencies, or possible trajectories of a focal dyadic relation within the stated research configuration.

Definition 7.77 emphasizes change in organization rather than simple increase in actor count. It also prepares later work on brokerage, mediation, network structure, and generative mechanisms.

7.9.3 Higher-Order Configurations

Some relational structures are poorly represented as collections of pairwise ties. A committee decision, a team production process, a joint obligation, a coalition, a household arrangement, a collective ritual, or a multi-party contract can depend on the simultaneous organization of several positions. Higher-order network research provides formal tools for representing interactions that involve groups of three or more units and for examining structural and dynamical properties that can differ from pairwise approximations Battiston et al. 2020. The broader methodological point is that the relevant relation can sometimes attach to a set or configuration rather than decomposing cleanly into independent dyads.

A pairwise projection can lose several kinds of information. It can erase whether participation was simultaneous, whether an outcome required a threshold number of participants, whether an obligation was joint or several, whether a coalition acted collectively, or whether the meaning of participation depended on group membership. Suppose four organizations jointly authorize a standard. Representing the event as six pairwise ties records co-participation but may fail to preserve the fact that authority was exercised through a collective procedure. Similarly, a research team can contain pairwise collaborations while producing an outcome that depends on coordinated complementarity across the team.

Higher-order configuration does not imply that pairwise relations become irrelevant. Pairwise and group-level relations can coexist and condition one another. A committee can possess a formal collective decision rule while members also have bilateral trust, rivalry, mentorship, or dependence. A household can have shared obligations at the group level alongside differentiated dyadic care relations. A coalition can act jointly while internal bargaining remains asymmetric. Reconstruction should therefore specify which properties belong to the higher-order unit and which remain

properties of constituent relations.

Formal representations such as hypergraphs or simplicial complexes can be useful where they preserve the relevant relational arity. Their use remains representational rather than ontological. The fact that a phenomenon can be encoded as a hyperedge does not establish that the world is fundamentally hypergraphical. Conversely, qualitative or legal inquiry can reconstruct higher-order organization without adopting those formalisms. The methodological requirement is preservation of the joint relational condition relevant to the target claim.

Proposition 7.78 (Higher-order preservation). *When a substantive claim depends on a relation or condition that is jointly constituted by several relata, a representation becomes methodologically stronger when it preserves that joint condition rather than replacing it with pairwise ties whose combination does not retain the relevant structure.*

Proposition 7.78 is deliberately scoped. Pairwise approximations can remain useful when the target property survives projection or when the approximation is explicitly treated as such. The point is to identify the remainder created by the projection and determine whether it matters for the inference.

7.9.4 Nested Relations

Nested relations arise when one relational configuration is situated within another configuration whose organization is analytically consequential. Teams operate within organizations, organizations within legal and market institutions, local communities within regional infrastructures, and national systems within transnational regimes. Nesting can also occur temporally or functionally: a short-term project can operate within a durable institutional relation, or a local authority relation can be nested within a wider governance arrangement.

Nesting should not be equated automatically with hierarchy. A nested unit can possess substantial autonomy, reciprocal influence, overlapping membership, or cross-cutting relations that complicate simple top-down ordering. Organizational teams can coordinate laterally across departmental boundaries. Municipalities can participate in national legal structures while also forming translocal networks. Households can be embedded in markets, kinship structures, welfare institutions, and digital platforms simultaneously. Several nesting relations may therefore coexist and fail to align perfectly.

The methodological task is to specify the container relation or broader configuration and the pathway through which it conditions the nested configuration. A national law can alter local authority by defining jurisdiction. An organizational budget can constrain team activity. A professional field can shape what counts as legitimate practice. A digital infrastructure can mediate interactions across organizations. The existence of a larger-scale context alone does not establish that it causally explains local variation; the cross-scale bridge developed in Section 171 remains necessary when stronger claims are made.

Nested analysis also requires care with aggregation. A property of the containing configuration should not be assigned automatically to each nested unit, and a property observed locally should not be generalized automatically to the containing level. A university can possess a formal commitment that is enacted unevenly across departments. A region can show economic growth while particular communities experience contraction. A national institution can remain stable while local implementations di-

verge. Multiscale reconstruction should preserve these differences.

Definition 7.79 (Nested relational configuration). A *nested relational configuration* is a configuration whose relevant relations are situated within one or more broader configurations that condition its resources, meanings, constraints, enablements, boundaries, or possible transformations through specified relational pathways.

This definition treats nesting as a relational condition rather than a geometric metaphor alone. It also leaves room for partial, overlapping, and historically changing forms of nesting.

7.9.5 Relations among Relations

Relational inquiry sometimes requires analysis of relations whose relata are themselves relations, obligations, contracts, rules, or relational configurations. A guarantee relation can support a credit relation. A legal rule can authorize an organizational authority relation. A referral relation can create conditions for a later professional relation. A confidentiality obligation can constrain an information relation. A governance arrangement can specify how several contractual relations are interpreted or revised. In such cases, flattening the configuration into independent actor-to-actor edges can obscure the dependence among relations.

The phrase *relations among relations* should be used carefully. It does not require a commitment to relations as metaphysically independent entities. It identifies an analytical situation in which one relation becomes an object or condition within another relation. The category-theoretic language introduced in Chapter 4 provides one possible formal vocabulary for compositional and relational structure, but the methodological idea can be expressed equally through legal doctrine, institutional analysis, historical reconstruction, qualitative process mapping, or formal network representations.

Several forms are useful to distinguish. A *constitutive relation* can help define another relation, as legal status can define who is authorized to enter a contract. A *conditioning relation* can alter the intensity, risk, or meaning of another relation without constituting it. A *guaranteeing relation* can stabilize another relation by backing performance or enforcement. An *interpretive relation* can shape how participants classify or understand another relation. A *transformative relation* can change the terms or persistence conditions of another relation. These forms can overlap in empirical settings.

Relations among relations are especially important for institutional and economic analysis. Property, credit, employment, taxation, insurance, corporate governance, and platform access can be interconnected through layered rights, obligations, permissions, infrastructures, and conversion pathways. A change in one relation can therefore alter several others even when the focal actors remain the same. Later GRE chapters on economic architecture, allocation, value conversion, and generative return will depend on this capacity to represent relational interdependence without reducing it to actor attributes.

Definition 7.80 (Second-order relational specification). A *second-order relational specification* records a warranted relation in which one or more relata are themselves identified relations or relational configurations, together with the evidential pathway through which their dependence, authorization, interpretation, guarantee, or transformation is inferred.

The phrase *second-order* marks analytical level rather than ontological superiority. Higher-order analysis can be useful when the research question concerns the organization among relations; it can be unnecessary when the same claim is adequately supported at a simpler level.

7.9.6 Relational Motifs

Relational motifs are recurring local forms of relational organization that appear across cases, locations, periods, or portions of a larger configuration. Network science has developed motif-oriented approaches for detecting recurrent structural patterns within complex networks, while social network analysis more broadly studies clustering, positions, recurring connectivity patterns, and local structures Newman 2003. In GRE and GR inquiry, the methodological value of motifs lies in using recurrence to organize comparison and generate hypotheses about relational form without assuming that repeated topology entails repeated meaning or mechanism.

A motif can be specified qualitatively or formally. A recurring brokered triad can be identified through network data. A recurring legal configuration can involve principal, agent, and guarantor. A historical motif can consist of repeated sequences in which local innovation becomes institutionally standardized and later controlled by a gatekeeping organization. An ethnographic motif can involve recurrent patterns of informal mediation around a formal rule. An economic motif can link resource transfer, dependency, and symbolic legitimation across several cases.

Recurrence can be informative for several reasons. It can indicate that similar constraints produce similar relational forms, that institutions reproduce a template, that actors imitate established arrangements, that a configuration is selected because it supports a valued function, or that the motif emerges from broader topology. These possibilities should remain hypotheses until supported by evidence. Similar form can arise through different histories, and different forms can realize similar functions. The multiple-realization discipline from Chapter 4 therefore applies here as well.

Motif comparison benefits from explicit equivalence criteria. Two configurations can count as instances of the same motif under one criterion and differ under another. A purely topological criterion may treat relation types as interchangeable, while a typed-relational criterion preserves differences between authority, exchange, care, information, and recognition. A temporal criterion can require a shared sequence rather than merely a shared static pattern. A historical criterion can require lineage or institutional similarity. The selected equivalence relation should match the inferential purpose.

Caution 7.81 (Motif equivalence). Repeated relational form supports a claim of structural recurrence only under the equivalence criteria used to define the motif. Additional evidence is required before recurrence is interpreted as common meaning, mechanism, historical origin, normative standing, or generative consequence.

Caution 7.81 prevents a common overextension from pattern detection to explanation. Motifs can orient inquiry, especially in AI-assisted or computationally large search spaces, while substantive interpretation remains tied to evidence and context.

7.9.7 Relational Topology

Relational topology concerns broader organization among positions and relations: connectivity, separation, clustering, reachability, bridging, redundancy, centralization, components, positional equivalence, and other forms of structural arrangement. Network science offers a mature formal vocabulary for many of these properties Newman 2003, while blockmodeling and relational sociology provide approaches to roles and positions defined through patterns of relations across several networks White et al. 1976; White 2008. The present framework treats these tools as important methodological resources while preserving the distinction between formal topology and substantive relational meaning.

Topology can matter because the consequences of a relation often depend on where it is located in a wider configuration. The same dyadic trust relation can have different implications if it bridges otherwise separated communities, sits within a dense cluster, or depends on a highly centralized gatekeeper. The same resource transfer can be redundant in one configuration and indispensable in another. The same institutional rule can be buffered by alternative pathways or become decisive when it controls a narrow bottleneck. Positional properties therefore complement the dyadic characterization developed in Section 7.7.

Topological analysis can be conducted with several kinds of representation. Quantitative network analysis can estimate centrality, clustering, components, paths, or community structure. Historical maps can reconstruct changing centers and peripheries. Institutional analysis can identify veto points, jurisdictional overlaps, or chains of authorization. Ethnographic inquiry can reveal informal pathways that differ from formal organizational charts. Legal analysis can reconstruct networks of rights and obligations. A topology claim should therefore state what counts as a node, relation, path, and boundary in the chosen representation.

Formal topology also has limits. A short path in a network does not necessarily imply practical accessibility when language, law, trust, cost, discrimination, or institutional procedure obstructs movement. A central node in communication data may not possess authority. A dense cluster may reflect repeated reporting rather than substantive cohesion. A disconnected component can still be influenced by a field-level condition not represented as an edge. Topological properties become substantively meaningful through interpretation of the represented relations and the mechanisms through which position matters.

Topology is scale-sensitive. A configuration can be decentralized at one scale and centralized at another. A local network can appear cohesive while depending on a single external infrastructure. Aggregation can create apparent bridges that do not exist for particular subgroups, and decomposition can hide institutional coherence visible at a coarser resolution. The scale-selection principles of Section 171 and the multiscale architecture planned for later generative inquiry are therefore integral to topological reconstruction.

Proposition 7.82 (Topology–meaning separation). *A topological property becomes a substantive relational claim only when the representation of nodes, relations, boundaries, and scales is linked to an interpretation of how the identified structural property bears on the research question.*

This proposition preserves the usefulness of formal structure while maintaining ontological and epistemic restraint. A network representation can reveal organiza-

tion that is difficult to perceive otherwise; its analytical force depends on the adequacy of the mapping between representation and target relation.

7.9.8 Configuration Uncertainty

Configuration uncertainty arises when the organization among relations remains incompletely observed, ambiguously specified, contested, or sensitive to plausible alternative reconstructions. It can originate from uncertain relation identification, missing ties, uncertain direction, ambiguous relation type, disputed institutional status, incomplete archives, changing boundaries, uncertain scale, or unresolved historical continuity. These uncertainties can interact. A single uncertain edge can have minor consequences in a redundant configuration and major consequences when it determines whether two regions are connected.

Uncertainty should therefore be represented at the configuration level rather than inherited only from individual relations. Researchers can preserve alternative maps, intervals for edge or relation confidence, competing historical reconstructions, uncertain group membership, plausible boundary variants, or several motif codings. Sensitivity analysis can then examine whether substantive conclusions depend on one uncertain component or remain stable across several plausible configurations.

Definition 7.83 (Configuration uncertainty profile). A *configuration uncertainty profile* records the principal uncertain components of a reconstructed relational configuration, the evidence and alternatives associated with those components, the resulting plausible configuration variants, and the substantive conclusions that change or remain stable across those variants.

Definition 7.83 encourages preservation of alternative relational worlds when available evidence does not justify a single reconstruction. A historical study can present two plausible alliance structures for an interval with missing records. An organizational study can report formal and enacted networks separately. A network analysis can examine results under several plausible edge thresholds. A qualitative study can preserve competing participant accounts of who mediated a conflict. The purpose is not to multiply uncertainty gratuitously, but to show where a conclusion depends on a reconstruction choice.

Configuration uncertainty is also a site where contingent encounter can be methodologically productive. An unexpected archive, interview, residual pattern, or institutional inconsistency can reveal a previously invisible relation that reorganizes the whole configuration. Aesthetic judgment can make the anomaly salient before its evidential significance is known. The subsequent task is to test whether the new relation is sufficiently warranted and whether adding it materially changes the configuration, motif, topology, or interpretation. This sequence preserves the distinction between generative orientation and epistemic validation developed in Chapter 6.

AI-assisted configuration reconstruction expands the scale at which candidate structures can be generated and compared. Automated relation extraction, entity resolution, graph construction, pattern detection, and higher-order representation can expose configurations that would be difficult to inspect manually. The same processes can also propagate extraction errors, merge distinct relations, infer links from semantic similarity, or create visually persuasive structures from uncertain evidence. Provenance should therefore remain attached to identified relations and to the transformations through which configuration-level representations are built.

Proposition 7.84 (Configuration reconstruction discipline). *A relational configuration becomes methodologically more accountable when its constituent relations, organizational assumptions, boundary and scale choices, higher-order structures, uncertainty, and revision conditions remain traceable to the evidence and transformations through which the configuration was reconstructed.*

The sequence developed in Sections 169–175 now reaches a first methodological closure. The research object is provisionally specified; its boundary and scale are selected; relations are identified and characterized; persistence is reconstructed; and configurations among several relations are then mapped with explicit attention to higher-order organization and uncertainty. The next sections turn from this general relational architecture toward particular modes of evidential access. Section 176 begins with documentary inquiry, where administrative, institutional, organizational, public, and digital records become sources for reconstructing relations while raising questions of provenance, selective recording, and documentary silence.

7.10 Documentary Inquiry

Sections 7.3–7.9 established a general procedure for specifying relational objects, constructing boundaries, selecting scales, identifying and characterizing relations, reconstructing persistence, and mapping relational configurations. The present section turns from that general architecture toward a first family of evidential access: documentary inquiry. Its role is to specify how records, documents, registries, correspondence, public files, and digital traces can support relational reconstruction while preserving the mediation introduced by record production itself. The discussion examines administrative, institutional, organizational, personal-correspondence, public, and digital records before developing provenance and documentary silence as cross-cutting methodological problems.

Documentary inquiry is particularly important for relational research because many consequential relations become visible through records before they become directly observable to the researcher. Contracts register obligations; minutes register authorized decisions; case files register classifications and interventions; budgets register allocations; registries register legal or administrative status; correspondence registers communication and interpretation; digital systems register events, transactions, access, and sequence. Documentary sources can therefore extend inquiry across time, institutions, and scales that are inaccessible to direct observation. Documentary-method traditions have long emphasized that such sources require source assessment rather than transparent reading Scott 1990. Within the present framework, the requirement is stronger: a document is treated as a historically and institutionally produced manifestation whose evidential significance depends on the relation between the record, the process that produced it, and the relational object being reconstructed.

A document can enter inquiry in several roles. It can function as evidence *about* a relation, as evidence about the institution or practice that produced the record, and in some cases as an operation that helps constitute or transform the relation itself. A signed contract can record an agreement while also changing the parties' legal relation. A register can record a classification while helping institutionalize that classification. A rating can describe a position while contributing to later access, reputation,

or allocation. A digital log can record an event while being produced by a technical architecture that determines which events count as recordable. Documentary inquiry therefore requires separation among descriptive, infrastructural, and performative roles.

Definition 7.85 (Documentary relation record). A *documentary relation record* is a materially or digitally preserved inscription that bears evidence concerning a relation, relational event, position, configuration, or institutional act, together with identifiable conditions of production, classification, preservation, access, and interpretation relevant to the target claim.

Definition 7.85 keeps the record and the target relation analytically distinct. A document can be authentic as a record and still provide incomplete, strategically produced, category-dependent, or misleading evidence about the target relation. Conversely, a document produced for administrative rather than research purposes can become highly informative when its production conditions are understood. Table 7.9 summarizes the source forms developed below and their characteristic relational uses and risks.

7.10.1 Administrative Records

Administrative records arise from the routine operation of organizations and public authorities. Tax files, school records, health-service encounters, benefit registers, migration files, licenses, censuses, transaction systems, case-management databases, inspection records, and regulatory submissions can provide repeated traces across large populations and long intervals. Contemporary data infrastructures increasingly make such records central to economic and policy research, while international data-governance frameworks distinguish administrative data from survey, citizen-generated, and machine-generated sources World Bank 2021. Their value for relational inquiry lies in the possibility of reconstructing recurrent interactions between persons, organizations, and institutions at scales that direct observation rarely reaches.

The same feature that gives administrative records analytical power also requires caution. Administrative data are generated for operational purposes. Their categories reflect eligibility rules, organizational responsibilities, legal definitions, information systems, reporting practices, and changing administrative priorities. Statistical and administrative categories have histories, and the production of comparability often requires classification, coding, aggregation, and standardization rather than merely recording a pre-given world Desrosières 1998; Bowker and Star 1999. A category such as employed, unemployed, resident, household, firm, disability status, educational completion, or service user can therefore carry institutional assumptions that matter to relational interpretation.

For relational inquiry, an administrative record should be analyzed at two levels. The first concerns the target relation indicated by the record: payment, registration, service provision, sanction, referral, attendance, licensing, or another institutional interaction. The second concerns the administrative relation that made the record possible. A benefits record can provide evidence about a transfer while simultaneously revealing an eligibility relation between claimant and authority. A migration database can record entry and exit while also expressing a jurisdictional classification. A school record can register attendance while being generated through institutional

Table 7.9: Documentary source forms and characteristic relational inference problems

Source form	Characteristic relational access	Analytical strength	Characteristic risk
Administrative records	Classification, transactions, eligibility, service contact, taxation, registration, compliance	Repeated large-scale traces generated through routine administration	Administrative categories are treated as natural categories or complete descriptions of lived relations
Institutional records	Authority, rules, rights, obligations, decisions, jurisdiction, formal status	Reconstruction of institutional position and authorized action	Formal record is equated with enacted institutional relation
Organizational documents	Procedures, roles, workflows, strategy, reporting, resource allocation, internal coordination	Access to organizational self-description and formalized coordination	Prescribed practice is mistaken for actual practice
Correspondence	Communication, negotiation, interpretation, expectation, conflict, trust, mediation	Fine-grained access to relational meaning and sequence	Survival, authorship, audience, and strategic self-presentation biases are ignored
Public records	Legal events, public decisions, ownership, filings, proceedings, official disclosures	Publicly inspectable traces with institutional standing	Availability is treated as equivalent to completeness or equal visibility
Digital records	Transactions, interactions, timestamps, versioning, access, computational events	High-resolution and potentially large-scale event traces	Platform ontology and logging architecture are mistaken for the underlying relational ontology
Provenance record	Production, custody, transformation, linkage, extraction, version history	Supports auditability and calibrated reuse	Later transformations are detached from source history
Documentary silence	Missing, unrecorded, inaccessible, destroyed, uncategorized, or undiscoverable traces	Reveals limits and possible structure of visibility	Silence is converted too quickly into evidence of absence or deliberate suppression

definitions of enrollment and absence. These second-order relations can become analytically important when the research question concerns institutional power, recognition, access, or exclusion.

Administrative coverage is also selective. Populations outside registration systems, persons using informal institutions, organizations below reporting thresholds, or interactions that leave no required administrative trace can remain weakly visible. Changes in forms, coding standards, database migrations, or legal definitions can create apparent discontinuities that are partly documentary. Longitudinal analysis should therefore separate substantive change from changes in the recording regime where evidence permits.

Proposition 7.86 (Administrative mediation). *An administrative record supports stronger relational inference when the analysis specifies both the relational event recorded and the administrative categories, procedures, and institutional relations through which that event became recordable.*

Proposition 7.86 does not make administrative records epistemically inferior to researcher-generated data. It identifies their distinctive mediation. Their operational origin can provide valuable regularity and scale, while the administrative process itself remains part of the evidential pathway.

7.10.2 Institutional Records

Institutional records document formally recognized relations, positions, decisions, obligations, and authorities. Statutes, regulations, court decisions, treaties, contracts, licenses, incorporation records, minutes, appointment records, accreditation files, registries, and formal resolutions can establish what an institution recognized, authorized, prohibited, or required at a given time. Such records are especially important when relational status depends on institutional recognition. Ownership, office, citizenship, guardianship, fiduciary duty, corporate authority, legal liability, and many forms of entitlement may be difficult to reconstruct adequately from observed interaction alone.

Institutional records can therefore have constitutive force. A judgment, registration, license, appointment, or signed agreement can change what actions are authorized and what obligations can be enforced. In the three-register architecture developed earlier in the book, the institutional document is then more than a passive representation of relational reality. Its production can enter the recursive pathway through which a represented relation becomes institutionally stabilized and later causally effective. Documentary analysis should accordingly distinguish the record's evidential role from its possible performative role.

Formal institutional status nevertheless remains distinct from enacted relational practice. A regulation can authorize an entitlement that is difficult to exercise. An organizational charter can allocate authority that operates differently in practice. A contract can specify reciprocal duties under conditions of highly asymmetric bargaining power. A legal prohibition can coexist with recurrent informal conduct. Documentary inquiry should therefore resist equating formally documented relation with fully realized relation. Institutional records are often strongest for claims about recognized status, authorized procedure, formal obligation, or official decision; additional evidence may be required for claims about enactment, experience, compliance, or consequence.

Versioning matters as well. Institutional records can be amended, repealed, superseded, interpreted, or selectively enforced. A current text can obscure the rule in force during an earlier period. A digitized legal database can collapse amendment histories into an apparently timeless document. Historical relational reconstruction should therefore identify the applicable version and the institutional pathway through which it acquired force.

Definition 7.87 (Institutional documentary act). An *institutional documentary act* is a recorded institutional operation whose issuance, registration, authorization, or recognition can itself alter the rights, obligations, status, authority, or recognized position of one or more relata.

This definition helps distinguish documents that merely report institutional activity from documents whose institutional standing participates in producing the relation under study.

7.10.3 Organizational Documents

Organizational documents include policies, standard operating procedures, internal reports, budgets, organizational charts, project plans, audit files, meeting minutes, memoranda, performance dashboards, strategy documents, training materials, workflow descriptions, and internal guidance. They offer access to how organizations describe their own roles, categories, objectives, responsibilities, resource distributions, and expected relations among units. In relational inquiry, these materials can help reconstruct formal coordination, reporting chains, decision rights, budgetary dependencies, institutional interfaces, and the organizational categories through which activity becomes legible.

Their evidential role should be differentiated carefully. A policy manual records prescribed practice. A strategy document records an authorized orientation or declared priority. An organizational chart records a formalized structure. A budget records approved or reported allocations under particular accounting conventions. None of these documents alone establishes how practice was enacted. Informal coordination, workarounds, discretion, tacit norms, conflict, and cross-unit dependence can diverge from the documented structure. The contrast between formal and enacted relation developed in Sections 172–175 is therefore particularly relevant.

Organizational documents can also be strategic artifacts. They may be written for internal coordination, regulatory compliance, fundraising, external legitimacy, litigation preparation, employee instruction, or public communication. The intended audience changes what is likely to be recorded and how. A performance report written for a funder can emphasize different relations from an internal incident log. A strategic plan can express an aspirational configuration that has not yet been realized. A post-crisis review can reorganize earlier events into a coherent account. Documentary interpretation should therefore ask what practical task the document performed within the organization.

Classification systems deserve particular attention. Organizational categories can determine which cases move through which workflows, which costs appear in which budget line, which people are treated as belonging to a role, and which outcomes become measurable. Bowker and Star's analysis of classification infrastructures provides an important precedent for treating categories and standards as socially consequential components of information systems rather than neutral labels Bowker and Star 1999. In GRE applications, this matters because categories can channel access to resources, recognition, labor, evaluation, and future opportunity.

Organizational documents can be compared across layers. Formal policy, internal reporting, case records, and correspondence can reveal whether the same relation is represented consistently across the organization. Divergence among these records can itself become evidence about institutional fragmentation, ambiguity, discretion, or contested interpretation. Such disagreement should not be averaged mechanically; it can disclose the configuration through which organizational reality is produced.

7.10.4 Correspondence

Correspondence provides a different documentary access relation. Letters, memoranda, email, direct messages, meeting follow-ups, diplomatic communications, professional exchanges, and other addressed communications can reveal negotiation, ex-

pectation, uncertainty, trust, conflict, interpretation, obligation, and changing relational meaning with a temporal resolution that formal records often lack. Correspondence is therefore particularly useful for reconstructing how participants understood relations while those relations were developing.

The evidential value of correspondence depends on audience and communicative situation. A private letter, an official memorandum, a copied email, and a message written with anticipated disclosure are different documentary acts. Participants can strategically present motives, conceal information, exaggerate agreement, soften conflict, or write for multiple audiences simultaneously. The relation between writer, recipient, copied parties, institution, and anticipated future reader should therefore enter interpretation where relevant.

Survival is also selective. One side of a correspondence can be preserved while the other disappears. Institutional archives can retain official email while deleting informal channels. Senior actors can leave extensive records while precarious workers, clients, migrants, or community participants leave fewer durable traces. Differences in literacy, language, access to recording technologies, archival custody, and legal risk can structure whose relational interpretations survive. Documentary abundance from one position should therefore not be mistaken for greater relational importance.

Sequence matters. A single message can be ambiguous outside the exchange that preceded and followed it. Thread reconstruction, date verification, drafts, attachments, and changes in address or audience can alter interpretation. Where a claim concerns relational change, correspondence should be situated within a sequence rather than extracted solely as a quotable statement.

Correspondence is also a useful site for identifying latent and contested relations. Repeated requests for approval can reveal dependence; copied recipients can reveal authority or monitoring; shifts in salutation can accompany changes in distance or status; strategic silence can indicate uncertainty, conflict, or withdrawal. Such interpretations remain hypotheses until linked to broader evidence. The methodological value of correspondence lies partly in generating candidate relational interpretations that can then be checked against institutional records, behavior, interviews, or subsequent outcomes.

Caution 7.88 (Correspondence asymmetry). The volume, detail, and survival of correspondence from one relational position should not be used as a direct proxy for that position's importance, credibility, or influence without evidence concerning the communication and preservation conditions that produced the asymmetry.

7.10.5 Public Records

Public records include court filings, legislative records, company registries, procurement notices, public budgets, election records, land and property records, regulatory disclosures, public hearings, official statistics, published decisions, and other materials made available through institutional procedures. Their public status can support inspectability, replication, and contestation, but public availability should be distinguished from epistemic completeness.

A public record exists within a regime of disclosure. Law, institutional capacity, filing requirements, publication formats, fees, retention rules, redaction, search interfaces, language, and digitization shape which relations become visible to whom. Two jurisdictions can both maintain "public" records while providing very different

practical access. A record can be formally public yet difficult to discover, technically inaccessible, costly to retrieve, or intelligible only with specialized knowledge. Publicness is therefore a relation between record, institution, access infrastructure, and user rather than a simple binary property.

Public records often provide identifiable provenance through an issuing authority, date, case number, registry, or legal process. Yet their substantive meaning still requires interpretation. A corporate filing can establish reported ownership at a filing date while leaving beneficial control more complex. A court filing can establish that an allegation was made without establishing its truth. A procurement notice can establish formal award conditions while leaving implementation uncertain. Documentary claims should track the level of warrant appropriate to the record.

Public records can also be linked across institutions to reconstruct configurations whose relevant traces are distributed across several sources. Company registration, procurement, court, licensing, and budget records can together reveal organizational and institutional relations. Such linkage introduces additional identity-resolution and boundary problems. Names can change; entities can split or merge; identifiers can be reused or inconsistently recorded. The relational identity procedures of Section 174 remain applicable to documentary linkage.

Ethical obligations persist even when records are public. Aggregation, linkage, and computational search can change the practical visibility of information. A dispersed set of individually public records can become a highly revealing relational profile when assembled. Research design should therefore consider foreseeable harms, contextual expectations, and institutional requirements rather than treating public availability as automatic ethical permission for unrestricted reuse.

7.10.6 Digital Records

Digital records extend documentary inquiry into event logs, platform traces, transactional databases, version histories, metadata, machine-generated records, sensor outputs, access records, repositories, collaborative editing histories, and born-digital communication. Their granularity can make relational sequence, frequency, timing, and topology visible at scales difficult to achieve through conventional documents. Digital systems can also preserve transformation histories, identifiers, and timestamps that support fine-grained provenance.

Digital abundance does not remove documentary mediation. A platform logs events according to its technical ontology: accounts, sessions, clicks, messages, transactions, permissions, commits, views, or other predefined event types. Events that the system does not instrument can become weakly visible or invisible. System redesign can change the meaning of an event code. Automated deduplication, synchronization, moderation, ranking, retention, or privacy mechanisms can alter the record before the researcher encounters it. The digital trace is therefore produced jointly by participants, software, infrastructure, institutional policy, and data-management practice.

This point is important for AI-assisted relational inquiry. Automated extraction can identify entities, relations, temporal order, and patterns across large documentary corpora, but its outputs add another representational layer. Entity resolution can merge distinct actors; relation extraction can infer a tie from linguistic co-occurrence; summarization can suppress minority interpretations; retrieval can privilege well-

indexed documents; and generated metadata can detach a claim from its original context. Datasheet-style documentation and related provenance practices provide useful precedents for making dataset composition, collection, transformations, and intended use more inspectable Geburu et al. 2021. FAIR principles similarly emphasize reusable data and metadata with provenance and community standards Wilkinson et al. 2016.

Digital authenticity and provenance also deserve separate treatment from substantive truth. Contemporary content-provenance standards can support cryptographically verifiable claims about origin, modification, and signing while explicitly avoiding the stronger conclusion that authenticated content is true or normatively trustworthy Coalition for Content Provenance and Authenticity 2026. The distinction aligns closely with the epistemology of this book: provenance strengthens knowledge about the history of an artifact; it does not settle the adequacy of the artifact's representation of the world.

Digital records can disappear rapidly despite apparent abundance. Platforms close, accounts are deleted, APIs change, links decay, formats become obsolete, retention policies shift, and access permissions can be revoked. Reproducible documentary inquiry should therefore record retrieval dates, versions, identifiers, export procedures, relevant software transformations, and preservation decisions where those details affect later reconstruction.

Proposition 7.89 (Digital trace discipline). *A digital trace supports a relational claim more strongly when the analysis distinguishes participant activity from the platform, software, logging, and transformation processes through which that activity became a researchable record.*

7.10.7 Provenance

Provenance concerns the history through which a documentary object reaches the researcher in its present form. It includes origin, authorship or issuing authority, date, custody, version, classification, transmission, preservation, redaction, digitization, extraction, transcription, linkage, transformation, and access history where these are consequential to interpretation. In relational inquiry, provenance is not merely bibliographic housekeeping. It is part of the evidential relation connecting manifestation to claim.

A record can pass through several transformations before analysis. A handwritten register can be microfilmed, scanned, transcribed, normalized, translated, coded, linked to another dataset, and processed by an AI system. Each transformation can improve access while also introducing loss, reinterpretation, or error. The final spreadsheet or graph may therefore be many operations removed from the source inscription. Provenance makes those operations recoverable enough for later researchers to assess whether the transformation preserved the properties relevant to the claim.

Definition 7.90 (Documentary provenance chain). *A documentary provenance chain is the recorded sequence of source production, custody, versioning, selection, preservation, transformation, linkage, and analytical processing through which a documentary object becomes evidence for a research claim.*

The appropriate depth of a provenance chain depends on the claim. A quotation from an official regulation may require source, version, date, and issuing authority. A longitudinal dataset assembled from changing administrative systems may require

detailed mapping of coding changes, linkage rules, missing periods, and transformations. A digital image used to establish authenticity may require cryptographic or repository-level metadata. Epistemic humility therefore favors claim-relative provenance rather than an unrealistic demand to document technical events at uniform depth.

Provenance also interacts with relational identity. If records from two periods are linked as referring to the same organization, person, institution, or relation, the linkage rule becomes part of the evidential chain. If an archival series changes filing practice, the apparent relation between documents can partly reflect archival reorganization. If a dataset is reclassified to match later categories, historical differences can be compressed. The transformation itself should remain visible when it bears on the substantive inference.

Proposition 7.91 (Provenance adequacy). *Documentary provenance is methodologically adequate when it preserves the source and transformation history needed to evaluate the specific inferential moves on which the research claim depends.*

Proposition 7.91 aligns documentary inquiry with the broader research-practice principle of recoverable translation. More provenance can be valuable, but adequacy is tied to the risks and dependencies of the claim rather than to maximal metadata accumulation.

7.10.8 Documentary Silences

Documentary silence concerns the structured limits of what enters, survives, becomes accessible within, or becomes discoverable through a documentary corpus. Historical and archival scholarship has shown that power can shape source production, preservation, narrative construction, and retrospective significance Trouillot 1995. For relational inquiry, silence is especially important because the absence of a record can arise at several different stages. An interaction may never have been recorded; a record may have been destroyed; access may be restricted; a category may not exist in the recording system; the item may be misclassified; digitization may exclude it; search systems may fail to retrieve it; or the researcher may lack the language, resources, or institutional position required to encounter it.

These forms should be distinguished because they support different inferences. Failure to find a record is not equivalent to evidence that the relation did not exist. Section 172 developed this distinction for absent relations; documentary inquiry adds a source-production layer. A documented absence can sometimes be informative when a system was designed to record the relevant event reliably and the record series is sufficiently complete. In other settings, non-recording may reflect weak administrative reach, strategic concealment, informal practice, archival loss, or categories that rendered the relation unrecordable.

Silence can also be relationally patterned. Powerful actors may produce extensive records while less institutionally recognized actors appear mainly through records produced about them. Organizations can document financial transfers carefully while leaving care, informal labor, or tacit coordination weakly recorded. Legal systems can preserve adjudicated disputes while leaving avoided claims invisible. Digital platforms can retain monetizable interactions more systematically than forms of social meaning that do not enter platform metrics. Such patterns affect whose relations become reconstructable and which forms of value, harm, contribution, or

dependence become visible.

Classification contributes to silence as well as visibility. A record system makes some distinctions possible by stabilizing categories, and the same categories can render other differences difficult to express. Bowker and Star emphasize the infrastructural consequences of classification and the invisibility that can accompany standardized categories Bowker and Star 1999. Documentary inquiry should therefore ask which relational distinctions the recording system could represent at the time, which were compressed, and which fell outside its ontology.

Strategic secrecy represents another form of documentary limitation. Institutions and actors may intentionally restrict access to information in order to preserve privacy, security, bargaining position, professional confidentiality, or power. Secrecy is itself relationally organized and can differentiate access among participants Simmel 1906. The existence of restricted records does not by itself establish wrongdoing; the methodological task is to identify how access conditions shape the available evidence and which claims remain correspondingly uncertain.

Definition 7.92 (Documentary silence profile). A *documentary silence profile* records the principal pathways through which potentially relevant relations, actors, events, or meanings may be absent or weakly visible in a documentary corpus, including production, classification, retention, access, digitization, discoverability, and interpretive limitations.

A documentary silence profile can guide sensitivity analysis. Researchers can compare formal records with correspondence, oral history, ethnography, interviews, external archives, or later records; examine whether missingness clusters around particular actors or periods; test whether coding changes coincide with apparent structural change; or report where evidence remains insufficient. The purpose is not to infer an unseen history automatically from silence. It is to prevent the available archive from being mistaken for the full domain of historically possible relations.

Caution 7.93 (Silence interpretation). A documentary silence warrants stronger substantive interpretation only when the study can identify plausible recording conditions, alternative explanations for non-observation, and evidence linking the silence to the proposed relational mechanism or historical process.

This caution is particularly important in AI-assisted research. Search and retrieval systems can create an impression of documentary exhaustiveness because large corpora become rapidly searchable. Yet retrieval quality depends on digitization, indexing, language, metadata, access permissions, ranking, and model behavior. AI can enlarge the encounter surface of documentary inquiry by bringing distant records into relation, and aesthetic judgment can make an unexpected juxtaposition or absence salient. The later epistemic task remains to determine whether the encounter reflects a robust historical relation, a classification artifact, a retrieval bias, or an accidental similarity.

Documentary inquiry therefore extends the relational methodology developed earlier in this chapter without relaxing its epistemic discipline. Records can reveal relations across scales and historical intervals, institutional documents can participate in constituting relations, and digital infrastructures can vastly expand the volume of available manifestations. At the same time, documentary corpora ordinarily have histories of production and preservation that matter to interpretation. Administrative categories, organizational purposes, institutional authority, platform architectures, provenance chains, and documentary silences shape what can be reconstructed from

it. The next section turns from documentary sources broadly construed to archival inquiry, where selection, custody, arrangement, preservation, and archival encounter become methodological objects in their own right.

7.11 Archival Inquiry

Section 7.10 treated documentary inquiry as a method for reconstructing relations from records whose production, classification, transformation, and silences remain epistemically consequential. The present section narrows the focus from documentary objects in general to archives as organized infrastructures of historical visibility. Its role is to specify how selection, custody, arrangement, preservation, description, access, and later retrieval shape the set of traces through which past relations can become researchable. The discussion proceeds from archive construction and historical trace to record survival, missing archives, archival power, temporal reconstruction, competing historical interpretations, and archival re-epistemization. Throughout, the archive is treated as a historically generated relational configuration rather than as a transparent container of an already completed past.

This orientation follows directly from the ontology and epistemology developed in Chapters 4 and 5. A surviving record belongs to manifestational reality and can support inference toward earlier relational configurations, yet the passage from past relation to present archive is mediated by recording practices, institutional categories, custody, loss, appraisal, description, and access. The inverse problem therefore becomes temporally extended. Researchers encounter traces that have themselves passed through historical processes. Archival scholarship has emphasized that archives and archivists participate in the construction of social memory through selection, description, preservation, and access Schwartz and Cook 2002, while historical work on silencing has shown that unequal power can enter source production, preservation, narrative construction, and retrospective significance Trouillot 1995. Stoler's archival analysis further demonstrates the value of treating archival forms and habits as evidence about governing epistemologies and institutional uncertainty rather than using archives only as repositories from which facts are extracted Stoler 2009.

Archival inquiry within the present framework therefore works simultaneously on two relational objects. The first is the historical configuration the researcher seeks to reconstruct. The second is the archival configuration through which traces of that history have survived and become accessible. These objects overlap, because record-making, filing, preservation, and secrecy can themselves form part of the historical process. They should nevertheless remain analytically distinguishable so that archival structure does not silently become historical structure.

Definition 7.94 (Archival configuration). An *archival configuration* is the historically situated arrangement of record-producing actors, documentary series, custodial relations, appraisal practices, classifications, preservation infrastructures, access rules, descriptive systems, and retrieval interfaces through which historical traces become retainable and researchable.

Definition 7.94 makes the archive an object of relational analysis in its own right. An archival configuration can be concentrated in a state repository, distributed across organizations and private collections, partially digital, fragmented across jurisdic-

Table 7.10: Archival operations and their characteristic epistemic consequences

Archival operation	Relational function	Potential analytical gain	Characteristic uncertainty
Construction	Selection, aggregation, custody, arrangement, description	Reveals how a researchable corpus came into being	Archival organization is mistaken for historical organization
Trace preservation	Retention of documents, objects, metadata, and contextual links	Extends access across historical distance	Surviving trace is treated as complete representation of the past relation
Record survival	Differential preservation across actors, media, periods, and institutions	Supports reconstruction of preservation pathways	Survival bias is confused with historical prevalence or importance
Missing archives	Non-formation, dispersal, destruction, restriction, format loss, weak discoverability	Makes limits of historical visibility explicit	Missingness is assigned a single cause without sufficient evidence
Archival power	Appraisal, description, access, secrecy, digitization, ranking, institutional authority	Reveals how visibility and memory are organized	Power is inferred from archival asymmetry without a specified mechanism
Temporal reconstruction	Ordering of events, records, revisions, and retrospective classifications	Supports process and sequence analysis	Record date, event date, filing date, and later interpretation are conflated
Interpretive comparison	Rival reconstructions from partially shared traces	Preserves contestability and evidential dependence	Disagreement is flattened into one synthetic narrative too early
Re-epistemization	Re-reading preserved traces under later questions, concepts, methods, and evidence	Retains future epistemic option value	Later categories are projected backward without historical discipline

tions, or reconstructed from dispersed traces. Its boundaries may differ from the boundaries of the historical phenomenon being studied. Table 7.10 summarizes the principal archival operations considered in this section and the epistemic questions associated with them.

7.11.1 Archive Construction

Archives are constructed through sequences of institutional and practical decisions concerning what becomes a record, what enters custody, what is retained, how records are grouped, how they are described, and under what conditions they can be encountered. Construction does not imply fabrication of the underlying historical events. It identifies the mediating processes through which some historical manifestations acquire durable archival form while others remain dispersed, ephemeral, privately held, restricted, or lost. Schwartz and Cook emphasize this active dimension of archival practice, including appraisal, selection, description, preservation, and communication Schwartz and Cook 2002.

For relational inquiry, archive construction begins before formal transfer to an archival repository. A ministry’s filing rules, a firm’s records-management system, a household’s preservation habits, a laboratory’s data-retention policy, a court’s

case-management procedure, or a platform's log architecture can influence which relations later become reconstructable. The archive therefore inherits properties from the record-producing system. If an institution organizes records by department, case, individual, transaction, project, or legal category, that arrangement can privilege some relational pathways and obscure others.

Archival arrangement can also create analytically useful relations among records. Series, folders, provenance groupings, accession histories, and finding aids preserve context that might be lost if documents were treated as isolated text fragments. At the same time, those structures reflect archival decisions and institutional histories. A researcher reconstructing a transorganizational relation may need to cross several archival series whose original arrangement follows administrative divisions rather than the relation of interest.

Proposition 7.95 (Archive–history distinction). *Archival organization supports stronger historical inference when the analysis distinguishes relations among archived records from relations among the historical actors, institutions, and processes those records are used to reconstruct.*

The proposition is especially relevant in digitized and AI-assisted archives. Search interfaces can dissolve original order by returning documents according to keywords, embeddings, relevance scores, or generated summaries. This can enlarge the encounter surface of inquiry, because records from distant series become juxtaposed rapidly. It can also weaken awareness of provenance and arrangement if retrieval detaches an item from its archival neighborhood. A robust workflow should therefore preserve both the retrieval path and the archival context needed for interpretation.

Archive construction is also multiscale. A single personal collection may sit within an organizational archive; organizational holdings may enter a national repository; national holdings may be linked through transnational digital infrastructures. Relations visible at one archival scale can disappear or acquire different significance at another. The scale discipline developed in Section 7.5 therefore applies to the archive as well as to the historical object.

7.11.2 Historical Trace

Archival inquiry proceeds through traces: surviving manifestations that bear a recoverable relation to earlier events, practices, classifications, decisions, interactions, or material conditions. A trace can be a letter, ledger entry, map, legal instrument, photograph, memorandum, dataset, marginal annotation, version history, recorded testimony, object, or metadata relation. Its value lies neither in mere age nor in archival location. It lies in the evidential relation that connects the surviving manifestation to the historical claim being considered.

Definition 7.96 (Historical relational trace). *A historical relational trace is a surviving manifestation whose provenance, content, material form, position within a record system, or relation to other traces provides evidence concerning a past relation, relational event, configuration, or transformation.*

Historical traces vary in distance from the target relation. A signed agreement may be closely connected to a formal obligation. A later memoir may provide retrospective evidence filtered through memory and subsequent experience. A statistical compilation may aggregate many earlier records. A finding aid may provide evidence about archival organization more directly than about the historical relation that motivated

the original documents. Relational inference should therefore state what kind of trace is being used and how its evidential role is established.

The same trace can support several historically distinct claims. A colonial administrative report can contain claims about a population, reveal categories used by officials, expose uncertainty or disagreement within the administration, and provide evidence about the procedures through which governing knowledge was produced. Stoler's analysis is instructive here because it treats archival documents and forms as evidence concerning the epistemic and affective organization of colonial governance itself Stoler 2009. Such use differs from treating the report as a transparent description of the population it classifies.

Material and textual features can also matter. Revision marks, attachments, omissions, signatures, circulation lists, stamps, annotations, damaged pages, duplicated forms, and changes in handwriting or format may carry relational information that a plain-text extraction does not preserve. Digitization can improve access while reducing some of these material cues. Where the claim depends on material form, the digital surrogate should be treated as a transformation within the provenance chain rather than as an interchangeable substitute.

Remark 7.97 (Trace plurality). A historical trace can be evidentially relevant to several relational objects at once. Its interpretation should specify which trace–claim relation is being used in the local argument.

Trace plurality is important for AI-assisted archival analysis. Models can extract entities, dates, relations, and themes at scale, yet the same document may carry evidential significance through tone, omission, filing context, material form, or relation to adjacent records. Automated extraction can therefore operate as one layer of access while retaining pathways back to the original archival object and its contextual metadata.

7.11.3 Record Survival

The historical record available to a researcher is shaped by differential survival. Paper decays, digital formats become obsolete, private collections disperse, organizational records are destroyed according to retention schedules, records are lost in conflict or disaster, confidential materials remain closed, and some institutions possess substantially greater preservation capacity than others. Survival can therefore be uneven across social position, organizational form, geography, media, and historical period.

This unevenness matters because surviving records can create misleading impressions of historical prevalence. An actor who generated extensive bureaucratic documentation may appear more relationally central than an actor whose activities were oral, informal, poorly funded, or weakly institutionalized. A large institution may preserve correspondence across decades while a short-lived association leaves only fragments. A highly regulated transaction can leave repeated documentary traces while care, trust, informal labor, avoidance, or unrecorded exchange remains comparatively faint.

Definition 7.98 (Record survival trajectory). A *record survival trajectory* is the reconstructable sequence through which a historical record or record series passes from production through use, retention, custody, preservation, migration, restriction, digitization, and present accessibility.

The survival trajectory extends the documentary provenance chain developed in Section 7.10. Provenance asks how a documentary object became evidence for a claim; survival analysis asks which processes allowed that object to remain available while possible alternatives disappeared. The distinction is useful when comparing archival abundance across actors or periods.

Researchers can sometimes estimate survival conditions indirectly. Retention schedules, accession records, catalog histories, repository reports, references in surviving correspondence, later citations to missing documents, duplicate copies, and discontinuities in numbering can reveal that a corpus was once larger or differently organized. Such evidence rarely reconstructs the missing corpus completely. It can nevertheless narrow interpretations of what present abundance and absence mean.

Proposition 7.99 (Survival-aware inference). *Comparisons based on archival frequency or documentary abundance become more credible when plausible differences in record production, retention, preservation, and access are incorporated into the interpretation.*

Survival-aware inference is especially important for quantitative text analysis of historical corpora. Counts, topic frequencies, network edges, and named-entity distributions can appear precise while inheriting severe preservation asymmetries. Computational precision at the level of the surviving corpus does not resolve uncertainty concerning how that corpus came to survive.

7.11.4 Missing Archives

Missing archives extend documentary silence from individual records to archival formations. A relevant archive may not have been formed, may have been dispersed across repositories, may remain privately held, may have been destroyed, may be subject to legal restriction, may exist in an unreadable or obsolete format, may lack adequate description, or may be technically present while remaining difficult to discover. These conditions have different epistemic meanings and should not be compressed into a single category of absence.

Definition 7.100 (Missing-archive profile). *A missing-archive profile records the principal reasons a potentially relevant body of historical traces is unavailable, weakly visible, fragmented, restricted, unpreserved, undiscoverable, or only indirectly reconstructable, together with the consequences of that condition for the research claim.*

The profile can distinguish at least several situations. Non-formation arises when practices generated few durable records. Destruction removes previously produced traces. Dispersal separates records across custodians or jurisdictions. Restriction limits access according to privacy, security, ownership, or institutional policy. Format loss makes records technically inaccessible. Description gaps weaken discoverability. Private custody can make access contingent on relationships or permissions. These pathways can coexist within one project.

Missing archives should also be analyzed relationally. The capacity to preserve, classify, and transfer records is unevenly distributed. Communities with limited archival resources may leave fragmented traces even when their historical activity was extensive. Institutions with coercive or administrative authority may preserve records about others while those others retain fewer records produced from their own positions. Trouillot's analysis of silencing across the production of sources, archives, narratives, and retrospective significance provides an important precedent

for tracing such asymmetries through historical knowledge production Trouillot 1995.

A missing archive can sometimes become partially reconstructable through external traces. Correspondence held by another party, court records, newspapers, financial ledgers, diplomatic files, oral histories, photographs, citations, institutional minutes, and later compilations can provide indirect evidence. Such reconstruction should preserve the asymmetry of access. Evidence produced about an actor is not equivalent to records produced by that actor, and later testimony is not equivalent to contemporaneous documentation.

Caution 7.101 (Missingness interpretation). A missing archive should be assigned a specific historical explanation only when evidence distinguishes that explanation from plausible alternatives such as non-formation, loss, dispersal, restriction, weak description, or retrieval failure.

This caution preserves epistemic humility. Archival absence can itself be historically significant, yet its cause may remain underdetermined. Reporting the structure of uncertainty is preferable to converting missingness into an overly confident narrative.

7.11.5 Archival Power

Archival power concerns the capacities through which actors and institutions influence historical visibility, preservation, description, access, and later interpretation. It can operate during record creation, appraisal, retention, transfer, classification, cataloging, restriction, digitization, funding, interface design, and public communication. Schwartz and Cook describe archives as active sites in which social memory is shaped through professional and institutional practices Schwartz and Cook 2002. Within relational methodology, this insight can be translated into a more specific question: which relations influence what can become a durable and discoverable trace, and through which mechanisms?

Power analysis should remain mechanism-sensitive. Unequal archival visibility does not by itself establish intentional suppression. Differential record production can arise from organizational function, legal obligation, resource capacity, media practices, survival conditions, or historical accident. Stronger claims about suppression, exclusion, strategic secrecy, or deliberate destruction require evidence concerning the relevant pathway. This discipline is consistent with the broader writing principle that claim strength should track available support.

Archival power can also be productive rather than merely restrictive. Classification and description create pathways through which researchers can encounter records. Preservation programs can rescue fragile materials. Community archives can establish forms of memory that were previously weakly represented. Digitization can broaden geographic access. Translation, transcription, and metadata can create new interfaces between records and research communities. These operations can simultaneously privilege some classifications or access paths over others.

Definition 7.102 (Archival visibility architecture). An *archival visibility architecture* is the configuration of record-production practices, appraisal decisions, preservation resources, descriptive systems, access rules, digitization priorities, retrieval interfaces, and institutional capacities that conditions which historical traces become visible to a given research community.

The architecture is audience-relative as well as historically situated. A record may be physically preserved yet functionally invisible to researchers who lack language skills, institutional credentials, travel resources, technical tools, or knowledge of the relevant finding system. Digital access can reduce some barriers while introducing others through paywalls, platform design, metadata quality, OCR performance, ranking systems, or uneven digitization.

AI-assisted archival research adds a further layer of visibility architecture. Retrieval-augmented systems, semantic search, transcription, translation, entity linking, and clustering can widen access across large corpora. Their outputs depend on the corpus supplied, metadata, ranking procedure, model behavior, and prompt or query design. A model can surface an unexpected relation that a keyword search would miss, yet it can also repeatedly privilege highly indexed or linguistically dominant materials. AI therefore participates in archival visibility without replacing the underlying archival power relations.

Proposition 7.103 (Archival power localization). *Claims about archival power are strengthened when the analysis identifies the stage, actor, institutional capacity, and mechanism through which historical visibility, preservation, description, access, or retrieval is altered.*

7.11.6 Temporal Reconstruction

Archival inquiry reconstructs relations across several temporal layers. The time of an event may differ from the time at which it was recorded. A document may be revised later, transferred to an archive after institutional closure, reclassified during cataloging, digitized decades afterward, and interpreted by researchers under later conceptual conditions. Temporal reconstruction therefore requires more than sorting records by their present metadata date.

Definition 7.104 (Archival temporal stack). *An archival temporal stack distinguishes, where relevant to the claim, the time of the historical event or relation, the time of record production, later revision or annotation, custodial transfer, archival arrangement, digitization or transformation, and present research interpretation.*

This stack helps separate retrospective records from contemporaneous traces. A report written years after an event may contain valuable synthesis while incorporating later categories and political concerns. A registry updated retrospectively can make an earlier status appear contemporaneous. A digitized database may assign standardized dates that compress uncertain historical intervals. Temporal metadata therefore require interpretation in relation to the record-making process.

Sequence reconstruction can draw on explicit dates, internal references, version history, handwriting, administrative procedure, serial numbers, correspondence chains, material characteristics, and relations among records. Contradictions among dates can be informative rather than merely problematic. They may reveal delayed reporting, contested chronology, retrospective classification, or several institutional clocks operating at once.

Multiscale temporal analysis is particularly relevant here. Individual encounters, organizational decisions, institutional reforms, archival transfers, and long-term historical transformations can operate on different timescales. The fast-slow distinctions planned later in the book can therefore be grounded partly in archival reconstruction, provided the relevant temporal bridges are supported by evidence. A rapid

sequence of transactions, for example, may sit within a slowly changing legal regime whose archival traces appear in a different record series.

Temporal reconstruction also interacts with relational identity. The continuity criteria developed in Section 7.8 can be applied to archival evidence when the researcher asks whether an institution, obligation, coalition, or other relation persisted through changing names, forms, and documentary regimes. The archival temporal stack helps distinguish historical change in the relation from change in how the relation was recorded.

7.11.7 Competing Historical Interpretations

Archival evidence frequently supports more than one plausible historical reconstruction. Sources can conflict, actors can describe the same relation differently, records can be incomplete, later documents can reinterpret earlier events, and archival organization can privilege one sequence over another. Methodological discipline therefore requires a way to preserve interpretive plurality without treating historical interpretation as unconstrained.

Definition 7.105 (Interpretive divergence profile). An *interpretive divergence profile* records competing historical reconstructions, the archival traces each reconstruction relies upon, the inferential steps connecting those traces to its claims, and the points at which the reconstructions differ in source weighting, chronology, category use, causal interpretation, or treatment of missing evidence.

This profile shifts disagreement from a contest between finished narratives toward a comparison of evidential dependencies. Two interpretations may share most sources but differ in the meaning assigned to one administrative category. Another pair may disagree because one relies heavily on official records while the other incorporates private correspondence. A third disagreement may arise from different temporal boundaries or criteria of relational persistence. Making these dependencies visible can clarify which new evidence would be most informative.

Competing interpretations can also be scale-relative. A policy may appear stable in national records while local archives reveal divergent implementation. An organization may describe a relation as contractual while correspondence reveals negotiated informal practices. A field-level history may identify long continuity while actor-level records show repeated interruption and reconstitution. Such divergences can reflect genuine multiscale organization rather than simple error.

Archival inquiry should therefore preserve disagreement when available evidence remains underdetermining. Synthesis is valuable when it can show how apparently conflicting interpretations refer to different scales, periods, actors, or relational properties. Forced synthesis can erase meaningful incompatibility. The methodological aim is calibrated historical reconstruction: claims should be as strong as the surviving traces and inferential bridges support.

Proposition 7.106 (Interpretive traceability). *Competing historical interpretations become more productively comparable when their principal claims can be traced to identifiable archival sources, transformations, inferential bridges, temporal assumptions, and treatments of missing evidence.*

AI systems can assist this comparison by mapping claims to sources, locating contradictions, grouping alternative chronologies, or identifying documents used asym-

metrically across interpretations. Such tools can increase analytical coverage while also producing plausible synthetic narratives whose source dependencies are difficult to see. Human-readable provenance and source-level contestability therefore remain important when AI participates in historical synthesis.

7.11.8 Archival Re-Epistemization

Archives preserve the possibility that historical materials may acquire new epistemic significance under later questions, concepts, methods, and evidential infrastructures. Section 156 introduced re-epistemization as the re-examination of earlier research under later epistemic conditions. Archival inquiry extends this principle to historical traces more broadly. A record preserved for administrative, legal, personal, or institutional purposes can later become relevant to a question that its creators did not anticipate.

Definition 7.107 (Archival re-epistemization). *Archival re-epistemization* is the disciplined reconstruction of preserved historical traces under later questions, concepts, methods, or evidential resources while retaining the provenance, historical categories, and original production conditions needed to distinguish new interpretation from the earlier context of the record.

Re-epistemization can occur through several pathways. Newly opened archives can change the evidence available for an established debate. Digitization can connect geographically dispersed holdings. New statistical or computational methods can reveal patterns across records that were previously difficult to compare. New conceptual vocabularies can make earlier distinctions newly salient. Oral histories or community archives can alter the interpretation of institutional records. Later institutional changes can also make the historical significance of earlier records more visible.

This process requires historical discipline because later concepts can clarify as well as distort. A contemporary category can help formulate a new question while failing to match the categories through which historical actors understood their situation. Re-epistemization should therefore preserve both the later analytical vocabulary and the historical language encountered in the archive. Translation between them can remain partial.

The preservation argument developed in Sections 156 and 164 becomes especially important here. Archives retain future epistemic option value partly because later researchers are often poorly positioned to predict which traces will become significant. A marginal annotation, failed policy draft, abandoned classification, technical manual, local ledger, correspondence fragment, or apparently routine form may acquire importance when later questions expose a previously unrecognized relation. The value of archival preservation therefore includes possibilities that are difficult to specify prospectively.

This is also where contingent encounter and aesthetic judgment enter archival praxis most directly. Researchers often encounter significance through an unexpected juxtaposition, anomalous phrase, changed category, unusual silence, or record whose form does not fit the current explanatory structure. The initial recognition can be aesthetic in the broad sense developed earlier in the book: a sense that a pattern, discrepancy, or relation deserves attention before its epistemic status is settled. Archival method then subjects that salience to provenance analysis,

comparison, contextual reconstruction, and alternative explanation.

AI can greatly expand this encounter surface. Semantic retrieval, transcription, translation, clustering, and multimodal search can bring a researcher into contact with traces that would have been difficult to locate through traditional finding aids alone. The same abundance makes judgment more consequential. Generated connections can reflect real historical structure, model-induced similarity, metadata bias, corpus imbalance, or accidental lexical resemblance. Re-epistemization therefore benefits from AI-assisted discovery when the resulting relation remains traceable to archival objects and open to historical verification.

Proposition 7.108 (Re-epistemization discipline). *Archival re-epistemization is strengthened when later analytical categories and methods remain distinguishable from the historical categories, production conditions, and archival transformations through which the underlying traces became available.*

Archival inquiry thus extends documentary methodology from the interpretation of individual records toward the historical infrastructure of record survival and visibility. Archive construction, trace formation, differential survival, missing archives, archival power, temporal layering, competing interpretations, and re-epistemization jointly condition what can be known about past relations. The archive provides neither unrestricted access to the past nor an arbitrary field of interpretation. It provides a structured and historically mediated evidential environment whose possibilities and limits can themselves be investigated. The next section turns to ethnographic inquiry, where relational evidence is generated through situated presence, observation, participation, and reflexive engagement with ongoing social practice.

7.12 Ethnographic Inquiry

Sections 7.10 and 7.11 examined documentary and archival access to relations that become researchable through records, preservation, classification, and historical trace. The present section turns toward relations encountered through sustained presence in fields of practice. Its role is to specify how ethnographic inquiry can reconstruct situated interaction, tacit coordination, informal institutions, embodied routines, relational meaning, and the researcher's own position within the setting. The discussion proceeds through participant observation, situated observation, everyday relations, tacit practice, relational meaning, field position, reflexive field notes, and limits of ethnographic access. The aim is methodological: ethnography is treated here as one mode of relational access whose strengths and limitations depend on the research object, field conditions, duration, researcher position, and evidential question.

This treatment follows directly from the ontology and epistemology developed in Chapters 4 and 5. Ethnographic observation concerns manifestations of relations in practice and provides mediated access to relational reality. Conduct, speech, silence, spatial organization, artifacts, routines, interruptions, and participant interpretations can support inference toward relations, yet each manifestation is situated within a field and mediated by the researcher's access. Hammersley and Atkinson describe ethnography as a reflexive process in which research activity remains part of the social world being studied Hammersley and Atkinson 2019. Geertz's account of interpretive inquiry provides a precedent for treating situated action as intelligible through contextual reconstruction of situated action Geertz 1973. Bourdieu's theory

of practice further supports attention to practical regularities that may be enacted without being exhaustively articulated by participants Bourdieu 1977.

Ethnographic inquiry is especially useful where formal rules, administrative categories, documentary representations, or interview accounts leave important aspects of practical relational organization unresolved. A workplace may possess an official reporting hierarchy while everyday coordination depends on informal brokers. A public service may be governed by formal eligibility criteria while access is practically shaped by queues, discretionary interpretation, language, familiarity, or repeated interaction. A market may be described through prices and contracts while trust, reputation, timing, embodied skill, and tacit conventions organize exchange. The ethnographic task in such cases is to reconstruct how practical and formal relations are enacted together and how they diverge or reinforce one another.

Definition 7.109 (Ethnographic relational access). *Ethnographic relational access* is sustained, situated empirical access to relations through observation, participation, interaction, contextual interpretation, and reflexive documentation of the researcher's position within a field of practice.

Definition 7.109 emphasizes access and keeps claims of epistemic privilege outside the definition. Sustained presence can disclose practical organization that remains weakly visible in records or retrospective accounts, while presence also changes what the researcher can encounter and how participants encounter the researcher. Table 7.11 summarizes the main ethnographic operations developed below.

7.12.1 Participant Observation

Participant observation combines presence in a field with varying degrees of participation in its activities. The methodological significance of participation lies in the forms of access it can create. Some relations become visible only when the researcher encounters schedules, interruptions, role expectations, embodied coordination, informal repair, mutual dependence, and practical constraints from within an activity. Participation can therefore reveal differences between a formally specified process and the process through which work is practically accomplished.

Participation should nevertheless be described precisely. A researcher who observes a meeting, works alongside participants, joins a volunteer activity, shadows a professional, resides in a community, or participates through a digital platform occupies different relational positions. The relevant distinction concerns what activities the researcher can enter, what responsibilities accompany that access, how participants understand the researcher's role, and which relations become observable or less observable because of that role.

Definition 7.110 (Participation profile). A *participation profile* records the activities, roles, responsibilities, access conditions, interactional permissions, temporal duration, and participant understandings through which the researcher enters and remains within a field setting.

A participation profile supports later interpretation because field access often changes over time. Initial observation may occur under formal supervision, while later access depends on trust or familiarity. Participants may become more candid, more guarded, or differently oriented toward the researcher as the relationship develops. The researcher's practical competence can also change. An unfamiliar routine that initially appears complicated may later become ordinary, while previously

Table 7.11: Ethnographic operations and characteristic relational access

Ethnographic operation	Primary relational access	Potential analytical contribution	Characteristic limitation
Participant observation	Interaction and practice encountered while the researcher participates in field activity	Reconstructs coordination, role expectations, practical judgment, and participation-dependent relations	Researcher participation can alter access, conduct, and interpretation
Situated observation	Conduct interpreted in relation to place, time, infrastructure, sequence, and local conditions	Preserves contextual conditions that make a manifestation intelligible	Local density can be overextended beyond the observed setting
Everyday-relations inquiry	Repeated ordinary interactions, routines, interruptions, and informal coordination	Reveals practical relational architecture weakly represented in formal descriptions	Familiar routines can become analytically invisible through habituation
Tacit-practice reconstruction	Skill, embodied coordination, practical know-how, and unarticulated regularity	Makes practical competence and informal ordering researchable	Researcher inference can exceed what observation supports
Relational-meaning reconstruction	Participant interpretations, categories, symbols, affective orientations, and contested meanings	Distinguishes materially similar actions that instantiate different relations	Meaning can be plural, strategic, retrospective, or contested
Field-position analysis	Access, role, identity attribution, trust, authority, language, and institutional location	Makes the conditions of observation and interaction visible	Reflexivity can become overly self-referential if detached from the research object
Reflexive field notes	Versioned records of observation, interpretation, uncertainty, positional change, and emergent questions	Preserves the trajectory from encounter toward later analysis	Notes remain selective constructions whose scope is narrower than the field itself
Access-limit analysis	Unobserved settings, restricted relations, temporal limits, ethical constraints, and participant selection	Bounds inference and identifies complementary evidence needs	Unobserved relations can be inadvertently treated as unimportant

unnoticed distinctions become salient.

Participant observation is therefore temporally structured. Early impressions can be analytically valuable because unfamiliarity makes tacit assumptions visible. Later participation can be valuable because practical understanding deepens. Neither phase should automatically be treated as superior. Recording how access, competence, trust, and role attribution change makes it possible to interpret differences between early and later observations.

The researcher can also become part of the relational configuration being studied. A request for explanation may interrupt a routine. Participation can redistribute labor, attention, authority, or social alignment. Participants may use the researcher’s presence strategically, seek recognition, avoid topics, perform compliance, or recruit the researcher into existing disputes. Reflexive ethnography therefore asks how observation is conditioned by participation while keeping the effects of researcher in-

volvement open to analysis. Hammersley and Atkinson's reflexive account is useful here because it treats researcher involvement as a condition to be analyzed within the research process Hammersley and Atkinson 2019.

Proposition 7.111 (Participation-conditioned access). *Ethnographic claims are strengthened when the analysis specifies how the researcher's form of participation enabled, restricted, or altered access to the relations on which the claim depends.*

7.12.2 Situated Observation

Ethnographic observation is situated in space, time, institutional arrangement, material infrastructure, and ongoing relational sequence. The same visible action can acquire different significance when its setting changes. Waiting may indicate exclusion in one context, procedural sequencing in another, strategic delay in a third, or ordinary temporal coordination in a fourth. A queue, doorway, screen, counter, office layout, shared tool, platform interface, or transportation route can condition who encounters whom and under what terms.

Situated observation therefore records more than behavior. It attends to where interaction occurs, what precedes and follows it, which participants are present or absent, what artifacts and infrastructures mediate it, what institutional rules are relevant, and how the scene relates to broader routines. Hutchins' analysis of distributed cognition provides a useful precedent for examining how practical activity can be organized across persons, artifacts, procedures, and material arrangements across persons, artifacts, procedures, and material arrangements Hutchins 1995.

The methodological boundary developed in Section 7.4 remains active. A field site is not automatically the boundary of the relation. A workplace observation may depend on supply chains, regulatory requirements, software systems, household obligations, or transnational communication that are only partially visible at the site. Ethnographic inquiry can therefore combine dense local observation with explicit boundary remainders. The field site provides a point of relational access, while the wider relational domain may extend beyond the site.

Scale selection from Section 7.5 is similarly important. An observed exchange may be analyzed at the dyadic level, while its practical meaning depends on organizational roles or institutional categories. Repeated local practices may aggregate into an organizational regularity, yet the cross-scale bridge requires evidence. Ethnographic density supports locally grounded claims; movement toward a broader population or field requires an additional inferential bridge.

Definition 7.112 (Situated observation record). *A situated observation record preserves an observed interaction together with the spatial, temporal, material, institutional, and relational conditions judged relevant to interpreting that interaction.*

This form of record supports later comparison. Two scenes that appear behaviorally similar can be distinguished by setting, authority structure, participant composition, temporal sequence, or infrastructural conditions. Conversely, different visible actions may instantiate a similar relation when they perform comparable functions under different local conventions.

7.12.3 Everyday Relations

Many consequential relations are reproduced through ordinary activity, while exceptional events can reveal different properties of the same configuration. Greeting practices, turn-taking, requests for help, informal advice, repeated deference, joking, correction, waiting, avoidance, shared maintenance, routine reporting, and small acts of coordination can sustain trust, hierarchy, belonging, expertise, dependency, exclusion, or mutual obligation. Ethnographic inquiry is particularly well suited to these relations because their practical significance can remain weakly represented in formal documents and retrospective interviews.

Everyday relations require analytical patience. Their recurrence can make them appear trivial to participants and researchers. Yet repetition can stabilize expectations and reduce the need for explicit negotiation. An informal colleague who repeatedly interprets rules for others may become a practical access point despite lacking formal authority. A routine pattern of who speaks after whom can reveal an interactional hierarchy that remains absent from the organizational chart. Repeated small acts of maintenance can sustain shared infrastructure while remaining weakly recognized in accounting or role descriptions.

Bourdieu's practice theory is relevant here because durable dispositions and practical regularities can organize conduct with limited explicit calculation or verbal formulation Bourdieu 1977. Within the present framework, observed regularity therefore remains a candidate for further reconstruction whose interpretation requires evidence beyond recurrence itself. It motivates a research question: which repeated relations appear sufficiently patterned to warrant further reconstruction, and what evidence distinguishes durable practice from temporary coincidence?

Everyday inquiry should also preserve interruption. Breakdown, absence, substitution, conflict, unexpected demand, or the arrival of an unfamiliar participant can expose relations that ordinary smooth functioning conceals. When a routine fails, participants may articulate assumptions that usually remain tacit. Repair practices can reveal who possesses authority, practical expertise, access to resources, or responsibility for continuity.

This point connects directly to contingent encounter. Ethnographic fields generate unplanned encounters whose significance may initially appear only as surprise, elegance, tension, anomaly, or a felt mismatch between formal expectation and observed practice. Aesthetic judgment can make such an encounter salient before its epistemic status is clear. Subsequent observation, comparison, participant interpretation, documentary evidence, or interviews can then determine whether the encounter represents a recurring relation, an exceptional event, a misunderstanding, or a feature of the researcher's position.

Remark 7.113 (Ordinary-event asymmetry). Routine events and exceptional events can disclose different properties of a relational configuration. Repetition may reveal stabilized expectations, while interruption may reveal dependencies, repair mechanisms, authority, and assumptions that remain less visible during ordinary functioning.

7.12.4 Tacit Practice

Tacit practice concerns competent action whose organization is only partly available through explicit participant description. Skilled work, timing, spatial orientation, embodied coordination, informal classification, practical sequencing, sensitivity to cues, and learned forms of anticipation can be difficult to reconstruct through interview accounts alone. Ethnography provides one route into these practices by observing performance across repeated situations and by participating where ethically and practically appropriate.

Tacit practice identifies a gap between enacted competence and explicit articulation. A participant may perform a task reliably while offering only a partial account of how judgments are made. Another participant may provide a formal explanation that differs from observed practice because the explanation draws on institutional categories that differ from the practical sequence. Ethnographic inquiry can place these forms of evidence in relation while keeping practice and speech as distinct evidential sources.

The identification problem from Section 7.6 remains important. Repeated co-occurrence of action and outcome supplies limited support for a tacit mechanism until additional relational evidence is available. Researchers can overinterpret gesture, timing, silence, or embodied routine through their own conceptual expectations. A stronger reconstruction combines repeated observation, variation across situations, participant explanation where available, comparison among practitioners, and attention to breakdown or learning.

Definition 7.114 (Tacit-practice reconstruction). A *tacit-practice reconstruction* is a provisional account of recurring practical organization inferred from observed performance, contextual variation, participant interpretation, artifacts, and relevant contrasts where explicit verbal description remains incomplete.

This definition keeps tacit-practice claims revisable. What initially appears tacit may later become explicitly articulated in training materials or interviews. What appears to be an embodied skill may depend heavily on material infrastructure. A practice that seems individual may prove distributed across colleagues, tools, and procedures. Hutchins' work is again useful as a precedent for this broader distribution of practical organization Hutchins 1995.

AI-assisted video, audio, sensor, or text analysis can expand the tractability of repeated practice, yet automated pattern detection introduces another representational layer. Detected regularities require substantive interpretation, and ethically sensitive recordings may be inappropriate to collect or process in some settings. Computational abundance therefore increases the value of field judgment, informed consent, contextual knowledge, and proportionality between data collection and the research question.

7.12.5 Relational Meaning

Ethnographic inquiry can reconstruct how participants understand, contest, and enact the meaning of relations. Materially similar actions can instantiate different relations. Sharing food can express hospitality, obligation, ritual membership, compensation, care, reciprocity, hierarchy, or strategic alliance. Silence can indicate deference, refusal, uncertainty, exclusion, fatigue, confidentiality, or practical irrelevance. A

repeated transfer can be interpreted as wage, gift, allowance, debt repayment, entitlement, patronage, or family support. Relational meaning therefore requires contextual reconstruction through contextual reconstruction that supplements visible form.

Geertz's interpretive approach is relevant because meaning becomes intelligible through contextual webs through contextual webs surrounding behavioral units Geertz 1973. Within GR methodology, contextual interpretation remains evidentially disciplined. Participants may disagree about what a relation means. Public descriptions can differ from private accounts. Meaning can shift historically or vary across roles. Strategic presentation can coexist with sincere interpretation. The researcher therefore reconstructs a field of meanings while preserving plurality and contestation where the evidence supports them.

Definition 7.115 (Ethnographic relational-meaning profile). An *ethnographic relational-meaning profile* records the participant categories, interpretations, symbolic forms, practical enactments, contextual contrasts, disagreements, and researcher inferences through which the meaning of a relation is reconstructed.

The profile links directly to the characterization work in Section 7.7. Relational meaning is one property among several. A relation can be materially asymmetric while interpreted by participants as reciprocal. A formally voluntary relation can be experienced as strongly constrained. A relation called friendship can carry substantial economic dependence. Ethnographic interpretation helps reconstruct these meanings alongside analysis of material flows, authority, legal status, and dependency.

Meaning can also be performative. A category, ritual, title, label, or repeated narrative can contribute to stabilizing the relation it describes. When participants repeatedly treat someone as senior, trusted, peripheral, indebted, expert, or outsider, symbolic recognition can become part of the relational configuration. This possibility should be examined through practice and consequence through practice, consequence, and vocabulary considered together.

Caution 7.116 (Interpretive closure). A coherent ethnographic interpretation should remain distinguishable from the range of participant meanings and evidential manifestations from which it was constructed, especially where interpretation is contested or role-dependent.

7.12.6 Field Position

Field position concerns the researcher's changing relational location within the setting. Access can depend on institutional sponsorship, gatekeepers, language, profession, age, perceived expertise, nationality, class position, organizational role, prior relationships, or the practical usefulness attributed to the researcher. Some of these properties may be relatively stable during fieldwork; others are interpreted differently by different participants or change through interaction.

Field position affects visibility. A researcher introduced by senior management may gain access to formal processes while encountering guarded behavior from junior staff. A researcher embedded with frontline workers may observe practical coordination while remaining distant from strategic decision making. Fluency in a local language can open informal interaction while also creating expectations about cultural familiarity. Digital fieldwork can provide extensive trace access while limiting embodied, spatial, or off-platform observation.

The methodological response is to document the position from which access occurs and examine how that position changes the evidential field. Hammersley and Atkinson's emphasis on reflexivity is useful precisely because the researcher is treated as part of the research situation as a participant in the research situation whose position can be examined Hammersley and Atkinson 2019.

Definition 7.117 (Field-position trajectory). A *field-position trajectory* records changes in the researcher's access, attributed role, trust relations, participation, dependencies, institutional affiliations, and interactional possibilities during ethnographic inquiry.

This trajectory can help interpret changes in evidence. If sensitive topics begin to appear only after several months, the timing may reflect increasing trust. If some participants disappear after the researcher becomes associated with another group, the change may reflect field alignment. If access expands following organizational authorization, observed practice may still differ from settings outside the authorized pathway.

Field position also has ethical consequences. Participation can create obligations, expectations of assistance, exposure to confidential information, or risks for participants whose association with the researcher becomes visible. Researchers may encounter harmful conduct, urgent need, or conflicting responsibilities. These issues require more than reflexive description; they call for ethical judgment, institutional safeguards where appropriate, and attention to consequences for participants and communities.

Proposition 7.118 (Positional traceability). *Ethnographic warrant is strengthened when changes in access, role attribution, trust, participation, and field alignment can be related to changes in the evidence available to the researcher.*

7.12.7 Reflexive Field Notes

Field notes create a documentary interface between lived encounter and later analysis. They can record scenes, dialogue, sequence, spatial arrangement, material objects, participant categories, emerging questions, interpretive hypotheses, uncertainties, access changes, emotional responses, and decisions about what to pursue next. Emerson, Fretz, and Shaw emphasize that fieldnotes are constructed through selective attention, memory, descriptive choices, organization, coding, and revision as selective records shaped through the process of writing Emerson et al. 2011.

This constructed character makes provenance important. A brief note written during an interaction, an expanded account written that evening, a later analytic memo, and a coded excerpt occupy different positions in the evidential chain. Collapsing them into one undifferentiated record can obscure when interpretation entered the account. A reflexive note system therefore benefits from versioning and from distinguishable layers of observation and interpretation.

Definition 7.119 (Reflexive field-note chain). A *reflexive field-note chain* is the recoverable sequence linking field encounter, contemporaneous notation where available, expanded description, interpretive memo, later coding or synthesis, and revisions to the researcher's understanding of the field.

This chain parallels the provenance disciplines developed for documentary and archival inquiry in Sections 7.10 and 7.11. Ethnographic perception is selective and

conceptually mediated. The purpose of the chain is to preserve enough of the trajectory that later researchers, and the researcher at a later stage, can distinguish an observed manifestation from a subsequent inference with reasonable clarity.

Reflexive field notes can also record contingent encounter and aesthetic judgment explicitly. A researcher may note that an event felt unusually striking, elegant, troubling, contradictory, or generative before understanding why. Preserving that initial salience can be useful because later theory may otherwise rewrite the encounter as if its significance had been obvious from the beginning. Subsequent notes can then record how the initial impression was confirmed, revised, contextualized, or abandoned.

AI-assisted transcription, summarization, coding, and retrieval can support large ethnographic corpora, particularly where notes, interviews, images, and documents accumulate over long field periods. Such assistance should preserve source linkage and the distinction between researcher-authored description and model-generated synthesis. Sensitive ethnographic material can also create privacy and security risks when processed through external systems. The appropriate workflow depends on consent, data sensitivity, institutional obligations, and the potential consequences of disclosure.

Proposition 7.120 (Field-note provenance). *Ethnographic analysis is strengthened when consequential interpretations remain traceable to the field-note stages, observations, interactions, and later analytic transformations through which they were produced.*

7.12.8 Limits of Ethnographic Access

Ethnographic access is dense yet partial. Researchers observe selected sites during finite periods, interact with a subset of participants, and encounter practices conditioned by their field position. Some relations occur in restricted spaces, private communication, moments of crisis, executive settings, households, informal networks, or digital channels beyond the researcher's access. Ethical limits can appropriately prevent observation of vulnerable participants or highly sensitive activity. Language, mobility, institutional permission, cost, and time further shape what becomes observable.

Partiality calls for claim calibration while leaving room for well-supported local inference. A dense account of one organizational unit can strongly support a claim about how a practice is enacted there while providing weaker support for population prevalence. Repeated observation across settings can widen inferential reach, yet broader generalization still requires a specified bridge. Complementary documentary, interview, archival, quantitative, legal, or computational evidence may be appropriate when the claim extends beyond what field access can sustain.

Definition 7.121 (Ethnographic access profile). *An ethnographic access profile records the sites, periods, participant groups, activities, communication channels, roles, restrictions, ethical exclusions, and materially relevant inaccessible domains that bound the evidential field of an ethnographic study.*

The profile should include absences created by the research design itself. Daytime observation may miss night-shift relations. Formal organizational access may exclude informal spaces. Participation in one group can reduce access to another. Digital observation may miss embodied and off-platform activity. Long residence in

one location may deepen local understanding while narrowing comparative exposure. These are research-design properties that should remain visible in the interpretation of ethnographic evidence.

Reactive effects also require calibration. Participants can alter conduct when observed, yet this effect need not be constant. Some changes diminish with familiarity; others persist because the researcher's presence remains consequential. The relevant question is which relations appear sensitive to observation and what evidence supports that interpretation. Comparing periods, settings, observer roles, documentary records, or participant accounts can help reconstruct such effects.

Ethnographic interpretation also faces temporal limits. A stable practice observed over several months may later dissolve under policy change, turnover, crisis, technological transformation, or economic restructuring. Historical and archival evidence can therefore become important when a claim concerns persistence or origin. Similarly, an ethnographic snapshot of a rapidly changing field may require shorter temporal intervals and more explicit versioning.

Caution 7.122 (Ethnographic reach). The inferential reach of ethnographic evidence should remain aligned with the sites, periods, participants, practices, and field positions through which the relevant relation became observable.

A final limit concerns recognition. Sustained presence can reveal relations unavailable through distant observation, but familiarity can also make recurring structures less noticeable. Deliberate comparison, return to early field notes, discussion with participants, movement across settings, and encounters with contradictory evidence can reopen attention. AI-assisted retrieval may surface forgotten passages or recurring patterns, yet algorithmic salience can reflect coding choices, frequency, or model expectations and therefore requires separate assessment of substantive importance.

Ethnographic inquiry therefore contributes a distinctive form of relational evidence as one situated route into relational reality with identifiable strengths and limitations. Its strength lies in sustained access to enactment, context, practical meaning, tacit coordination, and situated change. Its limitations arise from partial presence, positionality, interpretation, ethics, temporal scope, and the uneven visibility of relations within the field. These properties make ethnography especially valuable when combined with the object, boundary, scale, relation-identification, characterization, persistence, configuration, documentary, and archival disciplines developed across Sections 7.3–7.11. The next section turns to interview-based inquiry, where participant accounts, memory, narration, and the interviewer–participant relation become the primary evidential interface.

7.13 Interview-Based Inquiry

Section 7.12 examined ethnographic access to relations through situated presence, observation, participation, and reflexive documentation. The present section turns to interview-based inquiry, where participant accounts become a primary evidential interface for reconstructing experience, interpretation, memory, relational meaning, and historically situated knowledge. Its role is to specify what interviews can contribute to relational inquiry, how interviewer–participant relations condition the evidence produced, and how narrative divergence, memory, silence, and comparison can be handled without treating testimony as transparent access to an underlying

relation. The discussion proceeds through narrative accounts, relational accounts, experiential knowledge, memory, contradictory testimony, interviewer–participant relations, interpretation of silence, and comparative interview analysis.

The approach follows the ontology and epistemology developed in Chapters 4 and 5. Interview speech belongs to manifestational reality and can provide mediated access to relational reality through recollection, interpretation, narrative organization, categorization, and interaction. A participant may describe a relation directly, recount events from which a relation can be inferred, interpret the meaning of an institutional practice, or explain how a relation changed through time. These contributions can be evidentially valuable while remaining conditioned by memory, language, present interests, interviewer prompts, institutional setting, and the relational history of the interview encounter. Brinkmann and Kvale emphasize the practical, epistemological, and ethical dimensions of qualitative research interviewing and describe interview knowledge as produced through a social practice Brinkmann and Kvale 2015. Weiss similarly treats qualitative interviewing as a method for eliciting detailed accounts of events and experiences through a cooperative research relation Weiss 1994. Holstein and Gubrium develop an explicitly active conception of interviewing in which interviewer and participant contribute to the situated production of meaning Holstein and Gubrium 1995.

Within the present framework, these traditions support a relational interpretation of interview evidence without requiring a single theory of interview knowledge. Some research questions depend strongly on factual reconstruction, others on experience, meaning, institutional interpretation, narrative form, or disagreement among positions. The methodological task is therefore to specify what kind of claim an interview segment is being asked to support and what inferential bridge connects the account to that claim.

Definition 7.123 (Interview-based relational access). *Interview-based relational access* is mediated empirical access to relations through elicited participant accounts whose evidential significance depends on the account’s content, production conditions, temporal position, interviewer–participant relation, and connection to the relational object under study.

Definition 7.123 keeps the interview encounter within the evidential architecture developed in Section 7.6. An interview can support relation identification, characterization, persistence analysis, configuration reconstruction, and historical interpretation, while the evidential route varies across these uses. Table 7.12 summarizes the main interview operations developed below.

7.13.1 Narrative Accounts

Narrative accounts organize events and relations through sequence, selection, emphasis, and retrospective interpretation. In relational inquiry, their value often lies in reconstructing how participants connect episodes through time: how a professional relationship formed, how trust changed, when an institutional rule became consequential, how an obligation was interpreted, or how a conflict reorganized a wider configuration. Narrative therefore contributes more than a list of remembered facts. It can reveal the participant’s temporal organization of relational change.

A narrative account is still a present production about a past or ongoing configuration. Events may be compressed, causal connections sharpened, uncertainty re-

Table 7.12: Interview operations and characteristic relational access

Interview operation	Primary relational access	Potential analytical contribution	Characteristic limitation
Narrative reconstruction	Sequenced accounts of events, episodes, transitions, and consequences	Reconstructs temporal ordering, perceived turning points, and participant-defined continuity	Narrative coherence can be produced retrospectively and may compress uncertainty or competing sequences
Relational elicitation	Accounts of dependence, authority, trust, obligation, access, conflict, care, exchange, and coordination	Identifies candidate relations and participant interpretations of relational properties	Named relations may rely on local categories whose meaning requires contextual reconstruction
Experiential inquiry	Felt consequences, practical knowledge, embodied difficulty, recognition, and situated judgment	Makes participant experience and first-person practical knowledge researchable	Experience does not by itself establish population prevalence or external mechanism
Memory reconstruction	Recollection of prior events, relations, routines, and change	Extends inquiry beyond directly observed periods and can reveal historical meaning	Recall is selective, reconstructive, temporally displaced, and influenced by later events
Contradictory-testimony analysis	Divergent accounts of a shared event, relation, category, or institutional process	Reveals positional differences, contested meaning, unequal information, or uncertainty	Divergence can arise from memory, incentives, vocabulary, temporal position, or genuinely different experiences
Interview-relation analysis	Prompting, trust, authority, identity attribution, language, disclosure conditions, and interactional sequence	Makes conditions of elicitation visible and supports interpretation of response variation	Reflexive analysis can become detached from the substantive research object if expanded without purpose
Silence analysis	Pauses, refusals, omissions, topic avoidance, inaccessible domains, and interviewer non-elicitation	Identifies candidate boundaries of disclosure, knowledge, legitimacy, or relevance	Silence is multiply interpretable and requires contextual or comparative evidence
Comparative interview analysis	Structured comparison across participants, positions, times, sites, and interview conditions	Distinguishes shared patterns from positional, institutional, and historical variation	Apparent comparability can exceed equivalence of prompts, categories, access, or participant positions

duced, or earlier meanings reinterpreted through later outcomes. These properties need not invalidate the account. They indicate that the interview contains several analytically distinguishable objects: recollected events, present interpretation of those events, narrative ordering, and the interview situation in which the account is produced.

Definition 7.124 (Narrative account profile). A *narrative account profile* records the events, temporal ordering, actors, relations, turning points, interpretive categories, uncertainty markers, and present standpoint through which a participant reconstructs a relational trajectory.

The profile is useful when a study compares narrative chronology with documen-

tary, archival, observational, or other interview evidence. A participant may remember that an informal collaboration preceded a formal agreement, while institutional records date the relation from contract signature. The difference can be substantively meaningful. It may distinguish practical formation from legal recognition, reveal retrospective reinterpretation, or expose disagreement about what counts as the beginning of the relation.

Narrative analysis should therefore preserve temporal markers with an appropriate degree of precision. Approximate phrases such as “around that period,” “after the reorganization,” or “before the new director arrived” can be analytically informative even when calendar dates remain uncertain. Converting such phrases into falsely exact dates would strengthen the representation beyond the evidence. Historical triangulation can later narrow the interval where the research question requires it.

Narrative form can also reveal attributed causality. Participants often connect events with formulations such as “because,” “after that,” or “that was when.” These connections provide evidence about participant interpretation and can orient mechanism reconstruction. Additional evidence is needed when the research claim concerns an external causal relation extending beyond the participant’s interpretation. This distinction preserves experiential and interpretive knowledge while keeping causal warrant proportionate to the evidence.

7.13.2 Relational Accounts

Interview participants frequently describe relations using categories such as colleague, friend, supervisor, client, partner, competitor, creditor, family member, ally, intermediary, or authority. These labels can provide efficient entry points into relational inquiry, yet the labels alone rarely characterize the relation sufficiently. The same category can contain substantial variation in dependence, reciprocity, obligation, trust, material exchange, authority, duration, emotional meaning, or exit capacity.

Relational elicitation therefore benefits from moving between category labels and concrete episodes. Questions about who was involved, what happened, what could be requested, what happened when expectations were violated, how decisions were made, and what alternatives were available can help connect named relations to the properties developed in Section 7.7. The goal is not to replace participant vocabulary with an external analytical vocabulary. The goal is to preserve both and make the translation between them explicit.

Proposition 7.125 (Relational elicitation discipline). *Where an interview account supports a claim about a relation, analytical reconstruction should preserve the participant’s relational category, the manifestations or episodes through which the relation is described, and the researcher’s mapping from those materials to the analytical relation under study.*

Proposition 7.125 is especially important where local language carries institutional or historical meaning. A word translated as “support,” “family,” “connection,” “trust,” or “responsibility” may organize relations differently across communities, organizations, languages, or historical periods. Interview comparison can become misleading when such terms are treated as semantically identical before their practical use is reconstructed.

Relational accounts can also identify positions that remain weakly visible in records. Participants may know which person actually mediates access, whose approval carries informal weight, which team absorbs coordination work, or which relation becomes active only during crisis. Such accounts can orient configuration reconstruction, while later evidence should distinguish recurrent structure from a participant's local or positional interpretation.

Interview questions can themselves impose relational categories. Asking "Who do you trust?" assumes that trust is a relevant and sufficiently intelligible category for the participant. In some settings, asking about concrete reliance, disclosure, advice, risk sharing, or expected support may produce a more differentiated evidential basis. The choice depends on whether the study seeks participant-defined meanings, analytically specified relations, or comparison across cases. Interview design should state that choice.

7.13.3 Experiential Knowledge

Interviews provide access to forms of experiential knowledge that may remain difficult to reconstruct from external observation or documents. Participants can describe what an institutional process felt like, which constraints became practically salient, how uncertainty was navigated, what forms of dependence were recognized, or which interactions altered their willingness to act. Such accounts are particularly valuable when the research object includes subjective orientation, practical judgment, perceived possibility, or relational meaning.

Experiential knowledge has its own evidential domain. A participant can be well positioned to report pain, fear, confidence, confusion, recognition, humiliation, relief, perceived obligation, or felt dependence. The same account may be less well positioned to establish population frequency, hidden institutional motives, or the full mechanism producing the experience. The evidential strength should therefore be indexed to the claim being made.

Definition 7.126 (Experiential warrant). *Experiential warrant* is the claim-relative evidential support provided by a participant's situated account of experience, practical knowledge, interpretation, or perceived possibility within a specified relational context.

Experiential warrant can be strengthened through detailed episodes, internal consistency, repeated observation across time, comparison among positions, and convergence with other evidence. Divergence can also be informative. Two participants can experience the same institutional procedure very differently because their positions, expectations, resources, histories, or exposure differ. The methodological task is then to reconstruct the relational conditions of the difference while preserving those differences during analysis.

Experiential accounts can also contain knowledge of practice acquired through repeated participation. Workers may know how a formal procedure is practically navigated; patients may know where access bottlenecks occur; migrants may know which documentary steps create delay; researchers may know how review practices operate beyond written guidelines. Such knowledge can be highly specific, unevenly distributed, and difficult to articulate until the interview provides occasions for concrete reconstruction.

Researchers should retain the distinction between participant interpretation and

researcher extension. If a participant describes a service as inaccessible, the interview strongly supports a claim about experienced inaccessibility under that participant's conditions. A broader claim about institutional accessibility requires additional evidence concerning other participants, eligibility structures, geography, cost, language, timing, or other relevant relations. Epistemic humility here protects the value of the participant account by keeping it from carrying claims beyond its evidential domain.

7.13.4 Memory

Memory extends interview inquiry beyond the period of direct observation. It can provide access to earlier relational configurations, changing meanings, episodes of formation or dissolution, and historical conditions that have left weak documentary traces. At the same time, recollection is produced from a later temporal position. Subsequent events can alter salience, interpretation, sequence, and the categories through which earlier experience is narrated.

The methodological response should preserve memory as temporally situated evidence. A participant's present recollection can support claims about remembered events and present interpretation while carrying uncertainty about chronology, wording, frequency, or detail. Different dimensions of an account may have different levels of confidence. Participants sometimes explicitly distinguish what they remember clearly, infer retrospectively, heard from others, or remain unsure about. Such metacognitive markers should be retained in the research record.

Definition 7.127 (Memory-position profile). A *memory-position profile* records the temporal distance of an account, the participant's position during the recalled episode, later experiences likely to shape interpretation, expressed confidence, source mixing, and external traces available for temporal or substantive cross-checking.

Memory uncertainty is more informative when decomposed by claim type than when collapsed into a global credibility score. A participant may remember the existence of a relationship with high confidence while remaining unsure about the exact date of a meeting. Another may remember an institutional decision clearly but reinterpret its meaning after later conflict. Decomposing the account by claim type can preserve useful evidence while keeping local uncertainty visible.

Collective memory also matters. Participants can reproduce organizational stories, family narratives, professional folklore, public histories, or institutional explanations that circulate beyond individual recollection. These accounts may provide evidence about shared representations even when their correspondence to earlier events remains uncertain. In such cases, the research object should distinguish historical event reconstruction from the later relational effects of the remembered narrative.

Archive and interview can therefore correct one another. Documentary evidence can help establish dates, sequences, and formal decisions; interviews can reveal practical consequences, interpretations, informal relations, and experiences weakly represented in the record. Apparent conflict between memory and archive can become an object of inquiry where the discrepancy reflects different event definitions, institutional categories, or later reinterpretation.

7.13.5 Contradictory Testimony

Contradictory testimony is common where participants occupy different relational positions, possess unequal information, recall different moments, use different categories, or have stakes in how an event is represented. Relational methodology should therefore resist treating contradiction as a defect that has to be eliminated before analysis can proceed. Divergence can reveal the structure of the field in which testimony is produced.

Several sources of contradiction should be distinguished. Participants may disagree about an observable event, about its sequence, about the relation connecting events, about the meaning of an action, about responsibility, or about the persistence of a relation. These disagreements call for different forms of adjudication. Documentary evidence may help with dates; observation may help with enacted practice; additional interviews may reveal position-specific interpretation; formal records may clarify institutional status; uncertainty may remain where the evidence is genuinely incomplete.

Definition 7.128 (Testimonial divergence profile). *A testimonial divergence profile records the claims in disagreement, participant positions, temporal standpoints, informational access, relevant incentives, category differences, supporting evidence, and the degree to which the divergence can be adjudicated within the available research design.*

The profile keeps disagreement analytically decomposed. If a manager and employee provide different accounts of a workplace decision, the divergence may reflect authority, information asymmetry, strategic presentation, different definitions of the decision, or genuinely different experiences of implementation. A simple choice of one account as credible can erase the relational structure that generated the disagreement.

Contradiction can also indicate multiplexity. Two participants may describe the same pair as cooperative and conflictual because collaboration and competition co-exist across different domains. What appears to be inconsistency can therefore motivate a revision of the relational characterization. Similarly, accounts that diverge across time can indicate transformation and should be assessed before being classified as testimonial unreliability.

Proposition 7.129 (Divergence as relational evidence). *Where testimonial divergence is systematically associated with participant position, access, temporal standpoint, or relational domain, the pattern of disagreement can itself provide evidence about the configuration under study.*

Proposition 7.129 does not make disagreement self-validating. Contradiction can also arise from error, memory limitations, misunderstanding, or weak interview design. The proposition identifies a research possibility: patterned disagreement may carry information about relational organization and therefore deserves analysis before being treated as noise.

7.13.6 Interviewer–Participant Relations

The interview is itself a relation. Questions, follow-up prompts, disclosure, trust, perceived authority, identity attribution, language choice, institutional affiliation, recording practices, and expectations about use can influence what becomes sayable

and how an account is organized. Holstein and Gubrium's active-interview perspective is especially useful here because it foregrounds the interview encounter as a site of meaning production Holstein and Gubrium 1995. Brinkmann and Kvale likewise place the social and ethical conditions of interviewing within the methodology of interview research Brinkmann and Kvale 2015.

Reflexive analysis should remain connected to the substantive object. The relevant question is which features of the interviewer-participant relation plausibly affected access, disclosure, interpretation, or response form. Age, professional status, organizational sponsorship, language competence, perceived political or institutional alignment, prior acquaintance, and recording arrangements can matter in some studies while remaining less consequential in others.

Definition 7.130 (Interview-relation profile). An *interview-relation profile* records those features of the interviewer-participant relation that plausibly condition elicitation, disclosure, interpretation, or later use of the interview evidence.

The profile can include changes through the interview or across repeated encounters. Trust may increase, fatigue may accumulate, a sensitive topic may change the interaction, or the participant may revise their understanding of the research purpose. Repeated interviews can therefore provide access to relational change within the research encounter itself. This should be documented where it affects interpretation.

Question formulation is part of this relation. Leading assumptions, category choices, sequencing, requests for examples, pauses, and follow-up questions shape the space of possible responses. A transcript therefore preserves interactional production as well as participant speech. Analyses focused on narrative content may reasonably abstract from some interactional detail, while claims about hesitation, disclosure, category formation, or contested meaning may require closer attention to sequence and wording.

Power and ethics are also integral. Participants may perceive consequences for speaking, especially where interviews concern employers, governments, service providers, funders, families, or other consequential relations. Confidentiality procedures, recruitment pathways, consent, data storage, quotation practices, and the possibility of deductive identification can influence both participation and disclosure. Ethical design is therefore connected to evidential quality as well as participant protection.

7.13.7 Interpretation of Silence

Silence in an interview can take several forms: a pause, refusal, topic shift, minimal response, omission, claimed lack of knowledge, emotional interruption, or the absence of a topic that the researcher expected to appear. These forms may be analytically significant, but their meaning is underdetermined. Silence can reflect privacy, fear, uncertainty, irrelevance, fatigue, distrust, linguistic difficulty, interviewer error, institutional constraint, or a participant's judgment that the question is poorly framed.

Interview silence therefore requires the same restraint developed for documentary and archival silence in Sections 7.10 and 7.11. Non-response should not be converted directly into evidence for a hidden relation. The methodological task is to reconstruct the conditions under which the silence occurred and identify what additional evi-

dence could distinguish among plausible interpretations.

Definition 7.131 (Interview-silence profile). An *interview-silence profile* records the form, timing, topic, interactional context, prior and subsequent exchange, participant position, possible disclosure constraints, and comparative evidence relevant to interpreting a silence or omission.

Repeated patterns can strengthen interpretation. If participants from one institutional position consistently avoid a topic that participants elsewhere discuss freely, the pattern may justify inquiry into disclosure risk, category boundaries, shared uncertainty, or institutional norms. The interpretation remains a hypothesis until supported by further evidence. Follow-up interviews, changed wording, alternative interviewers, documentary evidence, observation, or confidential recruitment can help distinguish among explanations.

The researcher also produces silence through interview design. Topics left unasked, categories excluded from the guide, inaccessible participants, time limits, translation constraints, or early coding decisions can create absences later misread as participant silence. This is one reason interview guides and analytic revisions should remain versioned. A later discovery that an important relation was poorly elicited can then be linked to a specific design history.

Silence can also possess ethical meaning. Participants may choose not to disclose information whose revelation could expose themselves or others to harm. Treating such refusal as a technical obstacle would mischaracterize the research relation. In some settings, preserving the boundary of non-disclosure is part of responsible inquiry even when it limits the resulting evidence.

7.13.8 Comparative Interview Analysis

Comparative interview analysis moves from individual accounts toward patterned variation across positions, sites, periods, or relational configurations. Its purpose can include identifying recurring interpretations, comparing experiences of the same institution, tracing relation-specific vocabularies, reconstructing historical change, or examining how relational position shapes knowledge and narrative.

Comparison requires more than placing transcripts side by side. Participants may have received different prompts, occupied different positions, spoken at different historical moments, or used terms with different meanings. A relational comparison should therefore record the dimensions on which accounts are treated as comparable and preserve relevant asymmetries in access and context.

Definition 7.132 (Comparative interview matrix). A *comparative interview matrix* is a structured representation that relates interview claims to participant positions, relational roles, sites, periods, elicitation conditions, evidential domains, and uncertainty so that patterns and divergences can be compared without presuming full equivalence among accounts.

The matrix can support several forms of comparison. Positional comparison asks how accounts vary between managers and workers, providers and users, center and periphery, or insiders and intermediaries. Temporal comparison examines how accounts change before and after an institutional transition. Site comparison considers how a similar formal rule is experienced under different local relational configurations. Within-participant comparison can examine changes across repeated inter-

views or across different narrative domains.

Sampling should follow the relational question. A study of institutional access may need participants occupying distinct gatekeeping, applicant, intermediary, and administrative positions. A study of relational persistence may need participants connected to different phases of the relation's history. A study of disputed meaning may need deliberately heterogeneous interpretive positions. Numerical balance can be useful for some designs, while relational coverage may be more important for others.

Comparative analysis can also combine interviews with the evidential modes developed in preceding sections. Documentary records can clarify formal status, archival inquiry can reconstruct earlier categories, ethnography can reveal enacted practice, and interviews can provide participant interpretation and experience. Divergence among these sources should remain visible where it is analytically meaningful. Triangulation in later Section 194 will develop this coordination more systematically.

AI-assisted analysis can expand the practical scale of interview comparison through transcription, translation, retrieval, thematic grouping, relation extraction, and comparison of narrative segments. These capabilities can enlarge the encounter surface of a large corpus, making unexpected similarities, contradictions, or absences easier to notice. The same tools can also normalize vocabulary, flatten hesitation, mistranslate local categories, or create apparent thematic consistency through model-generated coding. Source-linked review and preservation of the original interview record therefore remain important when an AI-assisted transformation supports a substantive claim.

Contingent encounter and aesthetic judgment retain a distinctive role in interview research. An unexpected phrase, contradiction, metaphor, hesitation, relation named in passing, or surprising similarity across distant participants can make a possible structure salient before the research design contains a category for it. Such moments can motivate revised questions, new comparisons, or reconstruction of the research object. Their value lies in opening inquiry; later evidential work determines whether the perceived relation persists across accounts, contexts, and other forms of evidence.

Proposition 7.133 (Interview reconstruction discipline). *Interview-based relational claims are strengthened when the research record preserves the participant account, the conditions of elicitation, the interpretive transformation, the comparison set, and the inferential bridge connecting the account to the relational claim.*

Proposition 7.133 summarizes the section's methodological orientation. Interview inquiry can contribute unusually rich evidence about experience, memory, meaning, practical knowledge, contested interpretation, and relational history. Its evidential strength increases when these contributions remain differentiated and traceable. Narrative coherence, experiential authority, recollection, silence, and interviewer rapport each support particular kinds of inference under particular conditions. The next section turns to legal inquiry, where formal norms, legal categories, jurisdiction, doctrine, institutional authority, and legal interpretation provide a different mode of access to relational structure.

7.14 Legal Inquiry

Sections 7.10–7.13 developed documentary, archival, ethnographic, and interview-based routes into relational inquiry. The present section examines legal inquiry as a distinct mode of access to relations that are classified, authorized, constrained, enabled, recognized, contested, or transformed through legal institutions. Its role is to specify how legal categories, rights, duties, authority, legal relations, jurisdiction, institutional interpretation, legal change, and legal infrastructures can enter relational research without equating formal legal representation with the full relational configuration in which law operates. The discussion combines analytical jurisprudence, legal reasoning, socio-legal interpretation, and the relational methodology developed earlier in this chapter.

Legal inquiry can contribute several kinds of evidence. A legal text can identify a formally recognized status or rule; a judgment can disclose an institutional interpretation; an administrative decision can instantiate legal authority in a particular case; a contract can constitute obligations among parties; a jurisdictional rule can delimit the competence of an institution; and observed practice can show how formally specified relations are enacted, modified, resisted, or supplemented. These evidential functions overlap, yet they support different claims. Hart's analysis of primary and secondary rules provides one influential account of the institutional organization through which rules can be recognized, changed, and adjudicated Hart 2012. Hohfeld's analysis of legal conceptions offers a more fine-grained vocabulary for relational legal positions such as rights, duties, privileges, powers, liabilities, immunities, and disabilities Hohfeld 1919. McCormick's work on legal reasoning emphasizes interpretation, classification, precedent, analogy, coherence, and defeasibility within institutional argument McCormick 2005. Moore's analysis of semi-autonomous social fields, meanwhile, provides an important socio-legal precedent for examining formal law together with partially autonomous practices of rule formation and compliance Moore 1973.

Within the present framework, these traditions support a layered approach to legal inquiry. Legal norms and classifications belong to manifestational and institutional orders that can condition relational reality, while their practical consequences depend on interpretation, enforcement, organizational capacity, social practice, and historically situated relations. Legal inquiry therefore asks both what a legal order specifies and how that specification enters a relational configuration.

Definition 7.134 (Legal relational inquiry). *Legal relational inquiry* is the reconstruction of relations through legal categories, sources, institutions, interpretations, jurisdictions, and enacted practices, with explicit attention to the distinction between formally specified legal positions and the relational configurations through which those positions are realized, contested, or transformed.

Definition 7.134 gives legal materials a substantive methodological role while preserving ontological and epistemic restraint. A legally recognized relation can be important in its own right, yet a researcher should still specify the source, institutional competence, interpretive pathway, temporal scope, jurisdiction, and evidence connecting formal legal status to the relational claim under study. Table 7.13 summarizes the principal legal operations developed below.

Table 7.13: Legal inquiry operations and characteristic relational access

Legal operation	Primary relational access	Potential analytical contribution	Characteristic uncertainty
Category reconstruction	Legal classifications and status criteria	Identifies how persons, entities, events, and objects become legally intelligible	Category scope, historical change, contested classification
Rights and duties analysis	Correlative or otherwise connected legal positions	Clarifies claims, obligations, permissions, remedies, and institutional recognition	Source hierarchy, exceptions, enforceability, interpretation
Authority analysis	Competence to create, interpret, apply, or revise legal consequences	Reconstructs legal powers and institutional pathways	Delegation, ultra vires action, practical capacity, contested competence
Legal-relations mapping	Structured legal positions among actors and institutions	Connects legal status with relational configuration	Multiplexity, overlapping regimes, practical enactment
Jurisdiction analysis	Spatial, personal, subject-matter, and institutional competence	Specifies where and over whom legal authority is claimed or recognized	Overlap, conflict, extraterritoriality, forum and enforcement limits
Interpretive reconstruction	Institutional reasoning and application of legal materials	Traces how categories and rules acquire operative meaning in cases	Precedent, ambiguity, discretion, institutional variation
Legal-change analysis	Temporal transformation of legal positions and institutions	Reconstructs creation, amendment, reinterpretation, repeal, and transition	Lag, transitional rules, implementation, path dependence
Infrastructure analysis	Legal conditions shaping broader relational possibilities	Shows how law can stabilize, channel, enable, or constrain economic and social relations	Difference between formal design and enacted relational effect

7.14.1 Legal Categories

Legal inquiry often begins with categories. Legal systems classify persons, organizations, assets, transactions, events, territories, statuses, injuries, permissions, and forms of responsibility through terms whose consequences can be considerable. Examples include employee, tenant, creditor, dependent, corporation, resident, public body, regulated entity, beneficial owner, protected work, taxable income, contractual offer, administrative act, and legally relevant harm. Such categories can organize rights, duties, procedures, remedies, evidentiary burdens, eligibility, and institutional competence.

A relational methodology should treat legal categories as historically and institutionally generated specifications. Their presence in authoritative materials may establish how a legal order formally classifies a case, while the research task can extend to how the classification was produced, which relations it recognizes, which relations it leaves weakly represented, and how the category is enacted in practice. This is consistent with the documentary discipline developed in Section 7.10: the existence of a category in a legal text establishes a particular legal manifestation, while further inference is required before the category is treated as a complete description of the relevant social or economic relation.

Legal categories can be constitutive as well as descriptive. Classification as a cor-

poration, spouse, license holder, employee, beneficiary, debtor, or rights holder can alter the legal relations available to an actor. The legal category can therefore enter the causal and generative structure of the field. At the same time, institutional recognition can be incomplete, disputed, or practically difficult to obtain. A classification may be formally available while access to the procedures needed to establish it remains uneven.

Definition 7.135 (Legal-category profile). A *legal-category profile* records the category's authoritative source, criteria of inclusion, exclusions, legal consequences, relevant jurisdiction, temporal validity, interpretive disputes, institutional pathway of recognition, and relation to the empirical object under study.

The profile helps prevent a category from becoming an unexamined analytical primitive. A researcher studying platform work, for example, may encounter several legal and administrative classifications that overlap imperfectly with participants' practical relations. The methodological task is to retain the category's legal consequences while also examining the relations through which work, control, dependence, risk, and remuneration are organized. A similar discipline applies to property, family status, organizational form, migration status, and other domains in which legal categories structure access and obligation.

Category translation also requires care in comparative and historical research. A term may have different doctrinal content across jurisdictions or periods even when translated by the same English label. Conversely, differently named categories may perform partially comparable legal functions. Comparative inquiry therefore benefits from reconstructing category criteria and consequences before assuming equivalence.

7.14.2 Rights

Rights provide one of the most important relational objects in legal inquiry. A right can connect a rights holder to another actor, an institution, a protected domain, a procedure, or a remedy. Hohfeld's analysis is useful here because it differentiates several legal positions that ordinary language frequently groups under the language of rights Hohfeld 1919. The distinction between claim-rights, privileges, powers, and immunities, together with their correlatives, provides a disciplined starting point for relational reconstruction.

Within GRE and broader GR inquiry, rights should be analyzed through several dimensions. The first concerns the legal position itself: what conduct, status, claim, competence, or protected domain is recognized? The second concerns the correlated position of other actors or institutions. The third concerns institutional realization: which body recognizes, enforces, adjudicates, or remedies the right? The fourth concerns access: what procedures, resources, evidence, standing, language, time, or representation are needed to make the right practically usable? The fifth concerns interaction with other legal and non-legal relations.

This distinction is particularly important when formal rights and practical capabilities diverge. A right can exist as a legally recognized position while its practical exercise remains costly, uncertain, delayed, or dependent on intermediaries. The resulting research question is not whether the formal right is unreal. The question is how formal recognition interacts with access, institutional capacity, social relations, and material conditions.

Rights can also be multiplex. The same relation may include property rights, contractual rights, procedural rights, informational rights, organizational rights, and public-law protections. These positions can reinforce or constrain one another. A research design should therefore specify which legal position is under study and avoid compressing several distinct rights into a single variable unless the aggregation is substantively justified.

Rights also possess temporal structure. They can vest, expire, be suspended, waived, transferred, inherited, limited, or altered through later legal acts. A longitudinal study should therefore link rights analysis to the persistence methodology developed in Section 7.8. The continued use of the same legal label may coexist with changes in scope, remedy, institutional interpretation, or practical accessibility.

7.14.3 Duties

Duties provide a complementary route into legal relations. They can require action, restraint, disclosure, care, payment, performance, compliance, or the fulfillment of a procedural condition. The relational importance of a duty depends partly on the actor to whom it is owed, the institution capable of determining breach, the consequences attached to breach, and the legal setting within which performance is evaluated.

A duty should therefore be reconstructed with greater specificity than a binary indicator of obligation. Relevant dimensions may include the duty bearer, beneficiary or protected interest, triggering conditions, content of performance, temporal requirements, standards of conduct, exceptions, defenses, monitoring arrangements, remedies, and institutional pathway of enforcement. Some duties operate primarily through *ex post* adjudication; others are embedded in licensing, supervision, reporting, fiduciary relations, professional regulation, contractual governance, or administrative procedure.

The connection between rights and duties can be analytically powerful, yet the relation should not be generalized mechanically. Hohfeld's claim-right and duty correlation provides a precise legal structure for a particular class of legal positions Hohfeld 1919. Other positions, such as privileges, powers, and immunities, have different correlatives. A relational legal methodology therefore benefits from identifying the specific legal position before inferring the structure of the corresponding relation.

Duties can also be distributed across institutional levels. A statute may assign a duty to an organization, internal rules may allocate performance among units, and practical execution may depend on frontline staff, software systems, contractors, or professional judgment. A failure at the point of delivery can therefore arise from several relational locations. Multiscale inquiry from Section 7.5 is useful here: organizational duty, delegated authority, operational responsibility, and individual action may occupy different scales while remaining connected through an institutional pathway.

The same approach helps distinguish legal responsibility from causal contribution or moral responsibility. These concepts can overlap while remaining analytically different. A legal inquiry should identify the rule and institutional basis through which responsibility is attributed before extending the claim into broader normative or causal analysis.

7.14.4 Authority

Authority concerns legally recognized competence to create, interpret, apply, modify, or determine legal consequences. It can attach to legislatures, courts, administrative agencies, local authorities, private bodies exercising delegated functions, corporate organs, arbitrators, contractual decision makers, and other institutions whose acts receive legal significance. Hart's distinction between primary rules and secondary rules is relevant because secondary rules help organize recognition, change, and adjudication within a legal system Hart 2012.

For relational inquiry, legal authority is best reconstructed as a pathway rather than assumed from institutional title alone. A body may possess formal competence while practical decision-making is distributed through delegation, procedure, professional interpretation, information systems, budgetary constraints, and review mechanisms. Conversely, an actor may exercise substantial practical influence without possessing the legal competence to make a binding determination.

Definition 7.136 (Authority pathway). An *authority pathway* is a traceable sequence connecting a legally recognized competence to the actors, procedures, delegations, interpretations, records, and review mechanisms through which that competence is exercised in a particular relational setting.

Authority-pathway reconstruction can expose several forms of divergence. Formal competence may be delegated; delegated competence may be constrained by procedure; procedural discretion may be shaped by institutional guidance; automated systems may structure available choices; and review bodies may alter the practical meaning of an initial decision. These layers are especially relevant when legal authority intersects with economic allocation, licensing, welfare administration, employment, taxation, migration, financial regulation, or platform governance.

Authority also has boundaries. A decision can exceed competence, apply only to specified persons or subjects, depend on a valid delegation, or become effective only after procedural requirements are satisfied. Research should therefore connect authority to jurisdiction, source hierarchy, and institutional interpretation rather than treating legal power as a free-standing actor attribute.

The distinction between authority and influence is equally important. Political, economic, professional, reputational, or technological power may shape a legal decision without itself constituting legal authority. Later GRE analysis of power can examine these interactions, while legal inquiry specifies which actions receive legally recognized competence and consequence.

7.14.5 Legal Relations

The previous subsections provide components for reconstructing legal relations. A legal relation can connect persons, organizations, public bodies, assets, territories, procedures, or legally constituted positions through rights, duties, powers, liabilities, immunities, statuses, permissions, prohibitions, and remedies. The relation can be bilateral, multilateral, nested, institutional, or higher-order. It can also intersect with social, economic, symbolic, technological, or organizational relations that are only partially captured by legal categories.

Hohfeld's framework offers a classic demonstration that legal positions can be analyzed relationally rather than as isolated attributes Hohfeld 1919. The present

methodology extends that insight toward empirical reconstruction. A researcher can ask which legal positions exist, which sources establish them, which institutions interpret them, how they are recognized or enforced, and how they interact with the wider relational configuration.

Definition 7.137 (Legal-relation profile). A *legal-relation profile* records the relevant legal positions, relata, authoritative sources, jurisdiction, temporal scope, institutional interpreters, enforcement or remedy pathways, practical enactment, intersecting non-legal relations, and significant uncertainties associated with a legal relation.

This profile is useful when formal legal relation and empirical relation do not align neatly. An employment relation, for example, can contain contractual positions, statutory protections, managerial authority, economic dependence, workplace norms, professional obligations, technological monitoring, and informal expectations. Legal analysis can specify some of these dimensions with considerable precision while leaving others to ethnographic, interview, documentary, quantitative, or institutional inquiry.

Legal relations can also be higher-order. A guarantee can condition a credit relation; corporate law can constitute decision-making positions that organize contractual relations; procedural law can determine how substantive claims are recognized; insolvency rules can reorder relations among multiple creditors; and jurisdictional rules can determine which institution may interpret a disputed relation. Section 7.9 provides a general framework for such relations among relations.

A relational legal map should therefore preserve multiplexity. Collapsing several legal and non-legal relations into a single edge may conceal the mechanism through which law becomes consequential. When simplification is analytically useful, the omitted dimensions can be retained as characterization or configuration remainders for later analysis.

7.14.6 Jurisdiction

Jurisdiction specifies a dimension of legal boundary construction. It concerns the competence of institutions to make, interpret, adjudicate, administer, or enforce legal consequences with respect to persons, territory, subject matter, transactions, or other legally defined connections. Jurisdiction is therefore closely connected to the boundary methodology developed in Section 7.4, while adding a specifically legal account of competence and legal reach.

A jurisdictional analysis can distinguish several dimensions. Territorial jurisdiction concerns legally relevant spatial connections. Personal jurisdiction concerns persons or entities subject to an institution's competence. Subject-matter jurisdiction concerns the kinds of disputes or decisions an institution may address. Temporal jurisdiction concerns when competence applies. Functional jurisdiction can distinguish law-making, adjudication, administration, review, and enforcement. These dimensions can overlap without being identical.

Cross-border and multilevel relations make jurisdiction especially important. A single economic relation may engage contract law, tax law, labor law, corporate law, data regulation, financial regulation, public law, or international legal arrangements across several institutional levels. The applicable legal relation can therefore depend on connecting factors, choice-of-law rules, forum, recognition, enforcement, organi-

zational structure, and the practical location of activities or assets.

Definition 7.138 (Jurisdictional scope profile). A *jurisdictional scope profile* records the institution claiming or exercising competence, the legal basis of that competence, its territorial, personal, subject-matter, temporal, and functional scope, relevant overlaps or conflicts, and the practical conditions of recognition and enforcement.

The profile helps distinguish legal reach from practical reach. A legal order may assert competence while enforcement remains difficult; an organization may structure activity across several jurisdictions; or a transnational relation may be governed through overlapping public and private legal arrangements. The presence of jurisdictional complexity can itself become a relational finding, particularly when actors reorganize transactions, organizational forms, data flows, or contractual positions in response to differences among legal regimes.

Jurisdiction is also scale-sensitive. Local, regional, national, supranational, international, organizational, and contractual ordering can interact. A multiscale study should specify the pathways through which rules and decisions at one level become consequential at another rather than assuming direct transmission.

7.14.7 Institutional Interpretation

Legal materials acquire operative meaning through institutional interpretation. Statutes, regulations, precedents, contracts, administrative guidance, constitutional provisions, and other legal sources can contain ambiguity, open texture, conflicting principles, exceptions, or classification problems. MacCormick's analysis of legal reasoning is useful here because it treats interpretation, precedent, analogy, coherence, consequences, and defeasibility as structured components of legal argument rather than reducing legal judgment to mechanical deduction MacCormick 2005.

For relational inquiry, interpretation matters because a formally stated rule can support several possible applications before an institution resolves or narrows the question. Courts, agencies, arbitrators, administrative officials, corporate counsel, regulators, and other legal actors can develop interpretive practices that condition how categories and relations are realized. These practices may themselves vary across institutional levels, periods, or types of case.

An institutional interpretation should therefore be reconstructed through the source material and argumentative pathway supporting it. Relevant evidence can include authoritative decisions, reasoning, precedent, procedural posture, interpretive guidance, administrative practice, later review, and patterns across cases. A research design should distinguish the researcher's interpretation of a legal source from an interpretation adopted by an institution with legally recognized competence.

Definition 7.139 (Institutional interpretation chain). An *institutional interpretation chain* records the legal materials, interpretive claims, institutional actors, procedural setting, reasons, precedential or administrative relations, later review, and practical consequences through which a legal meaning becomes operative in a specified context.

This chain is particularly useful when legal interpretation changes incrementally. A formal text can remain stable while accumulated decisions, guidance, enforcement practices, or institutional conventions alter its effective meaning. Longitudinal legal inquiry should therefore track interpretive history alongside textual amendment.

Comparative interpretation requires similar caution. Two institutions may cite similar language while applying different doctrinal tests or evidentiary assumptions. Conversely, different legal vocabularies may produce partially comparable functional outcomes. The methodology should preserve these differences until the basis of comparison is explicit.

AI-assisted legal research can expand retrieval across cases, statutes, regulations, administrative materials, and contracts, and can help identify patterns of citation or interpretation. These tools can also compress contested reasoning into generated summaries, miss jurisdictional hierarchy, conflate current and superseded law, or produce plausible legal propositions without adequate source support. Source-linked verification, temporal validity, jurisdictional scope, and institutional authority therefore remain central when AI-assisted transformations support a legal claim.

7.14.8 Legal Change

Legal relations evolve through legislation, amendment, repeal, judicial interpretation, administrative rulemaking, contractual revision, constitutional change, institutional reorganization, and shifts in recognized practice. Legal change can therefore alter categories, rights, duties, authority, jurisdiction, remedies, and the institutional pathways through which legal positions are realized.

A relational approach distinguishes several temporal moments. A new legal rule can be formally adopted at one time, enter into force at another, receive implementing regulations later, become interpreted through subsequent cases, and produce uneven changes in organizational practice over a longer interval. The date of legal change is therefore often multidimensional. A research design should specify whether it studies enactment, legal effectiveness, institutional interpretation, compliance, organizational adaptation, or broader relational consequences.

Moore's analysis of the semi-autonomous social field provides a useful reminder that formal legal change enters fields that may possess their own rule-making practices, enforcement arrangements, and capacities for adaptation Moore 1973. The empirical effect of a legal reform can therefore depend on how organizations, professional groups, communities, markets, families, or other relational configurations interpret and absorb it. This does not diminish the legal significance of formal reform; it clarifies the additional pathways through which legal change becomes social and economic change.

Definition 7.140 (Legal-change profile). A *legal-change profile* records the formal legal transition, effective dates, transitional rules, affected legal positions, interpretive developments, implementation pathways, organizational adaptation, enforcement conditions, and observed relational consequences relevant to the research question.

The profile helps distinguish textual continuity from relational continuity and textual change from relational transformation. A new statute may leave some practices largely stable; a reinterpretation of an existing rule may substantially alter institutional behavior; an administrative change may reshape practical access without changing the underlying statutory text. Historical and archival methods from Sections 7.10 and 7.11 can help reconstruct these trajectories.

Legal change also invites scale analysis. A national reform can be implemented differently across organizations or localities, while local institutional innovations can later influence wider legal development. The cross-scale pathways should be demon-

strated through evidence rather than inferred from temporal sequence alone.

7.14.9 Law as Relational Infrastructure

The preceding analysis supports a broader methodological use of law within GR and GRE. Law can be investigated as relational infrastructure: a set of categories, statuses, rights, duties, powers, procedures, jurisdictions, remedies, and institutional practices that conditions which relations can be formed, stabilized, transformed, contested, or dissolved. This infrastructural perspective is particularly relevant to economic inquiry because property, contract, corporate organization, employment, finance, taxation, public administration, insolvency, intellectual property, and regulation can structure access, authority, risk, transfer, accountability, and value conversion.

Treating law as relational infrastructure requires two forms of restraint. First, formal legal structure should retain its specificity. Legal categories and institutional decisions can have consequences that should not be translated away into generic social relations. Second, formal law should not be presumed to exhaust the relational field. Moore's semi-autonomous-field analysis illustrates how social fields can develop rule-making and compliance practices while remaining situated within wider legal and political orders Moore 1973. Ethnographic, interview, documentary, archival, quantitative, and institutional inquiry can therefore complement doctrinal analysis by examining how legal infrastructures are enacted in particular settings.

Proposition 7.141 (Legal-infrastructure reconstruction). *Relational inquiry into law is strengthened when legal categories and authoritative sources are reconstructed together with jurisdiction, institutional interpretation, implementation pathways, practical access, and the wider configuration in which legal positions become consequential.*

Proposition 7.141 does not imply that each legal study requires a full socio-legal reconstruction. The appropriate depth depends on the research question. A doctrinal question may center on authoritative sources and institutional reasoning. An economic or organizational question may require closer attention to implementation, access, enforcement, and informal ordering. A historical question may require reconstruction of changing legal categories and institutional competence. The methodological requirement is correspondence between the claim and the evidential layers on which it depends.

Legal inquiry also provides a strong example of the distinction between relation identification and relation characterization developed in Sections 7.6 and 7.7. A legal source may establish that a recognized position exists, while its intensity, accessibility, dependence, asymmetry, practical meaning, or interaction with other relations can require additional evidence. Likewise, formal legal continuity can coexist with substantial change in interpretation or enactment, linking legal inquiry to the persistence analysis of Section 7.8.

Contingent encounter and aesthetic judgment can contribute to legal inquiry at the stage of orientation. An unexpected doctrinal distinction, unusual case, jurisdictional mismatch, anomalous administrative pattern, old legal category, or contradiction between formal status and lived practice can make a relational problem salient before its significance is fully understood. Subsequent legal and empirical inquiry can determine whether the encounter reveals a broader structure, a local exception, a transitional artifact, or a misclassification. AI-mediated access may substantially enlarge this encounter surface by making large bodies of legal material searchable and com-

parable, while the abundance of candidate analogies and generated interpretations increases the importance of source authority, jurisdiction, temporal validity, and responsible judgment.

Legal inquiry therefore contributes a distinctive evidential layer to relational methodology. It can identify institutionally recognized positions with considerable precision while also revealing the procedures through which categories, authority, jurisdiction, and legal change are produced. The next section turns to institutional inquiry, where the analysis broadens from specifically legal ordering toward the rules, routines, authority structures, practices, and organizational conditions through which institutions organize relational fields.

7.15 Institutional Inquiry

Section 7.14 examined legal inquiry through categories, rights, duties, authority, jurisdiction, interpretation, and legal change. The present section broadens the methodological field from specifically legal ordering to institutional inquiry. Its role is to specify how researchers can reconstruct the rules, roles, memberships, authority relations, coordination mechanisms, memories, boundaries, and transformations through which an institution organizes recurrent relations. The objective is methodological rather than definitional: the section does not seek a single universal essence of institution, but develops a research architecture for identifying how institutional order is manifested, enacted, reproduced, contested, and revised in a specified field.

Institutional inquiry sits at the intersection of several traditions. North's account of institutions as humanly devised constraints emphasizes formal rules, informal constraints, enforcement characteristics, and historically consequential institutional change North 1990. Ostrom's work on collective-action institutions demonstrates the importance of reconstructing rules in use, monitoring, participation, and locally organized governance rather than assuming a simple contrast between centralized administration and privatization Ostrom 1990. DiMaggio and Powell show that organizations situated in organizational fields can become more similar through coercive, mimetic, and normative pressures, indicating that institutional organization can extend beyond the internal rule structure of a single organization DiMaggio and Powell 1983. Nelson and Winter's evolutionary analysis further illustrates how routines can carry organizational competence and historical continuity while remaining subject to search and change Nelson and Winter 1982. These traditions differ in object and explanatory emphasis, yet they provide compatible methodological resources for reconstructing institutional relations across formal, informal, organizational, and historical dimensions.

Within the present framework, an institution is approached through ontological suspension. A researcher may reconstruct an institution through rules, roles, routines, expectations, authority, infrastructures, symbols, records, and patterns of coordination without treating one representation as the institution's final ontology. Chapter 4's distinction among ontological, relational, and manifestational reality remains relevant: statutes, policies, organization charts, procedures, meeting records, routines, narratives, access systems, and observed practices provide different manifestations through which institutional relations become researchable. Chapter 5's epistemic discipline likewise remains active. The existence of an institutional document,

Table 7.14: Institutional inquiry dimensions and characteristic evidential questions

Dimension	Relational object	Characteristic evidence	Primary uncertainty
Formal rules	Codified permissions, obligations, procedures, competences	Statutes, policies, contracts, procedures, official guidance	Interpretation, implementation, temporal validity
Informal rules	Expectations, conventions, sanctions, tacit permissions	Observation, interviews, correspondence, recurrent practice	Visibility, contestation, local variation
Organizational roles	Structured positions with differentiated tasks and authority	Role descriptions, workflow, practice, delegation, records	Gap between prescribed and enacted role
Membership	Conditions of inclusion, participation, recognition, and exit	Registers, eligibility criteria, practice, self-identification	Ambiguous status, layered participation, exclusion
Authority relations	Recognized capacities to decide, direct, allocate, interpret, or sanction	Legal sources, delegation, decisions, practice, compliance	Formal competence versus effective authority
Coordination	Mechanisms aligning differentiated activity	Procedures, routines, meetings, technologies, shared standards	Informal repair, hidden work, coordination failure
Institutional memory	Carriers of historically accumulated routines and knowledge	Archives, records, routines, personnel, infrastructures	Loss, selective preservation, reinterpretation
Institutional boundaries	Conditions separating and connecting institutional domains	Jurisdiction, membership, access systems, interfaces, practice	Permeability, overlap, cross-boundary dependence
Institutional change	Change in rules, roles, authority, coordination, memory, or boundaries	Longitudinal documents, decisions, practice, comparative traces	Pace, causation, continuity, uneven implementation

recurring practice, or recognized role can support a bounded claim while leaving other dimensions of institutional organization unresolved.

Definition 7.142 (Institutional relational inquiry). *Institutional relational inquiry* is the reconstruction of recurrently organized relations through formal and informal rules, roles, membership conditions, authority, coordination mechanisms, memory, boundaries, material and symbolic infrastructures, and processes of reproduction and transformation, with explicit attention to the evidential pathways through which these dimensions become observable.

Definition 7.142 treats institutional order as a configuration that may be partially visible through several kinds of evidence. Documentary and legal sources can identify prescribed rules and formal competence. Ethnographic and interview evidence can reveal rules in use, tacit expectations, informal authority, and practical coordination. Administrative and digital records can disclose recurring sequences, access conditions, and organizational outputs. Historical and archival materials can reconstruct formation, sedimentation, and change. Quantitative and network methods can characterize distributions, positions, flows, and patterned interaction. Institutional inquiry therefore provides a particularly clear case for the methodological pluralism developed in Section 7.2.

Table 7.14 summarizes the principal dimensions developed below.

7.15.1 Formal Rules

Formal rules provide one of the most visible manifestations of institutional order. Constitutions, statutes, regulations, bylaws, policies, contracts, procedural manuals, eligibility criteria, technical standards, and official protocols can specify positions, permissions, obligations, decision pathways, sanctions, and recognized forms of participation. North's institutional analysis gives formal rules a central role while placing them alongside informal constraints and enforcement characteristics North 1990. For relational inquiry, the methodological value of a formal rule lies in the structured relation it specifies and in the institutional processes through which that specification becomes consequential.

A formal rule can support several distinct claims. It may establish that an institution officially recognizes a category or procedure. It may define a competence or obligation. It may specify a sequence by which decisions are expected to be made. It may condition access to a resource, status, remedy, or organizational position. These claims remain different from claims concerning practical implementation. A written procurement rule can specify who is authorized to approve expenditure while empirical inquiry reveals how approvals are negotiated, delayed, delegated, or informally anticipated. A formal membership rule can identify eligibility while enacted practice determines whether prospective members can enter on comparable terms.

The legal methodology of Section 7.14 is particularly useful for institutions whose formal rules have legal status, yet institutional inquiry often extends further. An organizational policy may lack the status of public law while still shaping access and coordination. A technical standard may influence behavior through procurement, interoperability, certification, or professional expectation. A platform rule may govern participation through software implementation. The evidential question is therefore broader than legal validity: the researcher asks how the rule is authorized, communicated, interpreted, enforced, monitored, modified, and embedded in surrounding relations.

Definition 7.143 (Formal-rule profile). A *formal-rule profile* records the rule's source, authorized issuer, domain of application, targeted positions, permissions or obligations, implementation pathway, enforcement arrangement, temporal validity, interpretive variation, and relation to observed practice.

The profile supports comparison between prescribed institutional architecture and enacted institutional relations. It also helps with historical inquiry. A rule may persist textually while its interpretation, enforcement, or organizational significance changes. Conversely, practical reorganization may precede later codification. The temporal relation between rule and practice should therefore be reconstructed rather than inferred from publication dates alone.

7.15.2 Informal Rules

Institutional order frequently includes expectations that are weakly codified or absent from formal documentation. Informal rules can concern appropriate conduct, sequencing, reciprocity, deference, acceptable exceptions, trusted intermediaries, reputational consequences, and practical interpretations of formal procedure. North explicitly includes informal constraints within institutional analysis North 1990, while Ostrom's empirical work on collective-action institutions illustrates how rules in use

can depend on locally understood arrangements, monitoring practices, and participant knowledge Ostrom 1990.

Methodologically, informal rules are difficult because they can be both consequential and weakly visible. Researchers may infer them from repeated practice, sanctions, correction of newcomers, stable expectations, narrative accounts, or patterned departures from formal procedure. A single observed deviation rarely establishes an informal rule. Repeated coordination around the same expectation, recognition by participants, or recurrent sanction for violation can provide stronger evidence.

Informal rules also vary in explicitness. Participants may articulate a convention when prompted, even though it is absent from written policy. Other expectations may be tacit and become visible mainly when disrupted. A meeting norm, for example, can remain unnoticed until a participant violates expected speaking order. A tacit eligibility criterion may become visible when a formally qualified applicant is repeatedly excluded. Such episodes can create the contingent encounters discussed in Chapter 6: disruption makes a background relation salient, after which ethnographic, interview, documentary, or comparative inquiry can test whether the apparent pattern has wider institutional significance.

Definition 7.144 (Informal-rule reconstruction). An *informal-rule reconstruction* identifies a recurrent expectation or constraint through convergent evidence concerning practice, participant recognition, sanction, correction, coordination, or patterned consequence, while recording the setting and population within which the reconstruction is supported.

Definition 7.144 preserves scope discipline. A convention observed in one team may remain local. A professional norm may travel across organizations. A community practice may interact with state law while retaining partially autonomous enforcement. The researcher should therefore report the relational neighborhood and scale at which the informal rule appears operative.

Formal and informal rules can reinforce, reinterpret, or conflict with one another. Institutional inquiry benefits from representing these relations explicitly. A formal prohibition can coexist with tolerated exceptions; an informal expectation can make a formally optional practice effectively obligatory; an informal workaround can compensate for a rigid formal procedure. Such configurations are analytically richer than a binary coding of compliance and non-compliance.

7.15.3 Organizational Roles

Roles provide a practical interface between institutional rules and differentiated action. Positions such as director, caseworker, committee chair, reviewer, member, regulator, teacher, analyst, administrator, or volunteer can organize expectations concerning competence, access, responsibility, information, and coordination. A role is therefore more than an individual attribute. It is a relational position whose meaning depends on surrounding rules, counterpart positions, authority arrangements, and institutional purpose.

Institutional inquiry should distinguish the *prescribed role* from the *enacted role*. Job descriptions, statutes, organizational charts, delegation instruments, and workflow documents can specify expected functions. Observation, interviews, correspondence, decision records, and digital traces can reveal how the position operates in practice. Differences between these layers can be substantively important. A for-

mally junior position may coordinate crucial information flows. A nominally supervisory position may exercise limited practical control. A role can acquire brokerage functions that appear nowhere in the organization chart.

Definition 7.145 (Institutional role profile). An *institutional role profile* records a role's formal definition, expected tasks, authority, access rights, counterpart relations, accountability, practical routines, discretionary space, and observed departures from formal specification.

Role reconstruction also supports cross-scale analysis. A role can connect individual action to organizational and institutional structure. A caseworker's discretionary judgment, for example, may be shaped by organizational targets, professional norms, legal rules, information systems, and resource constraints. Treating the role as a bridge across these relations can reveal how institutional conditions become locally enacted without assuming that broad rules determine each local decision.

Roles can persist through personnel turnover, which makes them important for institutional continuity. At the same time, repeated enactment can transform the role itself. New technologies can relocate tasks; reform can alter competence; informal expectations can expand or narrow discretion; crisis can create temporary responsibilities that later become stabilized. Longitudinal inquiry should therefore track role identity and role transformation separately from the identity of individual occupants.

7.15.4 Membership

Membership specifies who is recognized as belonging to, participating in, or being governed through an institutional arrangement. Membership can be formal, contractual, professional, organizational, civic, associative, platform-based, or informally recognized. It can confer access, voice, obligations, protections, identity, eligibility, and exposure to institutional authority. It can also establish differentiated classes of participation.

A membership relation should be reconstructed through its conditions of entry, recognition, participation, suspension, exit, and exclusion. Formal registers may provide strong evidence of recognized membership, while practical participation can extend beyond the register. Contractors, caregivers, advisers, affiliates, former members, family members, clients, platform users, or affected communities may occupy consequential relational positions without fitting a simple member/non-member division. Institutional boundaries therefore often depend on layered participation rather than a single categorical edge.

Definition 7.146 (Membership profile). A *membership profile* records formal and practical conditions of entry, recognized status, participation rights, obligations, access, voice, exit, suspension, exclusion, and relevant intermediate or affiliated positions.

Membership is also a site of power and epistemic visibility. Institutions frequently know more about recognized members than about peripheral or excluded actors. Administrative systems can therefore reproduce the institution's own membership ontology in research data. Section 7.10's documentary discipline applies directly: the absence of an actor from an institutional register can mean non-membership, incomplete registration, informal participation, exclusion from the record, or a different category of affiliation.

Changes in membership can alter institutional organization. Expansion may require new coordination mechanisms; professionalization may create new eligibility standards; digital participation may blur territorial membership; exclusion can redistribute voice and dependence. For this reason, membership is both an institutional relation and a potential mechanism of institutional transformation.

7.15.5 Authority Relations

Authority relations organize recognized capacities to decide, direct, interpret, allocate, authorize, review, or sanction within an institutional configuration. Section 7.14 examined legal authority through competence and jurisdiction. Institutional inquiry broadens the question to include organizational and informal authority, while preserving the distinction between recognized authority and practical influence.

A formal hierarchy can identify who is authorized to make a decision, yet the effective decision process may involve advisers, technical experts, informal gatekeepers, information holders, or external funders. Conversely, an actor can possess considerable influence without holding recognized authority. Methodological precision therefore benefits from separating *authority*, *influence*, *control over resources*, *expertise*, and *dependence* when the evidence permits.

Definition 7.147 (Institutional authority pathway). An *institutional authority pathway* records the positions through which a decision or directive is authorized, interpreted, communicated, implemented, reviewed, and potentially contested within a specified institutional setting.

This pathway can reveal where authority is transformed as it moves across scales. A governing body may adopt a policy, a managerial layer may translate it into procedures, frontline actors may interpret those procedures, and participants may encounter the result through local practice. Divergence along the pathway can be analytically significant without implying that one layer alone represents the institution.

Institutional authority can also be distributed. Ostrom's analysis of self-governed arrangements shows that monitoring, rule modification, and collective decision capacities can be organized among participants rather than concentrated in one hierarchical center Ostrom 1990. Distributed authority should therefore be reconstructed through actual decision rights, monitoring relations, revision procedures, and recognized competence rather than inferred from the absence of centralized command.

7.15.6 Coordination

Institutions organize differentiated activity through coordination. Coordination can occur through hierarchy, routines, schedules, standards, markets, committees, professional conventions, shared infrastructures, information systems, interpersonal adjustment, or combinations of these mechanisms. A relational methodology studies how these mechanisms connect actors, tasks, resources, information, and temporal sequences.

Coordination is often easiest to observe when it fails. Delay, duplication, contradictory instruction, missing information, bottlenecks, improvised repair, and recurrent exception handling can reveal dependencies that remain invisible during routine operation. Such breakdowns can therefore function as diagnostic encounters. Their significance should be tested through repeated observation, workflow reconstruction,

interviews, records, or comparative cases rather than generalized from a single disruption.

Definition 7.148 (Coordination configuration). A *coordination configuration* records the actors, tasks, resources, information channels, sequencing arrangements, standards, decision points, feedback mechanisms, and repair practices through which differentiated institutional activity is aligned.

The configuration can contain both formal and informal elements. A formal workflow may depend on tacit knowledge about whom to contact when a case does not fit the standard category. A standardized information system may coordinate across departments while creating new dependencies on data quality and technical access. A meeting procedure may allocate speaking turns while actual coordination occurs through pre-meeting negotiation. These layers can be reconstructed jointly without collapsing their evidential differences.

Coordination also connects institutional inquiry to organizational fields. DiMaggio and Powell's account of coercive, mimetic, and normative isomorphism shows how organizational practices can converge through field-level pressures DiMaggio and Powell 1983. Similarity across organizations may therefore arise through shared standards, professional training, regulatory expectations, uncertainty, or inter-organizational dependence. Comparative inquiry should examine the pathway producing similarity before treating convergence as evidence of common efficiency or common causal mechanism.

7.15.7 Institutional Memory

Institutions persist partly through carriers of memory. Records, archives, routines, procedures, personnel, technologies, buildings, classification systems, professional communities, symbols, and recurrent narratives can preserve knowledge about how tasks have been performed, how exceptions have been handled, which distinctions matter, and which historical experiences remain institutionally salient. Nelson and Winter's evolutionary analysis treats routines as important carriers of organizational continuity and change Nelson and Winter 1982; the broader methodological point is that institutional memory can reside in several relational and material forms.

Institutional memory should not be treated as a complete archive of the past. Preservation is selective. Staff turnover can remove tacit knowledge. Data migration can alter records. Reorganization can disconnect routines from their historical rationale. A policy can survive after participants forget why it was introduced. Conversely, narratives about institutional history can remain influential even when their documentary basis is partial or contested. Section 7.11's archival methodology therefore provides an important complement to institutional inquiry.

Definition 7.149 (Institutional memory profile). An *institutional memory profile* identifies the principal carriers of retained knowledge, the practices through which that knowledge is accessed and transmitted, known losses or discontinuities, competing historical interpretations, and the present decisions or routines conditioned by the retained material.

Memory can support stability and adaptation. Stored procedures can reproduce established practice; historical case records can support learning; experienced personnel can interpret ambiguous rules; accumulated technical infrastructure can constrain redesign. Institutional memory can also preserve outdated categories or rou-

tines whose original conditions have changed. Methodologically, persistence should therefore be distinguished from continued adequacy.

AI systems increasingly participate in institutional memory through search, summarization, retrieval, workflow assistance, and automated decision support. These systems can enlarge practical access to records while also embedding corpus limitations, metadata structures, retrieval priorities, or outdated materials into present coordination. An AI-mediated memory claim should therefore retain provenance to the underlying institutional records and their temporal status.

7.15.8 Institutional Boundaries

Institutional boundaries specify domains of membership, authority, competence, responsibility, access, and coordination. They can be legal, organizational, territorial, professional, technical, or symbolic. Section 7.4 developed boundary construction as a general methodological problem; institutional inquiry applies that discipline to boundaries that are themselves part of the object under study.

An institution can possess several overlapping boundaries. Legal jurisdiction may exceed organizational membership. Information-system access may be narrower than formal responsibility. A professional community may extend across multiple employers. Funding relationships can connect formally separate organizations. Families, contractors, volunteers, clients, vendors, regulators, or partner institutions may occupy consequential positions at the institutional edge. Granovetter's analysis of embedded economic action provides one influential reminder that organizational and economic activity can be conditioned by ongoing social relations that cross formal organizational boundaries Granovetter 1985.

Definition 7.150 (Institutional boundary profile). An *institutional boundary profile* records the domains of membership, authority, resource access, information access, responsibility, jurisdiction, and practical interaction, together with interfaces and cross-boundary relations that connect the institution to surrounding fields.

Boundary permeability is often consequential. A university, firm, ministry, association, or platform can be formally distinct while depending on external expertise, finance, infrastructure, regulation, labor, or information. Institutional inquiry should therefore distinguish the boundary of formal organization from the boundary of the process being studied. This distinction becomes especially important in economic inquiry, where ownership, control, production, financing, labor, regulation, and value capture can span different organizational boundaries.

Boundary change can itself be an institutional event. Outsourcing moves activities across organizational edges; merger changes membership and authority; digitization creates new technical interfaces; decentralization relocates competence; internationalization introduces overlapping jurisdictions. Longitudinal analysis should record which boundary dimension changed rather than treating institutional expansion or contraction as a single scalar variable.

7.15.9 Institutional Transformation

Institutional transformation concerns change in the organized relations through which an institution persists. Such change can involve formal rules, informal expectations, roles, membership, authority, coordination, memory, boundaries, or

combinations of these dimensions. North emphasizes the historical significance of incremental institutional change and the interaction between formal rules, informal constraints, and enforcement North 1990. Evolutionary and field perspectives likewise suggest that institutional change can emerge through adaptation, search, competition, imitation, professionalization, crisis, or altered interdependence Nelson and Winter 1982; DiMaggio and Powell 1983.

A methodological difficulty arises because institutional transformation can be uneven. Formal reform may occur rapidly while routines change slowly. Membership can expand before authority arrangements adapt. New technologies can alter coordination while legal categories remain stable. Informal practice can shift before official policy recognizes the change. Section 7.5's multiscale discipline is useful here: transformation can occur at one scale while continuity remains visible at another.

Definition 7.151 (Institutional transformation profile). An *institutional transformation profile* records the dimensions of institutional organization that change, the temporal sequence of change, principal continuity carriers, relevant triggers and pressures, implementation pathways, cross-scale effects, contested interpretations, and evidence concerning stabilization or further revision.

The profile helps distinguish institutional change from institutional replacement. A relation may preserve historical lineage while roles, authority, routines, and boundaries are substantially reconfigured. Conversely, a renamed organization may retain many of the same institutional relations. The identity analysis developed in Section 7.8 therefore applies directly to institutions: continuity should be argued through specified carriers rather than inferred from labels alone.

Institutional transformation can also produce feedback into the categories through which researchers observe the institution. A reform may change record-keeping systems, membership definitions, reporting units, or organizational boundaries. Apparent longitudinal change can therefore reflect both substantive transformation and changing measurement architecture. Documentary, archival, quantitative, and qualitative evidence should be compared when these effects are plausible.

Proposition 7.152 (Layered institutional reconstruction). *Institutional claims are strengthened when formal rules, informal rules, roles, membership, authority, coordination, memory, boundaries, and historical transformation are reconstructed at the level relevant to the research question, while differences among these evidential layers remain visible.*

Proposition 7.152 provides the section's methodological synthesis. Institutional inquiry does not require maximal reconstruction of each dimension. A study of authority may focus on competence, delegation, decision pathways, and implementation. A study of institutional memory may emphasize archives, routines, personnel, and technical systems. A study of membership may center on entry, voice, exclusion, and exit. The appropriate depth depends on the claim. What matters is that institutional language does not substitute for the relational specification on which the claim depends.

This layered approach also preserves the distinction between institution and organization. An organization can be a formal entity with members, assets, offices, and decision structures, while institutional ordering can extend across organizations through professional standards, legal categories, conventions, infrastructures, or field-level expectations. Conversely, a single organization can contain several institutional orders whose rules and authority relations overlap imperfectly. Institutional inquiry therefore benefits from object, boundary, and scale specification before

aggregation.

Contingent encounter and aesthetic judgment remain relevant at the stage of orientation. A surprising procedural exception, informal workaround, inherited routine, unexplained role, boundary-crossing dependency, archival discontinuity, or contradiction between formal rule and practical coordination can make an institutional relation salient before its significance is fully established. Subsequent inquiry can determine whether the encounter reveals a recurrent institutional structure, a local adaptation, a transitional state, or an evidential artifact. AI-mediated search and organizational analytics can enlarge the institutional encounter surface, yet generated summaries and inferred structures still require validation against source records, local meanings, authority relations, and historical context.

Institutional inquiry therefore extends the relational methodology of this chapter from individual relations and legal positions toward recurrently organized fields of action. It provides tools for reconstructing how rules, roles, membership, authority, coordination, memory, and boundaries interact through time. The next section turns to comparative relational inquiry, where these reconstructed objects can be compared across cases, histories, cultures, and institutional configurations while preserving differences in relation type, scale, and evidential access.

7.16 Comparative Relational Inquiry

Section 7.15 reconstructed institutional inquiry through rules, roles, membership, authority, coordination, memory, boundaries, and transformation. The present section develops the comparative operation that follows once relational objects have been specified with sufficient clarity. Its role is to establish how cases, configurations, institutions, histories, and cultural settings can be compared without assuming that similarly named entities instantiate the same relations. The objective is to make comparison sensitive to object specification, boundary, scale, historical sequence, evidential access, and the distinction between relational and functional equivalence. The section proceeds through case selection, most-similar and most-different designs, relational and functional equivalence, historical and cross-cultural comparison, and the limits of comparability.

Comparative inquiry has a long methodological lineage in the social sciences. Przeworski and Teune developed a systematic account of comparative design centered on the relation between observed differences, system-level characteristics, and explanatory variables Przeworski and Teune 1970. Lijphart treated comparison as a distinctive methodological strategy whose inferential power depends partly on selecting sufficiently comparable cases and reducing an otherwise expansive property space Lijphart 1971. Sartori's critique of concept misformation remains especially relevant when categories travel across contexts, because terminological sameness can conceal differences in extension, intension, and institutional meaning Sartori 1970. Ragin's configurational approach further emphasizes that comparative explanation can concern combinations of conditions and case structures through configurational structures and conjunctions of conditions Ragin 1987. These traditions provide useful resources for relational inquiry, although the present framework places additional emphasis on the comparability of relations, configurations, and evidential pathways.

Within the present framework, comparison is an operation performed on already

specified research objects that follows explicit specification. Sections 7.3–7.9 established that entities, relations, boundaries, scales, identity conditions, and configurations are analytical constructions constrained by evidence. Comparative inquiry inherits those constraints. Two organizations can share a legal label while differing in authority relations; two households can occupy similar statistical categories while differing in dependency structure; two institutions can perform comparable functions through different rules and memberships; and two historical periods can display similar manifestations produced through different relational architectures. Comparison therefore requires an explicit account of what is being held comparable and at which level.

Definition 7.153 (Comparative relational inquiry). *Comparative relational inquiry* is the systematic comparison of specified relational objects, properties, configurations, trajectories, or functions across cases or periods through explicit criteria of case construction, equivalence, boundary, scale, historical context, and evidential adequacy.

Definition 7.153 makes comparison claim-relative. A pair of cases may be comparable for one question and poorly comparable for another. A study of formal jurisdiction may legitimately compare legal competences across institutions, while a study of enacted authority may require ethnographic, documentary, or interview evidence concerning how those competences operate in practice. Likewise, a comparison of relation intensity may require harmonized temporal windows, whereas a comparison of institutional transformation may require historically different periods whose sequence is substantively meaningful.

Table 7.15 summarizes the principal comparative strategies developed below.

7.16.1 Case Selection

Comparative inquiry begins with case construction. A case is rarely a neutral container waiting to be sampled. It may be an organization, institution, community, legal regime, event sequence, relational configuration, historical period, policy field, or other bounded analytical object. Section 7.3 therefore precedes comparison conceptually: the researcher first specifies what constitutes the case and then asks which contrasts can illuminate the research question.

Classical comparative methodology emphasizes the inferential consequences of case selection Lijphart 1971; Przeworski and Teune 1970. Relational inquiry adds a further concern. Cases may appear similar because their manifestational surfaces are similar while their relational architectures differ. A pair of organizations can report comparable staffing levels while differing in authority concentration, contracting relations, informal coordination, or external dependency. Conversely, visibly different cases may contain closely related configurations at the level relevant to the question.

Definition 7.154 (Comparative case profile). A *comparative case profile* records the research object, boundary, scale, temporal interval, focal relations or configurations, principal manifestations, relevant contextual conditions, evidential sources, and reasons for inclusion in the comparative design.

The profile makes case selection auditable. It can show whether cases were selected because they instantiate a theoretically relevant contrast, because they provide variation in a focal relational property, because they offer comparable evidence, because they represent a critical historical transition, or because a contingent encounter revealed an analytically promising contrast. These rationales can coexist, although

Table 7.15: Comparative relational strategies and characteristic inferential risks

Strategy	Comparative focus	Relational contribution	Characteristic risk
Case selection	Construction of cases relevant to a question	Aligns object, boundary, scale, and evidence before comparison	Selection on manifestations that already encode the expected result
Most-similar comparison	Cases similar on selected conditions and different on focal relations or outcomes	Helps isolate relational differences within a restricted field	Hidden differences in configuration or historical sequence
Most-different comparison	Cases different on many dimensions yet similar on a focal relation, function, or outcome	Tests whether a relational pattern travels across heterogeneous settings	Premature assumption that observed similarity has the same meaning or mechanism
Relational equivalence	Similarity of position, dependency, connection, or configuration	Compares structural location without requiring entity identity	Overlooking semantic, historical, or normative differences
Functional equivalence	Similarity in a specified contribution or consequence	Permits comparison across heterogeneous institutional forms	Inferring broader equivalence from one shared function
Historical comparison	Comparison across periods, sequences, and transformations	Reveals changing relation meanings, continuity carriers, and path dependence	Anachronism and changing evidence regimes
Cross-cultural comparison	Comparison across differently symbolized and institutionalized settings	Tests portability of categories and relational interpretations	Concept stretching, translation loss, and unequal evidential access
Comparability assessment	Evaluation of what comparison can support	Preserves scope, remainder, and uncertainty	Treating partial comparability as either full equivalence or complete incomparability

their inferential implications differ.

Selection on readily observable manifestations requires particular care. If researchers select cases because a manifest outcome is already extreme, then relations associated with that manifestation may appear more explanatory than they would in a differently constructed comparison. Selection can also occur through archives, administrative classifications, platform data, or institutional access, producing a sample shaped by visibility conditions whose relation to the wider relational field requires separate assessment. Comparative design should therefore record both substantive selection criteria and access conditions.

Case selection can remain iterative. An initial comparison may reveal that a nominally coherent case contains several relational configurations, or that a proposed contrast disappears after boundary or scale revision. In such situations, revising the case set can improve adequacy without implying methodological failure. The relevant requirement is that the revision pathway remain visible.

7.16.2 Most-Similar Comparison

Most-similar comparison examines cases selected to be similar on several theoretically relevant conditions while differing on a focal relation, configuration, process,

or outcome. The strategy has a long association with comparative social inquiry Przeworski and Teune 1970. Its value lies in reducing the field of plausible differences sufficiently to make a focal contrast more interpretable.

In relational inquiry, similarity needs specification at the level on which the comparison operates. Two municipalities may be similar in population, fiscal capacity, statutory competence, and national legal environment while differing in interorganizational coordination. Two laboratories may be similar in disciplinary field and funding while differing in authority distribution and collaboration topology. Two households may be similar in income yet differ in dependency, care, and decision relations. The analytical leverage comes from specified similarity through declared dimensions of similarity.

Definition 7.155 (Most-similar relational design). A *most-similar relational design* compares cases aligned on a stated set of contextual, boundary, scale, or institutional conditions while examining variation in one or more focal relations, configurations, trajectories, or outcomes.

The phrase “most similar” should therefore be understood relative to a declared property space. Cases can remain different in unmeasured or poorly observed ways. Historical timing is especially important. Two institutions can share formal architecture while occupying different stages of formation, crisis, or consolidation. A similarity judgment that ignores temporal position can conceal differences in the processes generating the observed configuration.

Most-similar comparison can also expose relational mechanisms through divergence. If two cases share a formal rule but display different practical authority patterns, the comparison directs attention toward implementation, informal norms, organizational capacity, external dependency, or other relational conditions. The result is not automatically causal identification, yet it can narrow the set of plausible explanations and guide subsequent process tracing, measurement, or formalization.

7.16.3 Most-Different Comparison

Most-different comparison begins from cases that differ substantially across selected dimensions while sharing a focal outcome, relation, function, or structural feature. Przeworski and Teune’s comparative logic provides a classical basis for this strategy Przeworski and Teune 1970. In relational inquiry, the design is useful for asking whether a relational pattern persists across heterogeneous institutional, cultural, economic, or historical settings.

The interpretive burden is substantial because similarity of manifestation can arise through different mechanisms. Two societies may exhibit similar rates of participation through distinct associational structures. Two organizations may achieve similar coordination through hierarchy in one case and peer governance in another. Two legal systems may produce comparable access outcomes through different combinations of rights, procedures, administrative discretion, and informal brokerage. The shared outcome therefore motivates investigation of the underlying relation while leaving equivalence to be established through further relational reconstruction.

Definition 7.156 (Most-different relational design). A *most-different relational design* compares cases that differ across a specified set of contextual or structural conditions while sharing a focal relational property, function, trajectory, or manifestation whose generative or organizational basis is under investigation.

Such designs can reveal robustness at one level and heterogeneity at another. A relational pattern may recur while its meaning differs. A common function may be achieved through different configurations. A similar outcome may emerge from distinct historical sequences. The design therefore benefits from the distinction among relational equivalence, functional equivalence, and manifestational similarity developed in the following subsections.

Most-different comparisons can also identify domain limits. A relation that appears portable across several contexts may fail to appear when a particular institutional condition changes. This absence can help specify the conditions under which the relation is sustained. The interpretation remains proportionate to the selected cases and available evidence.

7.16.4 Relational Equivalence

Relational equivalence concerns similarity in relational position, connection, dependency, role structure, or configuration. It differs from entity equivalence. Two entities can be materially, culturally, or institutionally different while occupying comparable relational positions relative to a specified structure. Likewise, two entities with similar observable attributes can occupy very different positions in networks of authority, dependence, exchange, care, or information.

Section 106 introduced scale-relative entityhood and local functional equivalence at the ontological level, while Sections 7.7 and 7.9 developed multidimensional relation characterization and configuration reconstruction. Comparative relational inquiry uses these earlier commitments to specify the dimensions along which equivalence is claimed. Position within a hierarchy, brokerage between groups, exposure to a common dependency, reciprocal obligation, or membership in a similar higher-order configuration can each ground a local comparison.

Definition 7.157 (Relational equivalence). Two research objects are *relationally equivalent with respect to a specified criterion* when their positions, dependencies, connections, or configurations preserve the relational properties relevant to that criterion within the declared boundary, scale, and temporal scope.

The phrase “with respect to a specified criterion” is central. Relational equivalence at one level does not imply semantic, functional, normative, causal, or ontological identity. A broker in a labor market and a broker in a humanitarian coordination network may share a structural position while differing sharply in authority, accountability, meaning, and consequence. A creditor relation and a patronage relation may exhibit asymmetric dependence while remaining institutionally and normatively distinct.

Sartori’s concern with concept misformation is relevant here because comparison can become misleading when a category travels farther than its defining properties support Sartori 1970. Relational inquiry responds by making the preserved property explicit. Researchers can then ask whether the same relation type is being compared, whether only structural position is shared, or whether the apparent equivalence arises from a coarse representation.

Proposition 7.158 (Criterion-local equivalence). *A comparative claim of equivalence gains clarity when it identifies the relational properties preserved by the comparison and keeps unpreserved semantic, historical, normative, and causal properties available as comparative remainders.*

Proposition 7.158 guards against premature synthesis. Two cases can be usefully comparable even when substantial differences remain. Those differences need not invalidate the comparison; they can define its scope and later become objects of inquiry.

7.16.5 Functional Equivalence

Functional equivalence concerns similarity in a specified contribution, role, or consequence within a system. It is especially useful when different institutional forms solve comparable coordination problems or when heterogeneous structures generate similar practical capacities. A formal regulatory agency, professional association, technical standard, and platform protocol could, under some conditions, perform comparable gatekeeping functions while remaining distinct in authority, membership, legitimacy, and enforcement.

Definition 7.159 (Functional equivalence). Research objects are *functionally equivalent relative to a specified function* when sufficiently supported evidence indicates that they contribute to the same analytically defined system-level or relational function within the scope relevant to the comparison, despite possible differences in form, mechanism, history, or meaning.

Functional equivalence is therefore weaker than general equivalence. It should identify both the function and the level at which the function is evaluated. A household arrangement and a public institution may both provide care, yet they can differ in authority, reciprocity, duration, financing, emotional meaning, legal status, and distributive consequence. Treating them as equivalent for one function can be analytically useful while preserving those differences.

Functional comparison also interacts with multiple realization. Similar capacities can emerge through heterogeneous relational architectures. The comparative task is then twofold: establish that the function is sufficiently comparable and reconstruct the different relations through which it is realized. This approach is well suited to GRE because economic coordination, allocation, security, knowledge transmission, trust, and value conversion can occur through diverse institutional forms.

Aesthetic resemblance can sometimes orient functional comparison. Researchers may notice that two very different arrangements possess an unexpectedly similar pattern of coordination or failure. Such recognition can motivate a comparison, while evidential analysis still determines whether the similarity is functionally substantive or only superficial.

7.16.6 Historical Comparison

Historical comparison introduces temporal heterogeneity into comparative design. Cases can be separated by periods, sequences, institutional eras, crises, technological regimes, or generational conditions. The aim is often to reconstruct how relations form, persist, transform, dissolve, or reappear under changing historical circumstances.

Historical comparison requires care with changing categories. A category such as worker, household, firm, citizen, profession, market, platform, or public authority can change in institutional meaning across periods. Sartori's warning about concept travel therefore applies temporally as well as spatially Sartori 1970. The researcher

should determine which features of a concept remain comparable and which have transformed.

Definition 7.160 (Historical comparison profile). A *historical comparison profile* records the periods or sequences compared, continuity and discontinuity criteria, changing category meanings, relevant institutional and technological conditions, evidential regimes, relation identities, and the inferential purpose of the temporal contrast.

The evidential regime itself can change historically. Earlier periods may leave administrative ledgers and correspondence, while later periods generate digital traces and standardized indicators. Apparent increases in interaction, visibility, or organizational activity can partly reflect changes in recording infrastructure. Section 7.11's archival discipline therefore becomes part of comparative design.

Historical comparison can be synchronic across several cases at similar times, diachronic within one case, or combined across cases and periods. The latter design can reveal whether a transition occurs through comparable sequences or whether similar institutional outcomes arise from different histories. Ragin's configurational orientation is relevant because historical outcomes can depend on conjunctions and sequences of conditions through configurations and sequences of conditions Ragin 1987.

Temporal comparison also supports multiscale analysis. Individual practices may change rapidly, organizational routines more slowly, and institutional categories over longer intervals. Comparing periods at one temporal resolution can therefore miss transformation occurring at another. The scale discipline of Section 7.5 should remain active in historical comparison.

7.16.7 Cross-Cultural Comparison

Cross-cultural comparison examines relational objects across settings in which language, symbolic classifications, norms, institutional forms, histories, and practical meanings may differ substantially. The methodological opportunity is significant because cross-cultural variation can expose assumptions that remain invisible within a single setting. The methodological risk is equally significant because a category developed in one context can travel into another while losing or changing the relations that gave it meaning.

The first task is therefore translation at several levels. Linguistic translation concerns words and expressions. Conceptual translation concerns the categories through which phenomena are distinguished. Institutional translation concerns the relation between categories and organized practices. Evidential translation concerns whether the same form of record, interview response, or administrative indicator supports a comparable inference across contexts. These levels can diverge.

Definition 7.161 (Cross-cultural comparison profile). A *cross-cultural comparison profile* records the concepts, relational objects, translation procedures, institutional meanings, local categories, evidential sources, researcher positions, and unresolved remainders relevant to comparison across culturally or linguistically heterogeneous settings.

A shared translated term can conceal different relational meanings. "Family," "community," "employment," "ownership," "trust," or "authority" can be instantiated

through different obligations, memberships, dependencies, legal forms, and symbolic expectations. Relational specification helps by asking which ties, roles, sanctions, permissions, histories, and meanings constitute the local object before comparison is attempted.

Cross-cultural inquiry also raises questions of epistemic position and justice. Unequal access to archives, language competence, local scholarship, participants, or institutional networks can produce asymmetry in evidential depth between cases. A comparison can appear balanced at the level of published variables while one case is reconstructed through far richer sources than another. The comparative record should therefore make access differences visible when they affect interpretation.

Contingent encounter can play a productive role here. A researcher may first notice an unexpected similarity or difference through language, practice, spatial organization, ritual, institutional routine, or an apparently minor discrepancy in translation. Aesthetic judgment can orient attention toward that contrast. Comparative warrant then depends on reconstructing the local relational meanings and testing whether the initial resemblance survives deeper inquiry.

7.16.8 Limits of Comparability

Comparability has limits because relational objects can differ in category meaning, boundary, scale, historical formation, evidential visibility, institutional realization, and normative significance. These limits need not terminate comparison. They can specify which claims remain defensible and which forms of equivalence are too strong for the available evidence.

Lijphart's account of comparative methodology emphasizes the difficulty of drawing inference from a restricted number of cases across a large property space Lijphart 1971. Sartori adds a complementary problem: concepts can stretch across cases until the shared category loses analytical precision Sartori 1970. Relational inquiry treats these as part of a broader comparability problem. Even when concepts are carefully defined, relations can differ in meaning, temporal structure, institutional embedding, and available traces.

Definition 7.162 (Comparability profile). A *comparability profile* records the dimensions on which cases are sufficiently aligned for the focal claim, the dimensions that remain heterogeneous, differences in evidence and access, relevant translation choices, alternative comparison criteria, and the principal remainders limiting broader equivalence.

This profile supports graded comparison. Two cases may be strongly comparable with respect to formal authority, moderately comparable with respect to enacted coordination, and weakly comparable with respect to symbolic meaning. A historical comparison may support continuity of function while leaving relation identity uncertain. A cross-cultural comparison may preserve relational position while leaving participant meaning only partially translatable. Reporting these differentiated judgments is more informative than forcing the comparison into a binary category of comparable or incomparable.

Proposition 7.163 (Comparative remainder). A comparison can remain analytically useful when unresolved differences are preserved as explicit remainders and the inferential claim is restricted to the properties for which comparability has been adequately established.

Proposition 7.163 parallels the boundary and scale remainders developed in Sections 7.4 and 7.5. A remainder records what the current comparison leaves unresolved without making those differences disappear. This is especially important for cumulative research because later evidence may transform a remainder into the central object of a new study.

Comparative inquiry also remains sensitive to representation. Quantitative harmonization, coding schemes, typologies, embeddings, and AI-assisted similarity measures can make heterogeneous cases appear commensurable by projecting them into a shared representational space. Such tools can be valuable for discovery and screening, yet the induced similarity belongs first to the representation. Researchers should still examine whether the relational properties relevant to the claim are preserved outside that representation.

The same point applies to AI-assisted comparative research. Large models and retrieval systems can rapidly propose analogies across legal systems, institutions, histories, literatures, and cultural settings. This greatly expands the comparative encounter surface. It can also generate persuasive correspondences whose local meanings, historical sequences, or evidential bases differ. Contingent comparison and aesthetic recognition therefore remain productive sources of research orientation, while relational specification, source verification, and scope discipline determine whether the proposed comparison survives scrutiny.

Comparative relational inquiry consequently serves as a bridge between the object-specific methods developed in Sections 7.10–7.15 and the broader methodological traditions examined next. It supplies a disciplined language for comparing cases without converting similarity into identity, and for preserving difference without treating heterogeneity as a barrier to inquiry. Section 183 now turns to mainstream historical-interpretive social science methods, locating case studies, comparative-historical analysis, process tracing, archival research, interviews, ethnography, discourse analysis, legal interpretation, conceptual history, genealogy, and thick description within the relational methodology developed so far.

7.17 Mainstream Historical-Interpretive Social Science Methods

Sections 7.10–7.16 developed several concrete modes of relational inquiry and then established a comparative discipline for moving among cases, periods, institutions, and cultural settings. The present section locates those techniques within a wider family of historical-interpretive social science methods. Its role is classificatory and methodological: it identifies the principal epistemic work performed by case study, comparative-historical analysis, historical institutionalism, process tracing, archival and documentary research, interviews, ethnography, discourse analysis, legal and institutional interpretation, conceptual history, genealogy, thick description, and contextual comparison. The objective is to clarify how these methods can contribute to relational inquiry while preserving their differences in evidential access, inferential ambition, temporal organization, and interpretive commitments. The discussion therefore treats historical-interpretive inquiry as a plural methodological family rather than a single epistemology.

Case study research illustrates this plurality particularly well. Gerring emphasizes

that case study design is not defined by one form of evidence and can incorporate qualitative, quantitative, ethnographic, textual, historical, experimental, and mixed materials depending on the research objective Gerring 2007. Comparative-historical research likewise contains multiple strategies for reconstructing sequence, causal processes, configurations, and historical variation Mahoney and Rueschemeyer 2003. Historical institutionalism adds explicit attention to institutional development and temporality Hall and Taylor 1996; Pierson 2000, while process tracing concentrates more directly on within-case evidence concerning hypothesized mechanisms Beach and Pedersen 2019. Interpretive traditions extend this repertoire through situated meaning, discourse, conceptual transformation, genealogy, and thick description Fairclough 2003; Koselleck 2004; Foucault 1977; Geertz 1973.

These traditions intersect with the ontology and epistemology developed in Chapters 4 and 5. Historical-interpretive evidence is encountered through manifestations whose production, preservation, classification, and interpretation are themselves relationally organized. A document, interview, legal category, institutional routine, concept, discourse, or archival trace therefore provides a mode of access whose relation to the target object requires reconstruction. Historical-interpretive methods can be especially strong where sequence, contextual meaning, changing categories, institutional mediation, and heterogeneous forms of evidence are central to the research question. Their warrant still depends on explicit boundaries, scale, provenance, inferential bridges, competing interpretations, and revision conditions.

Definition 7.164 (Historical-interpretive relational inquiry). *Historical-interpretive relational inquiry* is a family of research strategies that reconstructs relations, configurations, meanings, institutions, and trajectories through temporally and contextually situated evidence, with explicit attention to sequence, interpretation, provenance, category formation, and the conditions under which evidence becomes available.

Definition 7.164 gives the family a common methodological orientation without requiring methodological identity. Process tracing may pursue a relatively focused causal-mechanism claim. Thick description may pursue a densely contextual interpretation of meaning. Conceptual history can reconstruct changing semantic fields, while genealogy can examine contingent descent and emergence. Archival inquiry can foreground preservation and custody, and legal interpretation can foreground authoritative texts, institutional reasoning, and recognized legal positions. Relational methodology benefits from this plurality when each method states what it is designed to disclose and what remains outside its evidential reach.

Table 7.16 summarizes the principal methods discussed below.

7.17.1 Case Study

Case study research provides an intensive mode of inquiry into a specified case and its relevant context. Gerring's methodological treatment emphasizes that the case study can draw on varied evidence and can serve descriptive, interpretive, exploratory, and causal purposes depending on design Gerring 2007. For relational inquiry, its distinctive value lies in the possibility of reconstructing a case as an internally differentiated relational configuration rather than treating the case as a single observation with a fixed list of attributes.

A case can be an individual, household, organization, institution, event, policy episode, community, legal dispute, platform, historical transition, or relational field.

Table 7.16: Historical-interpretive methods and their principal relational contributions

Method	Primary access	Relational contribution	Characteristic caution
Case study	Intensive evidence concerning a bounded case	Integrates heterogeneous evidence around a specified relational object	Case construction and transfer beyond the case require separate justification
Comparative-historical analysis	Cases and sequences across time	Reconstructs conjunctures, trajectories, and historically differentiated configurations	Category meanings and evidence regimes can change across periods
Historical institutionalism	Institutions across temporal sequences	Examines path dependence, timing, institutional reproduction, and transformation	Persistence can be overstated when internal relations change
Process tracing	Within-case sequential evidence	Tests hypothesized mechanisms and intermediate relational steps	Dense sequence alone does not establish the proposed mechanism
Archival and documentary inquiry	Preserved records and documentary infrastructures	Reconstructs traces, provenance, classification, institutional memory, and silence	Record survival and documentary production are selective
Interviews and ethnography	Situated accounts and observed practice	Reconstructs lived meaning, tacit practice, interaction, and relational experience	Access and researcher position shape the evidential field
Discourse analysis	Text, speech, genres, and representational practice	Examines how categories, identities, and relations are represented and reproduced	Discursive evidence requires care when claims extend to material or institutional consequences
Legal and institutional interpretation	Rules, decisions, practices, roles, and authority	Reconstructs formal positions, enacted ordering, and interpretive pathways	Formal validity and practical realization can diverge
Conceptual history and genealogy	Changing concepts, categories, descent, and emergence	Reconstructs historical semantics, discontinuity, contingency, and power-laden formation	Present categories can distort earlier relational worlds
Thick description and contextual comparison	Dense contextual evidence across settings	Preserves situated meaning while supporting scoped comparison	Context can become too expansive unless analytically bounded

Section 7.3 established that the object specification precedes the evidential claim. Case study therefore begins by defining what makes the case analytically coherent, which relations are focal, which surrounding relations belong to context, and which temporal interval supports the intended inference. These choices affect what counts as within-case evidence.

Definition 7.165 (Relational case study). A *relational case study* is an intensive inquiry into a bounded case that reconstructs the relations, configurations, meanings,

institutional conditions, and temporal sequences relevant to a stated research question through one or more evidential modes.

The definition permits methodological combination. A study of one organization might combine archival records, interviews, legal documents, administrative data, network reconstruction, and ethnographic observation. The contribution of the case study then comes from the coordinated interpretation of these materials within a shared object specification. Evidence need not be homogenized. Documentary evidence may establish formal sequence, interviews may reconstruct participant experience, and quantitative records may show the distribution or frequency of observed manifestations.

Case studies are also useful for identifying relations that remain weakly represented in standardized data. An intensive investigation can reveal informal brokerage, tacit coordination, historical obligations, or institutional dependencies that become visible only when several sources are read together. This strength creates a corresponding discipline: transferring a finding beyond the case requires an additional argument about scope, comparability, mechanism, or relational equivalence. Intensive knowledge of one case can be strong within its stated domain while supporting only a more modest claim about a broader population.

7.17.2 Comparative-Historical Analysis

Comparative-historical analysis studies cases through historically ordered comparison. Mahoney and Rueschemeyer describe a broad tradition concerned with large-scale historical processes, comparative cases, causal analysis, and methodological problems arising from temporally extended evidence Mahoney and Rueschemeyer 2003. Relational inquiry can use this tradition to examine how similar outcomes emerge through different configurations, how similar configurations generate divergent trajectories, and how institutions or relations change under different historical sequences.

The temporal ordering of evidence is substantive. Two cases may contain similar components yet differ because a resource arrived before institutional consolidation in one case and after it in another, because a legal change preceded organizational restructuring in one setting and followed it in another, or because a crisis occurred during different phases of relational development. Comparative-historical inquiry therefore treats sequence as part of the explanatory object rather than a neutral ordering of observations.

Definition 7.166 (Comparative-historical profile). A *comparative-historical profile* records the cases, periods, focal relations, temporal sequences, category meanings, institutional conditions, evidential regimes, and comparison criteria used to support a historical relational claim.

This profile helps prevent two recurrent losses. The first is temporal compression, in which historically separated processes are collapsed into a contemporaneous variable set. The second is contextual equivalence, in which the same indicator is assumed to carry an unchanged relational meaning across periods. The methods developed in Sections 7.8, 7.11, and 7.16 provide safeguards through identity criteria, archival provenance, and graded comparability.

Comparative-historical analysis can incorporate quantitative evidence, event counts, demographic records, financial series, or network measures alongside doc-

umentary and interpretive materials. The relevant distinction is therefore less about data type than about the inferential role of historical sequence and contextual reconstruction.

7.17.3 Historical Institutionalism

Historical institutionalism studies institutional development through temporally situated structures, sequences, and processes. Hall and Taylor locate it among several major institutionalist traditions and emphasize its concern with institutional organization and historical development Hall and Taylor 1996. Pierson's analysis of increasing returns and path dependence further illustrates how timing, sequence, and self-reinforcing processes can shape political trajectories under specified mechanisms Pierson 2000.

Within relational methodology, historical institutionalism is useful for examining how rules, roles, authority, membership, coordination, and institutional memory become stabilized and how that stabilization affects later possibilities. Section 7.15 reconstructed institutions as layered relational arrangements. Historical institutionalism adds a temporal question: how did the arrangement acquire its current form, which elements reproduce it, and which events or gradual transformations alter its trajectory?

Path dependence should be specified with care. Persistence alone provides limited evidence of self-reinforcement. A durable institution may persist because of legal continuity, sunk infrastructure, coordination advantages, identity commitments, network dependence, strategic interests, administrative routines, or combinations of these conditions. A relational account therefore asks which carriers reproduce the institution and at which scale.

Historical institutional analysis also benefits from the distinction between formal persistence and relational transformation. A legal name, office, or organizational boundary may remain stable while authority, dependence, membership, or practical coordination changes substantially. The identity criteria from Section 7.8 help make that divergence visible.

7.17.4 Process Tracing

Process tracing examines within-case evidence concerning the processes that connect a proposed cause, condition, or configuration with an outcome. Beach and Pedersen develop process tracing as a family of approaches to causal mechanisms and within-case inference, with different variants suited to different research purposes Beach and Pedersen 2019. In relational inquiry, process tracing can be used to reconstruct a sequence of interactions, institutional decisions, transmissions, responses, and intermediate changes through which a relational mechanism is proposed to operate.

A relational mechanism requires more than chronological adjacency. If an institutional rule is proposed to change an organizational practice, and that practice is proposed to alter an interpersonal relation, the evidential chain should address the intermediate translations. The formal rule may be interpreted differently by organizational actors; implementation can be uneven; affected participants can adapt strategically; and downstream manifestations may arise through several pathways. Process tracing helps make these mediating steps explicit.

Definition 7.167 (Relational process trace). A *relational process trace* is a temporally ordered evidential reconstruction of the intermediate relations, actions, interpretations, institutional steps, and state changes through which a hypothesized mechanism is proposed to connect specified conditions with a target outcome.

The trace should preserve alternative pathways where evidence permits more than one reconstruction. An observed sequence can be consistent with several mechanisms, and missing evidence at a critical step can materially limit attribution. This is especially important when archives or administrative systems preserve outcomes more reliably than informal interactions. Process tracing therefore benefits from the evidential plurality developed earlier in the chapter.

7.17.5 Archival Research

Archival research provides access to historically preserved traces through infrastructures of custody, appraisal, arrangement, description, access, and retrieval. Section 7.11 developed this mode of inquiry in detail. Within the present methodological map, archival research contributes historical depth, provenance, sequence reconstruction, institutional memory, and evidence concerning categories or practices that later records may transform or obscure.

The archive also has a relational history. Producers, custodians, institutions, technologies, appraisal practices, access regimes, and digitization systems shape which traces survive and how they can be encountered. A historical relation that appears richly documented may partly reflect the administrative importance assigned to it by the record-producing institution. A weakly documented relation may have been informal, stigmatized, peripheral to administrative purpose, or carried through media that were poorly preserved.

Archival research consequently supports two simultaneous objects of inquiry. Researchers may reconstruct a historical configuration from preserved traces, and they may reconstruct the archival configuration that conditioned survival and visibility. Keeping these objects distinct reduces the risk of treating archival abundance as a direct measure of historical prevalence.

The expansion of digitized archives and AI-assisted retrieval enlarges the archival encounter surface. It also makes search infrastructure part of provenance. A retrieved cluster may reflect semantic embeddings, metadata standards, digitization priorities, or language coverage. Source-level verification and reconstruction of archival context remain important after computational discovery.

7.17.6 Documentary Analysis

Documentary analysis examines records, texts, forms, correspondence, reports, registers, and digital traces as produced evidence. Section 7.10 distinguished the documentary record from the relation it records and from the institutional process that produced the record. That distinction remains central within historical-interpretive inquiry.

A document can carry several evidential functions. It may record a transaction, prescribe a procedure, classify an actor, authorize a status, communicate an interpretation, justify a decision, or preserve an organizational memory. The evidential

question depends on which of these functions supports the research claim. An employment contract can provide strong evidence of formal legal obligations while offering limited evidence about everyday supervision. A meeting minute may establish that an issue entered institutional deliberation while leaving the informal negotiation preceding the meeting less visible.

Documentary analysis therefore benefits from a claim-relative provenance chain. Researchers should know, where relevant, who produced the record, for which purpose, under which classification scheme, through which custodial pathway, and with which subsequent transformations. Such information allows the document to be interpreted as a situated manifestation rather than an unmediated report of the underlying relation.

Documentary silence is similarly structured. Non-observation in a document collection may arise through non-recording, destruction, access restriction, poor indexing, incompatible categories, or weak retrieval. The negative-relations discipline of Section 7.6 therefore applies directly to documentary inference.

7.17.7 Interviews

Interviews provide situated accounts of experience, interpretation, memory, practice, and relational meaning. Section 7.13 treated interview evidence as jointly produced through participant, interviewer, question design, setting, timing, and the wider relational context of the interview. This makes interviews especially valuable for relations whose practical meaning or tacit organization is weakly recorded elsewhere.

Historical-interpretive interview research can reconstruct how participants understood an event, institution, obligation, conflict, transition, or relation at a particular time. Retrospective accounts can also reveal later reinterpretation. The difference between contemporaneous understanding and retrospective reconstruction may itself be analytically relevant, especially where institutional narratives evolve after crisis or reform.

Contradictory testimony deserves preservation. Participants occupying different relational positions can have access to different parts of a process and can experience the same institutional arrangement differently. Divergence can therefore indicate positional structure, changing memory, conflicting interests, differing temporal reference points, or ordinary error. Comparative interviewing becomes stronger when these alternatives remain visible.

Interview evidence also interacts productively with documentary and archival evidence. A record can anchor dates and formal actions; an interview can reveal interpretation, tacit practice, or perceived constraint; later comparison can identify convergence and disagreement without presuming that one source type automatically overrides another.

7.17.8 Ethnography

Ethnography provides situated access to practice, interaction, embodied routines, informal norms, and the everyday reproduction of relations. Section 7.12 developed a relational ethnographic approach in which field position and access are treated as part of the evidential configuration. Geertz's interpretive emphasis on thick description remains an influential precedent for connecting observed action with culturally

situated meaning Geertz 1973.

For relational inquiry, ethnography is particularly useful where formal rules and enacted relations diverge. Observation can disclose informal brokerage, tacit coordination, avoidance, repair, waiting, emotional labor, boundary work, or practical hierarchy that remains only partially visible in official documents. Repeated presence can also reveal how relations change across routine and exceptional situations.

The researcher's participation creates both access and limitation. Trust can deepen disclosure while changing interaction; organizational sponsorship can open one field position while closing another; language competence and social identity can influence which relations become visible. Reflexive reporting therefore concerns evidential conditions rather than autobiography alone.

Ethnography can also generate research orientation through contingent encounter. An unexpected interaction, silence, spatial arrangement, workaround, or repeated minor practice can become salient before its analytical significance is clear. Aesthetic judgment may orient attention toward the pattern. Subsequent observation, comparison, and triangulation determine whether the pattern warrants a relational claim.

7.17.9 Discourse Analysis

Discourse analysis examines how language, textual forms, categories, genres, representations, and styles participate in social practice. Fairclough's approach connects textual analysis with social events, practices, representations, identities, genres, and evaluative forms Fairclough 2003. Within relational inquiry, discourse analysis can investigate how relations are named, classified, legitimized, contested, obscured, or made available for institutional action.

The distinction between representation and represented relation remains important. A discourse about dependence can exist without accurately describing the material dependency structure of the actors concerned. At the same time, discourse can become causally consequential when classifications influence eligibility, legitimacy, authority, identity, policy, or organizational practice. Section 7.6's distinction between symbolized relations and other relation forms therefore provides a useful bridge.

Definition 7.168 (Discourse–relation interface). A *discourse–relation interface* specifies how a discourse represents, classifies, evaluates, authorizes, or contests a target relation and identifies the institutional or practical pathways through which that representation may become relationally consequential.

This interface discourages a rapid move from textual frequency to social causation. A category may circulate widely yet have weak institutional effect, while a rarely stated classification can carry substantial authority if embedded in legal or administrative procedures. Researchers should therefore examine circulation, audience, institutional position, uptake, and practical consequence where the claim extends beyond discourse itself.

AI-assisted text analysis can expand the scale of discourse inquiry through retrieval, clustering, classification, and semantic comparison. These tools create useful candidate patterns. Their categories and similarity structures remain representations that require validation against the historical and institutional meanings relevant to the study.

7.17.10 Legal and Institutional Interpretation

Legal and institutional interpretation reconstructs rules, statuses, authority, recognized positions, institutional reasoning, informal norms, and practical enactment. Sections 7.14 and 7.15 developed these domains separately because legal validity, institutional interpretation, and enacted practice can diverge. Historical-interpretive social science often needs to move among these layers while keeping their evidential status visible.

Legal texts can establish formal competences, duties, powers, procedures, and jurisdiction. Institutional records and observed practices can show how those positions are interpreted and enacted. Interviews can reveal tacit norms and practical expectations. Historical sources can reconstruct how a legal or institutional category acquired its present meaning. The resulting analysis is strongest when each inferential transition is explicit.

Institutional interpretation also depends on organizational position. The same rule may be read differently by administrators, regulated actors, courts, professional communities, or participants affected by the institution. Divergent interpretations can become evidence about authority, ambiguity, discretion, and the distribution of practical knowledge.

Historical analysis is particularly valuable during periods of institutional transition. A formal reform may precede practical change, follow an already developing informal transformation, or coexist with older routines. Mapping these temporal relations helps distinguish legal enactment from institutional reorganization and from changes in lived experience.

7.17.11 Conceptual History

Conceptual history examines the historical transformation of politically, socially, or economically consequential concepts and the temporal experiences carried through their changing use. Koselleck's work provides a major reference point for analyzing historical time through transformations in political and social semantics Koselleck 2004. Relational methodology draws on this tradition because research categories can change along with the relations they are used to describe.

Concepts such as “market,” “citizen,” “worker,” “family,” “development,” “security,” “public,” “platform,” or “intelligence” can acquire different extensions, normative associations, temporal horizons, and institutional uses across periods. A longitudinal dataset that applies one contemporary definition retrospectively may therefore generate an appearance of continuity unsupported by historical category meaning.

Definition 7.169 (Conceptual trajectory). A *conceptual trajectory* records historically situated uses, semantic fields, institutional locations, contested meanings, related categories, and practical consequences through which a concept changes across a specified temporal interval.

Conceptual history can contribute to relational inquiry in at least three ways. It can identify when the language available for naming a relation changes; it can show how institutional categories reorganize visibility and classification; and it can reveal when the researcher's own vocabulary would create an anachronistic description of earlier relations. These contributions are especially relevant to the historical identity problem developed in Section 7.8.

Conceptual change also need not correspond one-to-one with relational change. A new category can emerge before practices transform, or relations can change substantially while older vocabulary persists. Researchers should therefore examine conceptual and relational trajectories as linked but distinguishable objects.

7.17.12 Genealogy

Genealogical inquiry examines contingent descent, emergence, discontinuity, and the historical conditions through which practices, categories, subjects, and regimes of knowledge acquire recognizable form. Foucault's "Nietzsche, Genealogy, History" is a canonical statement of this orientation and appears in *Language, Counter-Memory, Practice* Foucault 1977. For relational methodology, genealogy is useful when a present arrangement appears natural, necessary, or timeless yet can be reconstructed through historically contingent sequences of classification, discipline, conflict, institutionalization, and knowledge production.

Genealogy differs from a search for a single origin. Its analytical force often comes from tracing heterogeneous antecedents and showing how later coherence can emerge from historically dispersed practices. This orientation fits the book's broader resistance to treating stabilized categories as timeless ontology. A currently durable relation can be causally real while still having a contingent history.

Definition 7.170 (Genealogical relational reconstruction). A *genealogical relational reconstruction* traces the heterogeneous practices, classifications, institutions, conflicts, knowledge forms, and contingent events through which a present relational object or category acquired its historically recognizable configuration.

Genealogical inquiry should also preserve evidential discipline. A discontinuity inferred from a change in vocabulary may require corroboration from institutional practice, legal form, material infrastructure, or participant accounts. Conversely, apparent continuity of vocabulary can obscure transformation in the relations carried by that vocabulary. Genealogy therefore benefits from the same provenance and identity disciplines developed elsewhere in Chapter 7.

The method is especially useful for reflexive research. Scientific categories, evaluation standards, and methodological conventions can themselves become genealogical objects. This supports Chapter 6's treatment of methods and theories as historically evolving components of research praxis.

7.17.13 Thick Description

Thick description provides a way of connecting observable action with the layered meanings, conventions, histories, and social contexts through which that action becomes intelligible. Geertz's interpretive anthropology is a canonical source for this methodological orientation Geertz 1973. Relational inquiry can use thick description to avoid treating similar manifestations as evidence of identical relations.

A gesture, payment, silence, queue, meeting, gift, refusal, title, ritual, or routine can carry different relational meanings across contexts. Description becomes analytically "thick" when it reconstructs enough of the surrounding symbolic and practical configuration to distinguish these meanings. The goal is not maximal contextual detail. Context becomes useful when it changes the interpretation of the focal relation or clarifies which alternatives remain plausible.

Proposition 7.171 (Context-preserving interpretation). *When the meaning of an observed manifestation depends materially on surrounding symbolic, institutional, historical, or practical relations, interpretation gains warrant by preserving the contextual relations necessary to distinguish among plausible relational meanings.*

Proposition 7.171 makes thick description compatible with scope discipline. A research report can be richly contextual while remaining selective. The relevant question is which contextual relations alter the interpretation, mechanism, or identity claim under examination.

Thick description can also be combined with quantitative or formal methods. A qualitative reconstruction may clarify what a coded interaction represents, while a quantitative analysis can test how widely a reconstructed pattern appears across cases. The methods remain partially irreducible because contextual meaning and distributional prevalence answer different questions.

7.17.14 Contextual Comparison

Contextual comparison compares cases while retaining the relational conditions required to interpret each case on its own terms. It therefore extends Section 7.16's graded comparability by treating context as a structured relational configuration rather than an undifferentiated residual category.

The method begins by identifying which contextual dimensions are relevant to the focal claim. These may include legal regimes, organizational forms, historical sequences, language, technological infrastructures, market structures, kinship relations, professional norms, ecological conditions, or prior institutional events. Contextual comparison then examines whether an apparent similarity persists after these dimensions are reconstructed.

Definition 7.172 (Contextual comparison profile). *A contextual comparison profile records the focal relational object, comparison criterion, contextual relations necessary for interpretation, relevant historical and institutional differences, translation choices, evidence asymmetries, and remainders that limit broader equivalence.*

This approach helps distinguish portability from superficial resemblance. A policy instrument can have similar formal design in two settings while operating through different administrative capacities and authority structures. A concept can share a translation while carrying different historical associations. A network position can appear structurally equivalent while being embedded in different legal or symbolic relations. Contextual comparison keeps these differences available for interpretation.

The method is also compatible with multiscale analysis. Context at one scale can be a focal object at another. National regulation can form part of the context for an organizational study; organizational routines can become the object of a meso-level comparison; individual experience can reveal whether the institutional difference has practical consequences. The relevant scale should therefore remain explicit rather than being absorbed into the word "context."

7.17.15 Limits of Historical-Interpretive Inference

Historical-interpretive inquiry encounters characteristic limits arising from source survival, access, retrospective reconstruction, interpretive plurality, historical cate-

gory change, case selection, positionality, and the difficulty of separating sequence from mechanism. These limits constrain particular claims without converting historical or interpretive evidence into weak evidence by definition.

The first limit concerns evidential survival. Historical inquiry often works with traces produced for purposes different from the later research question. Archives can be incomplete, institutions can preserve records selectively, and marginalized relations can leave weak documentary traces. The resulting evidence can support careful reconstruction while leaving some relations underdetermined.

The second limit concerns interpretation. Texts, actions, and categories can sustain several plausible readings, especially when participant meanings are contested or when the researcher works across temporal and cultural distance. Interpretive plurality can sometimes be reduced through triangulation, contextual reconstruction, or comparison. In other cases, preserving several live interpretations is more accurate than forcing premature closure.

The third limit concerns causal attribution. Sequence and contextual fit can provide important mechanism evidence, yet a temporally coherent narrative can still omit alternative pathways or common causes. Process tracing, comparison, quantitative evidence, formal modeling, or counterfactual analysis can sometimes strengthen attribution. Method selection should follow the inferential problem rather than a hierarchy of traditions.

Definition 7.173 (Historical-interpretive inference profile). A *historical-interpretive inference profile* records the focal claim, temporal and contextual scope, source types, provenance, interpretive transformations, comparison structure, alternative interpretations, missing evidence, researcher access conditions, and the principal limits on transfer or causal attribution.

This profile supports epistemic humility. A historically situated interpretation can be well warranted within a bounded domain while leaving population prevalence, causal magnitude, future stability, or cross-context portability unresolved. A process trace can strongly support an intermediate mechanism while leaving its frequency across a wider population uncertain. An ethnographic reconstruction can disclose tacit practice with considerable local depth while broader distribution requires additional evidence.

Historical-interpretive methods therefore enter relational methodology as complementary modes of access whose strengths depend on the research object and inferential purpose. Their particular contribution lies in preserving sequence, context, meaning, institutional mediation, category history, and the production conditions of evidence. Their remainders can be carried forward into quantitative, formal, network, spatial, temporal, or mixed inquiry without requiring complete methodological translation.

AI-assisted research changes the practical conditions under which these methods are conducted. Large-scale retrieval, transcription, translation, entity linking, semantic search, document comparison, and text synthesis can expand the quantity of historical and interpretive material brought into view. The resulting abundance increases the importance of provenance, source criticism, contextual competence, and judgment concerning which similarities or anomalies deserve sustained inquiry. Contingent encounter remains relevant because an unexpected archival phrase, conceptual discontinuity, contradictory testimony, or unusual institutional juxtaposition can open a new research trajectory whose significance was not specified in advance.

The historical-interpretive family thus provides relational inquiry with a substantial repertoire for reconstructing how relations are experienced, represented, institutionalized, contested, remembered, and transformed through time. The next section turns to mainstream quantitative-empirical social science methods, where measurement, sampling, statistical inference, experimental and quasi-experimental design, and population-level estimation provide a different set of epistemic affordances and limitations.

7.18 Mainstream Quantitative-Empirical Social Science Methods

Section 7.17 mapped a family of historical-interpretive methods whose principal strengths lie in reconstructing sequence, context, meaning, institutional mediation, and historically situated evidence. The present section develops the quantitative-empirical counterpart. Its role is methodological and integrative: it reviews sampling, survey design, descriptive statistics, regression, generalized linear models, panel and time-series methods, multilevel models, experimental and quasi-experimental designs, matching and weighting, measurement, missing-data methods, and robustness analysis. The objective is to clarify the kinds of claims these methods can support within relational inquiry, the assumptions that connect numerical manifestations to relational objects, and the limits that arise when measurement, dependence, interference, boundary selection, or historical change are consequential. The discussion therefore treats quantitative-empirical inquiry as a family of design and inference practices rather than a single technique or epistemology.

Canonical treatments of survey sampling and survey methodology emphasize that quantitative evidence begins before estimation, with the definition of target populations, sampling frames, modes of observation, questionnaires, response processes, and nonresponse Lohr 2021; Groves et al. 2009. Regression and panel-data methods provide flexible approaches to conditional comparison across cross-sectional and longitudinal data Wooldridge 2010; generalized linear models extend this logic to outcome distributions whose structure differs from the Gaussian linear model McCullagh and Nelder 1989; multilevel models allow variation and partial pooling across nested or grouped units Gelman and Hill 2007; and time-series methods represent temporal dependence, persistence, shocks, and changing dynamics Hamilton 1994. Experimental and quasi-experimental traditions then shift attention toward assignment mechanisms and research designs that support causal contrasts under stated assumptions Imbens and Rubin 2015; Angrist and Pischke 2009.

Within the ontology and epistemology developed in Chapters 4 and 5, these methods operate on manifestations that have already passed through measurement, classification, recording, and sampling processes. A variable can therefore be statistically well defined while remaining only one representation of a relational object. A coefficient can be precisely estimated while its substantive meaning still depends on boundary, scale, temporal scope, measurement validity, model specification, and the relation between observed units. Quantitative rigor is strengthened when these representational choices and identifying assumptions are made explicit.

Definition 7.174 (Quantitative-empirical relational inquiry). *Quantitative-empirical relational inquiry* is a family of research strategies that uses structured measurement,

Table 7.17: Quantitative-empirical methods and their principal relational contributions

Method family	Principal contribution	Relational caution
Sampling and surveys	Population representation, prevalence, distributions, reported states, repeated measurement	Frames, response processes, and question formats can selectively expose relations
Regression and GLMs	Conditional association, adjustment, prediction, modeled contrasts	Coefficients inherit measurement, functional-form, dependence, and specification assumptions
Panel and time-series methods	Repeated observation, temporal dependence, within-unit change, dynamic patterns	Persistence, anticipation, feedback, and changing regimes can complicate temporal interpretation
Multilevel models	Nested variation, partial pooling, cross-level heterogeneity	Statistical levels need substantive correspondence to relational scales
Experiments	Designed assignment and treatment contrasts	Interference and treatment diffusion can make relations part of the assignment process
Quasi-experiments	Causal contrasts from institutional or historical assignment structures	Identification depends on design-specific assumptions that can be relationally generated
Matching and weighting	Covariate balance and reweighted comparisons	Balance on observed variables does not resolve omitted relational structure
Measurement and scales	Structured representation of latent or composite constructs	Reliability and numerical coherence do not by themselves establish relational validity
Missing-data methods	Explicit treatment of incomplete observation	Missingness can be produced by access, exclusion, institutions, and relational position
Robustness and sensitivity	Evaluation of dependence on modeling and identifying choices	Robustness remains indexed to the set of alternatives actually examined

sampling, statistical comparison, experimental or quasi-experimental design, and uncertainty quantification to characterize distributions, associations, contrasts, temporal patterns, multilevel variation, and causal effects relevant to relational objects and configurations.

Definition 7.174 leaves room for several inferential purposes. Some studies estimate population quantities. Some describe covariation. Some model conditional distributions. Some estimate treatment effects under an assignment design. Some reconstruct temporal dynamics or multilevel heterogeneity. Relational methodology benefits when the inferential target is stated before a preferred estimator is selected.

Table 7.17 summarizes the principal methodological families developed below.

7.18.1 Sampling

Sampling determines which units and relations become available for quantitative inference. Probability sampling connects observed units to a defined target population through a design that supports design-based uncertainty statements; stratification, clustering, unequal selection probabilities, and complex survey structures can then be incorporated into estimation Lohr 2021. Relational inquiry adds a prior question: what is the sampling unit, and how does that unit relate to the object whose properties are being estimated?

A household survey can sample persons while the focal process is organized through households. A firm survey can sample registered enterprises while informal subcontractors participate in the economic configuration. A school sample can contain students nested within classrooms and schools, with peer relations crossing the boundaries of a nominal sampling unit. Sampling therefore inherits the object, boundary, and scale choices developed in Sections 7.3–7.5.

Definition 7.175 (Relational sampling frame). A *relational sampling frame* records the target population, sampling units, inclusion mechanism, relevant relational memberships or dependencies, coverage limitations, and the relation between sampled units and the relational object for which inference is intended.

A relational sampling frame is especially useful when inclusion probabilities are related to network position, institutional membership, mobility, documentation status, digital visibility, or organizational access. Undercoverage can then be substantively patterned. Sampling error and relational invisibility should remain distinct: a sample can have formally calculable sampling variance while the frame itself excludes actors whose relational positions matter to the research question.

Nonprobability samples can still support valuable empirical work when their selection process, coverage limits, and target of inference are stated carefully. The inferential burden then shifts toward modeling, calibration, comparison with external benchmarks, or explicitly bounded descriptive claims. The relevant discipline is correspondence between the sampling mechanism and the scope of the claim.

7.18.2 Survey Design

Survey design transforms questions about relations, states, expectations, experiences, and institutions into structured response opportunities. Survey methodology therefore includes sampling frames, questionnaire construction, response modes, interviewer effects, nonresponse, post-collection processing, and quality control Groves et al. 2009. Within GR, the survey instrument is an evidential interface: it creates a standardized manifestation whose relation to the target object requires interpretation.

Questions about trust, dependence, authority, access, discrimination, obligation, or institutional experience can be sensitive to wording, reference period, response scale, social desirability, translation, and the participant's understanding of the relational domain. A question such as whether a person "trusts" an institution can index competence, benevolence, predictability, legitimacy, familiarity, or strategic reliance. Quantitative comparability therefore benefits from prior semantic and contextual work.

Survey design can also encode relational structure directly. Roster questions, name generators, household relationship matrices, organizational affiliation questions, repeated-contact measures, and event histories can represent ties or configu-

rations rather than isolated individual attributes. These designs connect naturally to the network and relational-data methods developed later in this chapter.

Proposition 7.176 (Survey manifestation discipline). *When a survey item is used as evidence for a relational construct, the inferential claim gains clarity by specifying the construct, response process, reference domain, temporal frame, and plausible alternative meanings of the recorded answer.*

Proposition 7.176 keeps standardized measurement compatible with epistemic humility. Standardization improves comparability under shared response conditions; its substantive value depends on whether the standardized interface preserves the differences relevant to the research object.

7.18.3 Descriptive Statistics

Descriptive statistics summarize distributions, frequencies, central tendencies, dispersion, cross-tabulations, transitions, and other empirical patterns before stronger explanatory claims are introduced. Their apparent simplicity makes them methodologically important. A mean, rate, proportion, quantile, or variance already presupposes a population, measurement rule, observation window, weighting scheme, and aggregation level.

Relational analysis should therefore ask what variation is preserved and what variation is compressed. Aggregate improvement can coexist with deterioration for a subgroup; a stable mean can coexist with widening dispersion; a national rate can conceal organizational or geographic clustering. These possibilities connect descriptive statistics to the scale-induced distortion discussed in Section 7.5.

Descriptive work also provides a first diagnostic for relational heterogeneity. Stratification by role, institutional membership, network position, region, organizational unit, or temporal regime can reveal whether a seemingly homogeneous population contains substantively distinct relational configurations. Such stratification should be motivated by the research object rather than proliferated mechanically.

A useful descriptive practice is to report denominators and observation rules alongside summary quantities. Changes in who is observed, who remains eligible, how a category is defined, or how repeated units are counted can create apparent trends that originate in the measurement system. Descriptive transparency therefore supports later causal and relational inference.

7.18.4 Regression

Regression provides a flexible language for modeling conditional relationships between an outcome and a set of predictors, controls, interactions, or group indicators. In social-science practice it can be descriptive, predictive, associational, or part of a causal design. These uses should remain distinguishable. Wooldridge provides a broad treatment of cross-sectional and panel regression under explicit assumptions concerning data generation and estimation Wooldridge 2010.

For relational inquiry, regression coefficients are properties of a statistical specification and data-generating representation. Their substantive interpretation depends on the definition of variables, functional form, included and omitted covariates, dependence among observations, and the scale at which the model is estimated. A co-

efficient linking institutional membership with an outcome, for example, does not by itself identify the mechanism through which membership becomes consequential.

Interactions and nonlinear terms can represent conditional heterogeneity, yet they should be connected to a substantive relational hypothesis. A statistical interaction may correspond to different institutional regimes, dependence structures, or joint conditions; it can also arise from scale choices or model form. Relational interpretation therefore requires a bridge from statistical contrast to the configuration being theorized.

Regression can be especially useful as part of triangulation. Historical or qualitative evidence can identify plausible mechanisms and confounders; regression can estimate distributional patterns or conditional contrasts; later process or network analysis can examine whether the proposed relational pathway is present. The methods perform different epistemic functions without requiring one to validate the others mechanically.

7.18.5 Generalized Linear Models

Generalized linear models extend linear-model reasoning to outcomes with different distributional structures and link functions, including binary outcomes, counts, proportions, and related response forms McCullagh and Nelder 1989. Their methodological contribution is to align the statistical model more closely with the support and variance structure of the observed outcome.

Relational phenomena frequently produce outcomes that are discrete or bounded: entry into an institution, occurrence of an interaction, number of exchanges, presence of an event, or category of organizational status. Appropriate outcome models can improve statistical representation, while the interpretation still depends on how the event or category was generated and recorded.

The distinction between the link-scale parameter and substantive relational meaning deserves attention. A log-odds coefficient, rate ratio, or modeled probability difference is a statistical contrast. Its relational significance depends on the baseline conditions, units of change, relevant population, and mechanism under study. Presenting predicted probabilities or substantively scaled contrasts can sometimes make this interpretation more transparent than reporting model coefficients alone.

Model diagnostics remain important because a distributional family or link function can fit some aspects of a dataset while missing others. Overdispersion, zero inflation, clustering, repeated observations, or unmodeled heterogeneity can signal that the data structure requires a richer representation. Such signals can motivate revision of the statistical model or reconsideration of the relational object itself.

7.18.6 Panel Data Methods

Panel data repeatedly observe units across time and thereby allow researchers to study change, persistence, unit heterogeneity, and temporal ordering more directly than a single cross-section. Fixed-effects, random-effects, dynamic, and nonlinear panel methods provide different ways of representing repeated-unit variation and unobserved heterogeneity Wooldridge 2010.

Within relational inquiry, the meaning of a repeated “unit” should remain his-

torically and institutionally stable enough for the intended comparison. Section 7.8 showed that relational identity can persist with transformation, become interrupted, or be reconstituted. A panel identifier can remain numerically constant while the organization, household, role, jurisdiction, or institutional relation represented by that identifier changes substantially.

Panel methods are particularly valuable for separating within-unit change from cross-unit differences. Yet within-unit estimation does not automatically isolate a relational mechanism. Time-varying confounding, anticipation, feedback, treatment diffusion, and changing measurement systems can remain consequential. A study of institutional reform, for example, may observe repeated organizations while the reform itself changes their boundaries, reporting incentives, or membership composition.

A relational panel design should therefore record identity conditions, observation intervals, entry and exit, exposure histories, and possible cross-unit dependence. Attrition can also be relationally generated: units may leave the panel because of organizational closure, migration, exclusion, conflict, or changes in institutional access. Missingness then carries substantive information that later sections should preserve.

7.18.7 Time-Series Analysis

Time-series analysis focuses on ordered observations of one or several quantities and examines persistence, temporal dependence, shocks, trends, cycles, changing variance, and dynamic interaction. Hamilton's treatment includes autoregressive and multivariate dynamics, unit roots, spectral methods, time-varying variance, nonlinear models, and state-space approaches Hamilton 1994. These tools are relevant to relational inquiry when the timing and temporal organization of a process are central to the claim.

The first methodological question concerns temporal resolution. Daily, monthly, annual, and generational observations can reveal different dynamics. Aggregation can smooth short disturbances while fine temporal sampling can obscure slow institutional or structural change. The multiscale considerations of Section 7.5 therefore apply in the temporal domain as well.

Temporal dependence can reflect several relational processes: delayed response, institutional memory, habit formation, contractual duration, network diffusion, expectations, feedback, or shared exposure to an external condition. Statistical autocorrelation identifies dependence in the observed series; relational interpretation requires evidence concerning the mechanism that sustains it.

Regime changes create an additional challenge. A model fitted across a long historical interval may combine periods with different institutions, classifications, technologies, or policy rules. Structural breaks and changing parameters can therefore indicate historical transformation rather than mere statistical inconvenience. Time-series analysis becomes stronger when such changes are interpreted together with documentary, institutional, or historical evidence.

7.18.8 Multilevel Models

Multilevel or hierarchical models represent data in which observations are grouped, nested, or partially pooled across contexts. Gelman and Hill develop these models

as extensions of regression that allow varying intercepts, varying slopes, and group-level predictors while sharing information across groups Gelman and Hill 2007. They are especially relevant to the multiscale architecture developed in Section 7.5.

A statistical hierarchy, however, should correspond to a substantively meaningful scale structure. Students can be nested within classrooms and schools, workers within organizations, municipalities within regions, or repeated observations within persons. Yet many relational systems are cross-classified, overlapping, networked, or institutionally permeable. A person may belong to several organizations; an organization may operate across jurisdictions; a community may be connected through migration or digital infrastructure. Hierarchical models can be extended to some of these structures, while the substantive mapping should remain explicit.

Proposition 7.177 (Scale-model correspondence). *A multilevel statistical model supports a multiscale relational claim most clearly when its modeled levels correspond to substantively justified relational scales and when cross-level pathways are specified independently of the statistical nesting itself.*

Proposition 7.177 prevents statistical hierarchy from becoming an ontological hierarchy. Variation attributed to a school, organization, region, or institution can be empirically informative while still requiring explanation of the relations through which the contextual effect is generated.

7.18.9 Experimental Design

Experimental design uses an assignment mechanism controlled or structured by the researcher to create comparisons between treatment conditions. Randomization can support causal inference by balancing potential confounders in expectation and by grounding uncertainty in the assignment process Imbens and Rubin 2015. Experiments therefore provide a particularly explicit relation between design, assignment, treatment, outcome, and estimand.

Relational inquiry adds several considerations. Treatment may be delivered through relationships rather than to isolated units. Information can diffuse among participants. Peers can respond to one another's treatment status. Organizational practices can change when a subset of members is treated. A policy intervention can alter the field in which control units operate. These forms of interference make the relational structure part of the experiment rather than a nuisance external to it.

Treatment itself can also be heterogeneous. A nominal intervention can be implemented differently across organizations, mediated by different authorities, or interpreted differently by participants. Recording treatment implementation, exposure, contact, and institutional context can therefore strengthen the link between experimental assignment and the relational process being studied.

Experiments can be especially informative when combined with qualitative or process evidence. Randomization can identify an average contrast under a specified design; interviews, observation, administrative data, or mechanism-focused measures can help reconstruct why the contrast emerged and whether it reflects the generative relation of interest.

7.18.10 Quasi-Experimental Design

Quasi-experimental designs use institutional rules, policy changes, thresholds, timing, natural variation, or other assignment structures to construct causal comparisons without researcher-controlled randomization. Applied econometrics has developed a substantial repertoire around these designs Angrist and Pischke 2009. Their evidential strength arises from the design logic connecting observed variation to a counterfactual contrast.

The identifying assumption is therefore part of the substantive argument. Institutional assignment rules can be manipulated, anticipated, selectively enforced, or experienced differently across relational positions. Policy exposure can spill across jurisdictions. Eligibility can depend on administrative classification whose meaning changes over time. A plausible quasi-experimental design should reconstruct these relations sufficiently to assess whether the statistical comparison corresponds to the intended assignment mechanism.

Definition 7.178 (Relational identification profile). *A relational identification profile records the causal estimand, assignment or exposure mechanism, relevant units and relations, temporal ordering, interference pathways, identifying assumptions, diagnostics, alternative mechanisms, and the population or relational domain to which the estimate is intended to apply.*

This profile will remain useful across difference-in-differences, instrumental variables, regression discontinuity, matching, and related designs. It makes the design's relational dependencies visible before the resulting estimate is interpreted as evidence about a broader process.

7.18.11 Difference-in-Differences

Difference-in-differences designs compare changes over time between groups with different exposure to an intervention or event. Their appeal lies in using pre/post and between-group contrasts to remove stable group differences under an appropriate counterfactual trend assumption. Applied econometric treatments place the design among the central tools for policy evaluation Angrist and Pischke 2009, while Bertrand, Duflo, and Mullainathan show why serial correlation can materially affect uncertainty assessment in common applications Bertrand et al. 2004.

For relational inquiry, the parallel-trends argument should be considered together with institutional and historical comparability. Groups can face common macro conditions while occupying different relational positions. Anticipation can begin before the formal intervention date. Treatment can diffuse through markets, migration, information, organizations, or neighboring jurisdictions. Composition can also change if the intervention alters who remains observable in each group.

Pre-treatment trajectories, event-time patterns, alternative control groups, composition checks, and historically informed placebo periods can help assess design plausibility. These diagnostics do not transform the identifying assumption into an observed fact; they provide evidence concerning whether the counterfactual comparison is credible within the specified domain.

Difference-in-differences is especially compatible with GRE when institutional change occurs at a recognizable time while economic relations evolve before and after that change. Quantitative estimates can identify patterned changes, while pro-

cess and institutional evidence can examine how the policy entered organizational routines, allocation practices, or value-generation relations.

7.18.12 Instrumental Variables

Instrumental-variable methods use variation in an instrument to isolate a component of treatment or exposure that can support a causal contrast under design-specific assumptions Angrist and Pischke 2009; Wooldridge 2010. The substantive difficulty often lies less in the estimator than in the credibility of the instrument's relational pathway.

Relevance requires that the instrument changes exposure. Exclusion requires a defensible account of why the instrument affects the outcome through the specified treatment pathway within the relevant domain. Institutional rules, distance measures, assignment procedures, prices, timing, or policy shocks can create candidate instruments, yet each can also participate in additional relations that reach the outcome.

A relational analysis of an instrument therefore maps the instrument's connections to treatment, outcome, mediators, institutions, and populations. This makes the exclusion restriction a substantive pathway claim. Historical and institutional knowledge can be central because the same instrument can operate differently across periods, organizations, or jurisdictions.

Instrumental-variable estimates can also identify a local or subgroup-specific causal effect under particular conditions. Interpretation should therefore preserve the population whose treatment status is shifted by the instrument rather than automatically generalizing the estimate to broader populations or relations.

7.18.13 Regression Discontinuity

Regression-discontinuity designs use a threshold in an observed assignment variable to estimate a local treatment contrast when treatment probability changes discontinuously at the cutoff Imbens and Lemieux 2008. The design can provide strong local identification when units near the threshold are comparable under the relevant assignment process.

Relational inquiry should reconstruct the institution that creates and enforces the threshold. A score cutoff, age rule, income criterion, geographic boundary, or administrative ranking can be implemented with varying discretion. Actors may manipulate the running variable, anticipate the threshold, or receive additional services linked to the same cutoff. The formal rule and enacted assignment process therefore require joint examination.

The resulting causal estimand is usually local to observations near the threshold. This locality can be an advantage because it makes the comparison precise; it also places a boundary on broader transfer. Relations among units near the cutoff may differ from those farther away, especially when thresholds determine entry into institutions, programs, or status categories.

Visual inspection, density checks, alternative bandwidths, polynomial choices, covariate continuity, and institutional evidence can contribute to design assessment. These checks serve different purposes and should be interpreted in relation to the

assignment mechanism rather than combined into a single ritual of robustness.

7.18.14 Matching and Weighting

Matching and weighting create comparisons between treated and untreated observations with more similar distributions of observed covariates. Rosenbaum and Rubin's propensity-score framework formalizes one influential approach to balancing observed covariates through matching, subclassification, or related adjustment Rosenbaum and Rubin 1983. These methods can improve comparability when the relevant confounding information is observed and adequately represented.

The relational challenge concerns what enters the covariate set. Institutional membership, network position, prior exposure, neighborhood context, household structure, and access to resources can influence both treatment and outcome. If such features are omitted or poorly measured, covariate balance on the recorded variables can coexist with substantive imbalance in the relational configuration.

Balance diagnostics should therefore be interpreted together with measurement adequacy and the temporal ordering of covariates. Variables affected by treatment require different treatment from genuine pre-exposure characteristics. High-dimensional data can expand the available adjustment set, yet automated selection does not remove the need to understand which variables represent confounders, mediators, colliders, or proxies within the substantive process.

Weighting also creates a new analytic population. Large weights can make inference depend strongly on a small set of observations, and limited overlap can signal that the desired comparison is weakly supported by observed cases. Relational inquiry can treat such overlap problems as evidence about segmentation in the underlying population rather than merely as a computational inconvenience.

7.18.15 Measurement and Scale Construction

Measurement converts theoretical or substantive distinctions into observable indicators, indices, categories, scores, or scales. Scale-development methodology emphasizes item construction, reliability, validity, and the relation between indicators and the construct they are intended to represent DeVellis and Thorpe 2021. In GR, measurement is a transformation between an analytical object and a manifestational representation.

A high internal-consistency coefficient can show that items covary in a regular way; it does not by itself establish that the resulting scale captures the intended relational construct. Trust, power, dependence, generativity, institutional access, or perceived constraint can contain dimensions that are only partially commensurable. Collapsing them into one score can be useful for a specific inferential task while leaving a measurement remainder.

Definition 7.179 (Measurement transformation profile). A *measurement transformation profile* records the target construct, indicators, coding or scaling operation, unit of observation, temporal reference, assumptions of comparability, validation evidence, uncertainty, and substantive dimensions that are compressed or left outside the resulting measure.

Measurement invariance across groups or time is especially important for com-

parative and longitudinal research. A response category can shift meaning across languages, institutions, cohorts, or historical periods. A monetary measure can preserve numerical units while its practical purchasing or relational meaning changes. Measurement therefore connects quantitative analysis back to conceptual history, interview interpretation, and institutional inquiry.

Scale construction can also be explicitly relational. Measures can be derived from dyadic reports, network positions, institutional roles, transaction patterns, or cross-level configurations. In such cases the unit of measurement should correspond to the relational object rather than being forced into an individual-level format for convenience.

7.18.16 Missing-Data Methods

Missing-data methods address incomplete observation by modeling, weighting, imputing, or otherwise accounting for the process through which values become unavailable. Little and Rubin provide a comprehensive framework for analyzing missingness mechanisms and statistical inference with incomplete data Little and Rubin 2019. Relational inquiry adds a substantive question: which relations produce the missingness?

Nonresponse can follow mistrust, institutional exclusion, language barriers, migration, digital disconnection, conflict, organizational closure, survey fatigue, administrative classification, or legal restrictions. Record linkage can fail more often for actors with unstable identities or fragmented documentation. Transaction data can omit informal exchange. Network surveys can miss weak, stigmatized, or cross-boundary ties. Missingness can therefore be socially and institutionally patterned.

A missing-data strategy should distinguish the statistical assumptions required for estimation from the substantive explanation of missingness. Multiple imputation or weighting can provide useful uncertainty propagation under specified models, while qualitative or institutional evidence can inform whether those models are plausible. Sometimes the distribution of missingness is itself an empirical finding about access, visibility, or institutional participation.

Preserving missingness provenance also supports future re-epistemization. Researchers should record whether data were unavailable at source, lost in processing, suppressed for privacy, excluded by design, unmatched during linkage, or absent because a participant did not respond. These pathways can have different implications for inference and later reuse.

7.18.17 Robustness and Sensitivity Analysis

Robustness and sensitivity analysis examine how conclusions change under alternative modeling, measurement, sampling, boundary, or identifying choices. Their role is to expose dependence on assumptions that might otherwise remain hidden. In relational inquiry, this includes sensitivity to case inclusion, temporal windows, scale, clustering, exposure definitions, weighting, missing-data models, and alternative operationalizations of the focal relation.

A robustness result is indexed to the alternatives examined. Stability across several regression specifications provides evidence against sensitivity to those particular

specifications; it does not establish invariance to unexamined measurement error, interference, historical regime change, or omitted relational structure. Sensitivity analysis should therefore be organized around substantively plausible failure modes rather than around the number of alternative models produced.

Boundary and scale sensitivity deserve special attention. A result can be stable within one institutional boundary yet change when cross-boundary actors are included. An individual-level association can reverse or weaken after organizational structure is modeled. A treatment effect can vary across time because the surrounding field has changed. These shifts can reveal relational organization rather than merely model fragility.

AI-assisted workflows can generate very large specification spaces. This increases the practical value of preregistered design logic, transparent model families, held-out validation where appropriate, and explicit criteria for interpreting variation across specifications. Abundance of estimates can otherwise obscure the conceptual choices that produced them.

7.18.18 Limits of Quantitative Identification

Quantitative-empirical methods provide powerful tools for population description, uncertainty quantification, conditional comparison, causal estimation, dynamic modeling, and multilevel analysis. Their limits arise where identification depends on weakly supported measurement assumptions, incomplete assignment information, interference, unstable unit identity, limited overlap, changing institutions, selective observation, or model structures that compress consequential relational heterogeneity.

The first limit concerns representation. Statistical variables are constructed manifestations. A precise estimate of a poorly specified construct can remain substantively ambiguous. Measurement validity, classification history, and scale therefore precede interpretation of precision.

The second limit concerns dependence. Many social-science estimators become simpler when observations can be treated as conditionally independent or when dependence has a tractable structure. Relational systems can contain spillovers, shared institutions, network diffusion, strategic response, common shocks, and feedback. These structures can sometimes be modeled directly; in other cases they place boundaries on the estimand or uncertainty statement.

The third limit concerns identification. Experimental and quasi-experimental designs support causal claims through design-specific assumptions. Randomization, parallel trends, exclusion, threshold continuity, overlap, and related conditions carry substantive content. Their plausibility depends partly on institutional and relational knowledge. Statistical diagnostics can provide evidence about some implications of these assumptions, while historical, qualitative, legal, or organizational inquiry can illuminate the processes that generate them.

The fourth limit concerns transfer. A locally identified effect can be well warranted for a defined population, threshold neighborhood, period, or assignment mechanism while broader portability remains open. GRE is especially interested in generative consequences that unfold through changing relations, institutions, and scales. A treatment effect estimated at one stage of a trajectory may therefore require additional evidence before being treated as a stable property of the system.

Proposition 7.180 (Quantitative warrant). *The warrant of a quantitative-empirical claim is strengthened when its estimand, measurement system, sampling or assignment process, dependence structure, identifying assumptions, uncertainty model, and transfer scope are stated in the research design.*

Proposition 7.180 connects quantitative practice with the epistemic humility established in Chapter 6. The objective is disciplined strength rather than rhetorical caution: a tightly identified local effect, a carefully estimated population quantity, or a well-supported temporal pattern can be stated clearly when the design justifies it. Broader relational or generative interpretations then require additional inferential steps.

Quantitative-empirical methods also interact productively with contingent encounter and aesthetic judgment. Unexpected residuals, subgroup divergences, threshold discontinuities, temporal breaks, missingness patterns, unstable coefficients, or anomalous distributions can make a previously unnoticed relation salient. Statistical anomaly does not determine significance; it creates a candidate encounter whose interpretation can be pursued through revised measurement, historical reconstruction, institutional analysis, qualitative inquiry, or new quantitative design.

AI further changes this environment by reducing the cost of model fitting, variable construction, simulation, code generation, and specification search. The resulting methodological abundance increases the importance of design provenance, inferential purpose, source verification, multiplicity control, and judgment about which contrasts correspond to meaningful relational questions. Quantitative capacity therefore complements rather than displaces the earlier methodological requirements concerning object specification, boundary construction, scale selection, relation identification, and relational meaning.

The quantitative-empirical family thus contributes a substantial repertoire for estimating prevalence, distributions, contrasts, dynamic patterns, hierarchical variation, and causal effects under explicit designs. Its strongest integration with relational inquiry occurs when numerical representation remains connected to the relational conditions through which units are sampled, variables are measured, treatments are assigned, outcomes are generated, and observations become dependent. The next section turns to network analysis, where relations themselves become primary data structures and where the construction of nodes, edges, direction, weights, dynamics, multiplexity, community structure, and centrality requires a further set of methodological disciplines.

7.19 Network Analysis

The preceding sections developed quantitative-empirical methods while retaining the relational conditions through which units, measurements, exposures, and dependencies are produced. The present section turns to network analysis, where relations become primary components of the analytical representation. Its role is to specify how nodes and edges are constructed, how direction and weight alter relational interpretation, how temporal and multiplex networks extend static single-layer representations, how community structure and centrality can be used with substantive discipline, how network uncertainty should be preserved, and where graph representations reach their analytical limits. The discussion treats network methods as a

powerful family of relational representations while keeping their ontological status provisional and their evidential interpretation connected to the identification, characterization, boundary, scale, and configuration procedures developed earlier in this chapter.

Social network analysis has long emphasized patterned relations among social entities rather than limiting explanation to independently measured attributes Wellman 1983; Wasserman and Faust 1994. Contemporary network science extends this structural vocabulary across social, technological, biological, and other systems Newman 2003. For Generative Relational Theory, this family of methods is especially useful because it can represent dependence, reachability, brokerage, clustering, path structure, positional organization, and changing connectivity in forms that are often difficult to recover from variable-centered summaries alone. At the same time, a graph does not arrive directly from relational reality. A researcher constructs a graph by specifying which objects become nodes, which manifestations warrant edges, which relation types are preserved, how time is represented, and which parts of the surrounding field remain outside the network boundary.

Definition 7.181 (Network specification). A *network specification* is a question-relative and revisable representation consisting of a node set, one or more edge relations, boundary and scale conditions, temporal scope, direction and weight conventions where relevant, provenance for the underlying observations, and an account of the substantive meaning assigned to the resulting graph properties.

Definition 7.181 places graph construction within the broader methodology developed in Sections 169–175. A network can be formally precise while remaining substantively weak if its nodes combine unlike objects, its edges conflate different relations, or its boundary excludes relations central to the target claim. Conversely, a comparatively simple graph can be highly informative when node identity, edge semantics, and scope are well aligned with the research question.

Table 7.18 summarizes the principal network representations discussed below. The table organizes analytical choices rather than a progression toward increasingly complete models. A research project can combine several forms when the evidence and target inference support doing so.

7.19.1 Nodes as Analytical Constructions

A network representation begins with a node set. Nodes can represent people, households, organizations, institutions, jurisdictions, documents, technologies, places, events, concepts, or other analytically specified positions. Their apparent simplicity can conceal substantial methodological work. Section 169 showed that research objects require provisional individuation; node construction is one formal implementation of that problem.

The relevant question is therefore not only which entities are present in the source material, but which distinctions among them need to be preserved for the target analysis. An organization can be represented as one node when interorganizational exchange is the focus, while the same organization can be decomposed into departments, roles, or individuals when internal coordination matters. A household can function as one node for some resource-flow questions and as a configuration of differentiated members for questions concerning intra-household allocation. A digital account can be a technically stable identifier while remaining an uncertain represen-

Table 7.18: Network representations and characteristic methodological questions

Form	Primary analytical contribution	Specification requirement	Characteristic risk
Node set	Defines the represented positions or units	Individuation, identity, boundary, scale, inclusion rule	Analytical units are treated as naturally given
Edge set	Encodes the represented relation	Relation semantics, evidence, temporal scope, threshold or coding rule	Different relations are compressed into a single tie
Directed network	Preserves asymmetric relational orientation	Meaning of source and target, reciprocal-edge interpretation	Direction is inferred from data format rather than substantive relation
Weighted network	Preserves valued variation among edges	Meaning, unit, scale, sign, and transformation of weights	Weight is interpreted as generic tie strength
Dynamic network	Represents changing relational structure	Time stamps or intervals, node persistence, event ordering, observation window	Temporal aggregation creates spurious simultaneity or continuity
Multiplex network	Separates several relation types or layers	Layer semantics, interlayer correspondence, node-layer identity	Layers are combined before their differences are examined
Community structure	Identifies clustered or modular organization	Algorithm, resolution, relation type, stability, substantive interpretation	Detected clusters are reified as natural communities
Centrality	Describes selected forms of structural position	Measure, network type, edge semantics, direction, weight, scale	Numerical prominence is interpreted as generic power or importance
Uncertain network	Preserves ambiguity in nodes, edges, boundaries, or observations	Error model, alternative graphs, provenance, sensitivity procedure	One convenient graph is treated as settled structure

tation of a person, collective, automated agent, or shared device.

Node identity is also temporal. Mergers, renaming, migration, reorganization, account replacement, role succession, and institutional transformation can make longitudinal node matching difficult. The relational identity principles developed in Section 174 therefore apply directly to dynamic network construction. A persistent identifier provides one continuity carrier; it does not by itself settle whether the represented relational position has remained substantively continuous.

Node construction also has distributive consequences for visibility. Aggregating several actors into one node can suppress internal inequality, disagreement, or differentiated access. Splitting a collective actor into many nodes can weaken the representation of coordinated capacity. Excluding actors because they lack standardized identifiers can remove precisely those positions whose institutional marginality makes them important to the study. These choices should therefore be documented as part of the network specification.

Definition 7.182 (Node specification profile). A *node specification profile* records the analytical object represented by a node, the individuation and inclusion rules, boundary and scale, temporal identity criteria, relevant aggregation or decomposition choices, and uncertainties concerning whether the node corresponds adequately to the relational position required by the research question.

The profile makes node construction comparable across datasets and research designs. It also facilitates later revision when evidence indicates that a node should be split, merged, reclassified, or represented at another scale.

7.19.2 Edges as Analytical Constructions

Edges encode relations among nodes. Network analysis gains much of its analytical power by making these relations explicit, yet an edge remains a methodological construction supported by a relation-identification procedure. A message, transaction, citation, contract, co-membership, geographic adjacency, reported friendship, legal obligation, shared ownership, or observed interaction can each generate an edge under a suitable design. Their evidential meanings differ substantially.

The edge definition should specify what relational claim the edge represents. A communication edge can mean that at least one message was sent during a period, that communication exceeded a threshold, that reciprocal exchange occurred, or that a participant named another actor as a routine contact. A financial edge can represent a single transfer, cumulative flow, contractual exposure, ownership, credit dependence, or a recurrent exchange relation. These definitions can produce different network topologies from the same underlying archive.

Thresholding deserves particular care. Converting valued observations into binary edges can be useful for questions concerned with presence, reachability, or connectivity, while the chosen threshold may create or remove components, bridges, communities, and central positions. The threshold should therefore follow a substantive or measurement rationale where possible, and sensitivity to plausible alternatives can be examined when the choice remains uncertain.

Edge meaning can also vary across nodes or periods. The same administrative code can correspond to different practical relations in different institutions. A platform-defined “connection” can involve very different degrees of interaction. A legal relationship can remain formally present during periods of little enactment. Edge construction therefore benefits from the relation-characterization profile developed in Section 173, especially when direction, dependence, meaning, or institutional status is central to later interpretation.

Definition 7.183 (Edge semantics profile). An *edge semantics profile* records the substantive relation represented by an edge, the manifestations and inferential bridge supporting its identification, coding or threshold rules, temporal reference, direction and value conventions where relevant, and uncertainty concerning the relation’s presence or meaning.

This profile helps prevent computational convenience from silently determining relational ontology. It also supports reproducibility when several plausible edge definitions can be constructed from the same source material.

7.19.3 Directed Networks

Directed networks preserve orientation between source and target positions. Graph theory and social network analysis distinguish directed from undirected relations because the direction of an edge changes reachability, path structure, degree, reciprocity, centrality, and many other structural quantities Wasserman and Faust 1994; Newman 2003. Direction can correspond to flows of information, resources, authority, nominations, obligations, citations, referrals, commands, or other oriented relations.

The substantive meaning of direction should be stated explicitly. A payment from one actor to another, an order issued by one office to another, and a citation from one

document to another are directed, yet their direction represents different processes. For some relations, direction describes an event while the underlying relationship is reciprocal or mutually constituted. A request can move from one actor to another while the institutional relation that makes the request consequential extends in both directions through rights and obligations.

Reciprocal directed edges also require interpretation. Two opposing edges can indicate mutual exchange, sequential response, independent obligations, conflict, or simply two recorded events. The reciprocity of observed edges should therefore be distinguished from the reciprocity of the substantive relation discussed in Section 173. The network representation can preserve both directions while later interpretation examines whether they amount to balanced exchange, mutual recognition, asymmetric dependence, or another configuration.

Direction can become uncertain when data systems record origin and destination for technical reasons that do not map cleanly onto substantive relational orientation. A database may assign sender and receiver while both actors participate in a jointly constituted transaction. A co-authorship event has no natural direction unless the research design introduces one through contribution, sequence, or another criterion. Retaining an undirected representation can therefore be methodologically preferable when the substantive relation lacks a justified orientation.

Directed networks are particularly important for GRE because economic and institutional relations frequently involve asymmetric flows. Resources, authority, obligations, information, risk, and value can move differently across the same pair of positions. A directed representation can preserve these asymmetries before later analysis examines how they interact with dependence, return, capture, or generative consequence.

7.19.4 Weighted Networks

Weighted networks attach a numerical value to an edge. The value can represent frequency, volume, duration, probability, capacity, monetary amount, similarity, distance, exposure, confidence, or another measured quantity. Weighted network methods can preserve information that a binary representation would compress, and centrality measures can be generalized to incorporate both tie number and tie weight Opsahl et al. 2010.

A weight acquires meaning through its measurement model. Ten messages, ten million yen, ten hours of interaction, and a probability of 0.10 are numerically comparable only after a transformation chosen for a specific analytical purpose. Even within one data type, larger values can mean stronger connection, greater distance, higher cost, greater uncertainty, or weaker similarity. Algorithms that treat larger weights as shorter or stronger links can therefore require transformation before substantive interpretation.

The weight can also combine several processes. Transaction volume can increase because a relation is important, because prices changed, because reporting improved, or because one large event occurred. Interaction frequency can rise while trust declines. A survey rating can represent perceived closeness rather than observed exchange. The intensity dimensions discussed in Section 173 therefore remain distinct from network weight unless the measurement design justifies their alignment.

Signed or otherwise typed values can further complicate interpretation. Positive

and negative evaluations, gains and losses, support and opposition, or credit and debt can carry qualitatively different meanings that are poorly represented as points on one generic strength scale. In these cases, separate layers, typed edges, or a richer relational representation may preserve more of the relevant structure.

Weighted-network sensitivity analysis should examine whether substantive conclusions depend on a small number of extreme edges, transformations of the weight scale, missing observations, or the conversion between valued and binary representations. This is especially important when centrality, community structure, or shortest-path calculations are highly responsive to the weight convention.

7.19.5 Dynamic Networks

Dynamic network analysis represents change in relational structure through time. Temporal-network methods emphasize that the timing and ordering of edges can alter reachability, diffusion, coordination, and other processes that a time-aggregated graph can conceal Holme and Saramäki 2012. A relation appearing before another can create a feasible pathway, while the same two edges occurring in the reverse order may not.

Several temporal representations are available. Snapshot networks divide time into intervals and compare graph structure across those intervals. Event-based representations preserve edge times more finely. Interval-based representations record relations with duration. Dynamic models can estimate processes through which edges appear, persist, or dissolve. The choice should reflect the temporal resolution of both the evidence and the research question.

Temporal aggregation is therefore a methodological choice. A yearly collaboration network can represent durable patterns while concealing monthly turnover. A daily communication network can reveal rapid response while obscuring long-term institutional structure. The relevant temporal window can also differ across scales: interpersonal exchange may vary over hours or days, organizational partnerships over years, and institutional relations over decades. The multiscale considerations of Section 171 therefore interact with temporal network design.

Node identity and edge identity both require longitudinal discipline. An edge observed in two adjacent periods can represent persistence, repeated formation, or two events produced by a stable institutional rule. A missing edge can represent dissolution, dormancy, non-observation, or a temporary recording gap. The persistence criteria developed in Section 174 and the network uncertainty methods developed below help distinguish these possibilities.

Dynamic networks also prepare the way for generative analysis in Chapter 8. Structural change can be studied descriptively within the present chapter without yet attributing a generative mechanism. Later inquiry can ask how network position, feedback, institutional change, or cross-scale coupling contributes to the formation and transformation of relational structure.

7.19.6 Multiplex Networks

Multiplex and multilayer network representations preserve several types of relations, contexts, or layers within one analytical framework. Kivelä and colleagues review multilayer-network formalisms for systems containing multiple connectivity layers

and interlayer relations Kivelä et al. 2014. These representations are particularly relevant when the same positions participate simultaneously in communication, exchange, authority, trust, ownership, mobility, care, legal obligation, or other relation types.

The methodological advantage is preservation of relational heterogeneity. Two organizations can be weakly connected financially and strongly connected through personnel exchange. Two individuals can communicate frequently while occupying an asymmetric authority relation. Two jurisdictions can compete economically while sharing infrastructure. Collapsing these relations into one edge can produce a topology whose substantive meaning is difficult to recover.

Layer construction nevertheless requires its own specification. A layer can represent a relation type, communication channel, institutional setting, temporal regime, geographic domain, or another analytical distinction. These are different uses of multilayer representation. The researcher should therefore state why the layers are separated, how node identity is maintained across them, what interlayer relations mean, and whether weights are comparable across layers.

Multiplexity can also generate second-order questions. A relation in one layer can enable, constrain, substitute for, or reinforce a relation in another. Formal authority can enable information access; trust can support credit; shared infrastructure can create interdependence despite weak direct exchange. These relations among relations connect multiplex analysis to the second-order configurations introduced in Section 175 and to the higher-order analysis of Section 186.

A multilayer representation can increase descriptive fidelity while also increasing analytical complexity. Layer selection should therefore remain question-relative. Additional layers are valuable when they preserve differences that materially affect the target inference. A highly elaborate multilayer model can become difficult to identify or interpret when the evidence supporting interlayer structure is weak.

7.19.7 Community Structure

Community structure refers to clustered or modular organization in a network. Many methods seek groups of nodes with relatively dense internal connection, comparatively sparse external connection, similar connectivity profiles, or another algorithmically specified form of cohesion. Fortunato's review documents the breadth of community-detection approaches and the continuing methodological difficulties involved in defining and detecting graph communities Fortunato 2010.

The first discipline concerns interpretation. An algorithmic community is a partition or grouping induced by a criterion applied to the specified graph. It can correspond to a meaningful social group, organizational division, functional subsystem, market cluster, or knowledge community, while such correspondence requires substantive evidence. A modularity-based cluster in transaction data, for example, does not by itself establish shared identity, common norms, or institutional cohesion.

The second discipline concerns resolution. Large-scale partitions can conceal smaller cohesive structures, while highly resolved algorithms can fragment broader organizational units. Different algorithms can return different partitions from the same graph because they optimize different objectives or encode different assumptions. Community analysis should therefore report the method, relevant resolution parameters, treatment of direction and weights, and the degree to which the resulting

grouping remains stable under plausible alternatives.

The third discipline concerns boundary and scale. A community can appear cohesive because important external relations were excluded from the network boundary. A local cluster can be strongly dependent on an external infrastructure or gatekeeper. Aggregation can create apparent cohesion among units whose internal relations are heterogeneous. Community structure should therefore be interpreted together with boundary sensitivity and multiscale analysis.

Community detection can also be used comparatively without reifying communities. Researchers can ask whether a network becomes more modular over time, whether bridging relations shift, whether certain relation types cluster differently, or whether an institutional change alters the stability of partitions. These claims concern the specified representation and become stronger when they are connected to historical, qualitative, organizational, or economic evidence about the corresponding relational processes.

7.19.8 Centrality

Centrality describes selected forms of structural position. Freeman's classic clarification distinguishes several conceptions of centrality rather than treating centrality as one generic property Freeman 1978. Degree-based measures concern direct connection, closeness-based measures concern path distance under specified assumptions, and betweenness-based measures concern the frequency with which positions lie on selected paths between others. Other network settings motivate eigenvector, flow, brokerage, random-walk, or layer-specific measures.

The choice of centrality measure should therefore follow the substantive question. A node with many direct contacts can differ from a node connecting otherwise separated regions. A position close to many others under a path metric can differ from one embedded in a prestigious neighborhood. Weighted and directed networks further alter the interpretation, and weighted centrality can depend on how tie number and tie strength are combined Opsahl et al. 2010.

Definition 7.184 (Centrality interpretation profile). A *centrality interpretation profile* records the structural concept represented by a centrality measure, the network specification on which it is computed, the role of direction and weight, the assumed meaning of paths or walks, the boundary and scale, and the substantive claim that the resulting score is intended to support.

This profile helps separate structural position from broader evaluative concepts. A central position in a communication network can indicate visibility or brokerage while providing limited evidence about formal authority. A central position in a payment network can reflect transaction volume while revealing little about profitability or dependence. High betweenness can create brokerage opportunities in one institutional context and operational burden in another. Structural centrality can therefore contribute to analyses of power, access, vulnerability, or coordination when the mechanism connecting position to those outcomes is separately supported.

Centrality is also boundary-sensitive. Adding previously omitted nodes or cross-boundary edges can substantially change rankings and path-based measures. Scale matters as well: a local hub can be peripheral in a national network, while a globally central institution can be only weakly connected within a specialized local field. Longitudinal centrality can change because relations change, node identity changes, or

observation coverage changes. Centrality claims should therefore retain the network specification with which the score was generated.

7.19.9 Network Uncertainty

Network uncertainty arises because nodes, edges, weights, directions, times, layers, and boundaries can be imperfectly observed or ambiguously specified. Social-network research has long confronted measurement error and informant inaccuracy; Butts develops a Bayesian approach that jointly models social structure and informant accuracy in the presence of error and missing data Butts 2003. The broader methodological lesson is that a network can be treated as an uncertain reconstruction rather than a fully observed object.

Edge uncertainty is one component. A reported relation can be forgotten, strategically concealed, misclassified, or recorded by only one participant. Digital logs can omit interactions outside the platform. Administrative data can contain linkage failures. Historical networks can depend on incomplete archives. Inferred edges can carry model uncertainty. A binary graph constructed after these processes can conceal substantial variation in evidential confidence.

Node uncertainty can be equally consequential. Entity-resolution errors can merge distinct actors or split one actor into several identifiers. Hidden, anonymous, informal, or poorly documented participants can be absent from the node set. Historical actors can change names or organizational forms. Boundary uncertainty can determine whether peripheral or cross-system relations appear in the represented network.

Uncertainty can be propagated through analysis in several ways. Researchers can estimate probabilistic networks, compare alternative graph reconstructions, perturb uncertain edges, vary thresholds and boundaries, or report intervals and distributions for derived statistics. The appropriate strategy depends on the source of uncertainty and the claim being made. A centrality ranking that changes under a few plausible edge corrections deserves a different interpretation from a robust component structure that persists across many alternative reconstructions.

Definition 7.185 (Network uncertainty envelope). *A network uncertainty envelope is the set of substantively plausible network reconstructions generated by uncertainty in node identity, edge presence or type, direction, weight, timing, layer assignment, boundary, or measurement, together with the graph-level conclusions that remain stable or change across those reconstructions.*

The envelope extends the configuration uncertainty profile from Section 175 into computational network analysis. It is particularly useful when visually persuasive network maps could otherwise create a stronger impression of certainty than the underlying evidence supports.

AI-assisted network construction makes this issue increasingly important. Automated entity linking, relation extraction, graph completion, community detection, and embedding-based similarity can generate large candidate networks rapidly. These tools can enlarge the encounter surface of inquiry by exposing unexpected paths or clusters, while model-generated edges and representations require provenance and independent validation. A predicted relation should remain distinguishable from an observed, reported, legally established, historically reconstructed, or experimentally inferred relation.

7.19.10 Limits of Graph Representation

Graph representations provide a powerful language for pairwise relational structure, paths, connectivity, position, clustering, and change. Their analytical limits become visible when the target phenomenon depends on information that the chosen graph does not preserve. These limits are representation-specific rather than a general objection to network analysis.

The first limit concerns pairwise reduction. Some relations are jointly constituted by several positions. Committee decisions, team production, coalitions, multilateral obligations, and group interactions can lose important structure when projected onto dyadic edges. Higher-order network methods using hypergraphs, simplicial structures, and related representations address part of this problem, and the next section develops these approaches directly. Research on networks beyond pairwise interactions shows that higher-order structure can support dynamical behavior that pairwise descriptions fail to preserve Battiston et al. 2020.

The second limit concerns semantics. Two graphs can be topologically identical while representing substantively different relations. A path of legal authority, a path of friendship, and a path of financial exposure can share the same formal shape while implying different mechanisms, risks, and normative meanings. Graph isomorphism therefore does not establish substantive equivalence.

The third limit concerns field conditions and diffuse constraints. Prices, legal regimes, cultural expectations, technological standards, ecological conditions, or monetary systems can influence many positions without appearing naturally as pairwise edges. Some of these conditions can be represented through additional nodes, layers, or attributes; others may be better handled through field, institutional, spatial, or dynamical representations. Forcing each distributed condition into an edge can reduce interpretability.

The fourth limit concerns event and process structure. Static graphs can summarize relational architecture while concealing sequence, duration, negotiation, interpretation, and transformation. Temporal networks address part of this limitation, yet some processes require narrative, process-tracing, ethnographic, legal, or dynamical descriptions that preserve more than connectivity.

The fifth limit concerns ontological reification. Network visualizations can make analytical constructions appear concrete. A node's position, an edge's presence, or a community boundary can look self-evident once rendered graphically. The methodological response is to retain the network specification, provenance, alternative representations, and interpretation profile alongside the visual or numerical output.

Proposition 7.186 (Graph-representation discipline). *A network claim becomes more accountable when the node and edge constructions, boundary and scale, temporal representation, relation semantics, uncertainty, and mapping from graph property to substantive interpretation remain explicit and revisable.*

Proposition 7.186 aligns network analysis with the ontology, epistemology, and research praxis developed earlier in the book. The graph is treated as a formal representation whose usefulness depends on the relation between its construction and the target phenomenon. Strong topological evidence can therefore coexist with epistemic humility about what that topology means beyond the specified representation.

Network analysis also illustrates the continuing role of contingent encounter and aesthetic judgment. A visualization, unusual bridge, isolated component, temporal

rupture, multiplex mismatch, or unstable community can make a relational pattern salient before its significance is understood. Subsequent inquiry can test whether the pattern reflects substantive organization, measurement artifacts, boundary choice, data-generating infrastructure, or chance. AI can increase the number of candidate patterns available for inspection, making disciplined selection and verification increasingly important.

The network methods developed here provide a substantial toolkit for representing pairwise relational structure while preserving direction, value, time, layers, clustered organization, positional structure, and uncertainty. Their limits also identify the next methodological step. Section 186 turns to higher-order relational analysis, where hypergraphs, simplicial structures, multilateral relations, collective relations, relations among relations, and higher-order dependence are used to represent configurations whose relevant structure is only partially preserved by pairwise graphs.

7.20 Higher-Order Relational Analysis

Section 185 developed network analysis as a disciplined representation of pairwise relational structure and ended at a representational boundary: some empirical configurations derive their meaning or consequence from joint participation by three or more positions, while others involve relations that condition, authorize, compose with, or otherwise take other relations as their analytical objects. The present section develops methods for these cases. Its role is to distinguish higher-arity relations from relations among relations, to specify when hypergraphs and simplicial structures preserve information lost under dyadic projection, to reconstruct multilateral and collective relations, to characterize higher-order dependence, and to establish measurement and reduction criteria. The discussion treats higher-order representations as question-relative analytical instruments. Their usefulness depends on whether the additional structure corresponds to a substantively warranted feature of the research object and preserves information relevant to the target inference.

Research on networks beyond pairwise interactions has developed several mathematical languages for representing interactions involving groups of units and for studying dynamics whose behavior can differ from pairwise approximations Battiston et al. 2020; Bick et al. 2023. These methods are relevant to Generative Relational Theory because many institutional, economic, legal, organizational, and epistemic processes involve jointly constituted conditions. A committee decision can depend on a quorum; a guarantee can involve debtor, creditor, and guarantor positions; a research team can produce an output through a jointly organized task; a multilateral agreement can establish obligations whose operation depends on several parties; and an institutional authorization can condition relations among actors without being reducible to an additional interpersonal tie. Higher-order analysis provides ways to preserve these structures when pairwise projections would alter their interpretation.

Two uses of the term *higher-order* require separation at the outset. The first concerns *arity*: a relation involves several positions jointly. The second concerns *relational order*: a relation takes another relation, or a configuration of relations, as part of its object. A three-party contract illustrates higher arity. A regulatory relation that authorizes, limits, or invalidates a contractual relation illustrates a relation among relations. Some empirical cases combine both forms, while their analytical require-

Table 7.19: Higher-order relational forms and methodological requirements

Form	Structure preserved	Evidential requirement	Characteristic risk
Hypergraph	Joint membership in a relation involving several positions	Evidence that the relevant interaction or relation exists at group level	Co-membership is mistaken for joint interaction
Simplicial structure	Higher-order relation together with a justified closure across lower-dimensional faces	Evidence supporting the substantive meaning of the closure relation	Mathematical closure is interpreted as empirical closure
Multilateral relation	Role-differentiated relation among several parties	Party roles, joint conditions, obligations, temporal scope, institutional basis	A multilateral arrangement is flattened into homogeneous pairwise ties
Collective relation	Relation constituted through a group acting, deciding, producing, or bearing status collectively	Evidence of joint capacity, procedure, recognition, or coordinated enactment	Aggregation is mistaken for collective agency
Relation among relations	Dependence, authorization, composition, guarantee, constraint, or translation between relations	Evidence linking the focal relations and specifying the second-order condition	Relational complexity is described without an identifiable second-order pathway
Higher-order dependence	Outcome or state depends on a joint relational configuration	Evidence that the joint configuration contributes information beyond lower-order components	Statistical interaction is treated as a substantive higher-order mechanism by default
Higher-order measurement	Observation captures group events, joint states, or relational order	Measurement process preserves participation, roles, timing, and uncertainty	Data collection projects a richer relation into pairwise records
Pairwise projection	Lower-order representation used as an approximation of a higher-order object	Explicit assessment of which higher-order properties are preserved or lost	Projection creates ties, paths, or strengths absent from the original relation

ments remain distinguishable.

Definition 7.187 (Higher-order relational representation). A *higher-order relational representation* is a question-relative representation that preserves either a jointly constituted relation among several positions, a relation whose object includes another relation or relational configuration, or both, together with the evidential, temporal, boundary, scale, and semantic conditions required to interpret that structure.

Definition 7.187 places higher-order analysis within the methodological architecture already developed in this chapter. Object specification from Section 169 determines what the participating positions represent. Boundary and scale from Sections 170–171 determine which surrounding relations enter the analytical domain. Relation identification and characterization from Sections 172–173 establish what kind of relation is being represented. Configuration reconstruction from Section 175 determines whether joint organization adds information beyond the constituent ties.

Table 7.19 summarizes the principal higher-order forms developed below. The table emphasizes the structure preserved by each form, the evidential requirement for using it, and the characteristic error that can arise when the formal representation outruns the substantive relation.

7.20.1 Hypergraphs

A hypergraph extends the pairwise graph by allowing one relational element to connect a set of several nodes. If the node set is denoted by V , a hyperedge can be represented as a subset $e \subseteq V$ containing the positions that participate jointly in the represented relation. This simple extension changes the analytical object substantially. A three-person meeting recorded as one hyperedge differs from three pairwise communication edges because the hyperedge preserves the fact that the interaction occurred

jointly. A project consortium represented by a hyperedge differs from a clique among member organizations because the clique introduces pairwise ties whose direct evidential support may be weak or absent.

The methodological question is therefore whether the target relation is substantively group-constituted. Co-membership in a category, attendance at the same event, joint signature, co-production, shared liability, participation in a household, and coordinated decision-making can each generate higher-arity data, yet their relational meanings differ. A hyperedge should encode the relation relevant to the research question and distinguish substantive joint participation from incidental co-occurrence in the same record.

Hyperedges can carry additional structure. They may be directed when roles differ between sources and recipients; weighted when the measurement has a substantively defined magnitude; typed when several group relations coexist; and time-indexed when joint participation forms, changes, or dissolves. An aid allocation, for example, might involve a donor, intermediary, implementing organization, and beneficiary group with differentiated roles. A representation that records only common membership would preserve arity while losing role structure. A typed or role-aware higher-order representation would preserve more of the relation.

Definition 7.188 (Hyperedge semantics profile). A *hyperedge semantics profile* records the jointly represented relation, participating positions and their roles, evidential basis, arity, direction or role ordering where relevant, weight or value semantics, temporal scope, boundary and scale, and uncertainty concerning membership or joint constitution.

This profile parallels the edge semantics profile developed in Section 185. It also prevents one common projection error: a source record containing several names can be converted computationally into a hyperedge with little effort, while the substantive relation among those names may range from genuine joint action to incidental co-occurrence. Higher-order representation therefore places additional weight on semantic validation.

Hypergraphs are especially useful when the presence of the group as a group affects possible action. Quorum requirements, team production, multi-party approval, joint financing, household allocation, standards consortia, and collaborative authorship can possess properties that depend on a set of positions being present together. The hypergraph representation preserves that joint set so that later analysis can examine overlap, participation, group size, higher-order paths, or dynamics without first manufacturing pairwise ties.

7.20.2 Simplicial Structures

Simplicial structures provide a related higher-order representation with an additional closure property. Informally, a simplex involving several nodes includes lower-dimensional faces among its participating subsets. This property can be analytically valuable when the substantive object supports such nested inclusion. It can also become misleading when mathematical closure exceeds what the empirical relation supports. Higher-order network surveys therefore distinguish hypergraphs, which permit arbitrary sets of hyperedges, from simplicial complexes, whose structure includes downward closure Battiston et al. 2020; Bick et al. 2023.

The methodological importance of this distinction can be illustrated through col-

laboration. Suppose four researchers jointly produce one paper. A hypergraph can represent the four-author collaboration directly. A simplicial representation may additionally encode the faces associated with subsets of those authors. Such a representation is appropriate when those lower-order relations have substantive meaning for the inquiry. If the available evidence establishes only one four-person event, inferring each smaller collaborative relation from mathematical closure can exceed the evidence.

Simplicial representations become particularly informative when the research object genuinely contains nested group structure. Deliberative bodies with subcommittees, scientific collaborations built from overlapping teams, institutional arrangements in which larger coalitions contain active smaller coalitions, or collective practices that persist across several nested participation sets may justify this structure. The representation can then support analysis of holes, boundaries, connected higher-order components, and the way group structures fit together.

Definition 7.189 (Simplicial representation profile). *A simplicial representation profile records the higher-order relation represented by each simplex, the substantive justification for including lower-dimensional faces, the evidential status of those faces, the temporal and boundary conditions of the complex, and the analytical properties for which simplicial structure is being used.*

The profile protects against a subtle form of reification. Once data are encoded as a simplicial complex, closure appears as part of the object. Methodologically, closure remains an analytical commitment whose empirical status should be recoverable. The distinction matters particularly in social and economic settings where joint participation can coexist with weak, contested, or absent pairwise relations among some members.

Simplicial structures can also support multiscale reasoning. Faces and simplices of different dimensions provide a formal vocabulary for different orders of participation. This vocabulary should remain separate from the broader concept of analytical scale developed in Section 171. A simplex with more participating nodes does not automatically correspond to a macro-level phenomenon. Arity and scale are different dimensions: a large group relation may occur within a local organization, while a dyadic legal relation can connect transnational institutions.

7.20.3 Multilateral Relations

Multilateral relations arise when several parties participate in one relational arrangement whose meaning depends on their joint roles or joint conditions. Treaties, syndicated lending, consortium agreements, multi-party contracts, supply arrangements involving certifiers and intermediaries, coordinated humanitarian operations, and joint regulatory procedures provide examples. The analytical challenge lies in preserving differentiated participation across the multilateral arrangement.

A multilateral agreement can establish obligations that activate only under specified combinations of parties, events, or institutional conditions. A guarantee arrangement can involve a principal obligation together with a third-party commitment that changes the creditor's exposure. A procurement process can connect purchaser, supplier, auditor, regulator, and financing institution through role-specific relations whose joint operation defines the practical arrangement. Pairwise decomposition can represent some components, yet the multilateral condition may be the feature

that makes the arrangement intelligible.

Multilateral analysis therefore benefits from explicit role specification. Participants can occupy initiating, authorizing, guaranteeing, implementing, receiving, monitoring, adjudicating, or other roles. Role labels should be grounded in the evidence and institutional context with evidence from the institutional context and source material. Legal inquiry from Section 180 is especially relevant because formal multilateral relations often contain precisely specified powers, duties, liabilities, and jurisdictional conditions. Institutional inquiry from Section 181 complements the formal account by showing how the arrangement is enacted in practice.

Definition 7.190 (Multilateral relation profile). A *multilateral relation profile* records the participating parties, differentiated roles, joint conditions, relevant bilateral sub-relations, institutional or legal basis, temporal activation conditions, mechanisms of entry and exit, and uncertainties concerning how the arrangement is enacted.

The profile allows a study to retain both higher-order and lower-order structure. A multilateral relation can contain consequential dyads while remaining analytically distinct from their sum. The purpose of higher-order representation is therefore preservation of joint structure, not replacement of dyadic analysis.

Historical comparison also matters. Multilateral arrangements can persist nominally while membership, voting rules, enforcement, financing, or practical authority changes. The relational identity principles from Section 174 apply to the multilateral object itself. A stable treaty name, consortium label, or committee title can coexist with substantial transformation in the relation it denotes.

7.20.4 Collective Relations

Collective relations concern cases in which a plurality participates in a relation through some form of joint capacity, recognized collective status, coordinated procedure, or shared production. The analytical problem differs from ordinary aggregation. A collection of individuals with similar attributes is not thereby a collective actor, and repeated pairwise coordination does not by itself establish that the group bears a relation collectively. Evidence of joint constitution is therefore central.

Collective relations can be produced through several pathways. Formal institutions can authorize a body to decide or act in its own name. Organizations can coordinate members through routines and delegated roles. Informal groups can generate collective capacity through repeated practice, shared expectations, and mutual recognition. Households, teams, committees, communities, cooperatives, movements, and research collaborations can each exhibit different combinations of these pathways. Their collective status should be reconstructed for the specific relation under study.

A collective can also participate in external relations while containing internal disagreement. An organization may sign a contract, a committee may issue a decision, or a household may be classified as a unit for benefit eligibility. The external relation can be genuinely collective for a specified institutional purpose even when the internal configuration contains asymmetry, contestation, or differentiated benefit. This is one reason scale selection matters: treating the collective as one analytical node can be adequate for one question and obscure internal distributive relations for another.

Definition 7.191 (Collective relation specification). A *collective relation specification* identifies the plurality represented collectively, the basis of joint capacity or recogni-

tion, decision or coordination procedures, relation-specific boundaries, internal differentiation relevant to the claim, external counterpart positions, and the evidence supporting treatment of the plurality as a collective relational participant.

Collective relations connect naturally with Generative Relational Economics. Productive capacity, bargaining capacity, knowledge generation, resource stewardship, institutional representation, and generative return can be organized collectively. Later economic analysis will therefore require care in distinguishing value generated by a collective configuration from value attributable to one member, one dyad, or one institutional position.

Collective relation analysis also preserves the possibility that collective capacity is historically generated. A group may develop routines, trust, memory, standards, symbolic identity, or infrastructures that enable forms of action unavailable to its members when considered separately. Describing this as a higher-order relation does not establish the causal process by which the capacity emerged; it specifies the object whose formation can later be investigated through generative methods.

7.20.5 Relations among Relations

Higher-order relational analysis also includes cases in which the focal relation concerns other relations. Section 175 introduced this possibility through examples such as guarantees, legal authorization, confidentiality constraints, and governance arrangements. The present subsection develops it as a distinct methodological object. The central question is which relation changes the status, operation, interpretation, or possible trajectory of another relation.

Several forms can be distinguished. An authorization relation can establish who has standing to create another relation. A guarantee relation can condition the risk of an underlying obligation. A regulatory relation can constrain a market or contractual relation. A translation relation can connect classifications across institutions. A governance relation can determine how another relation is revised or terminated. A trust relation can affect whether an informational or exchange relation becomes actionable. These examples differ in substance while sharing the property that one relation conditions another.

Representing such structures requires more than drawing additional edges among the same actors. Suppose a regulator relates to a firm, and the firm relates contractually to a client. A simple three-node graph records both pairwise ties. It does not yet represent the claim that the regulatory relation constrains the contractual relation. That claim concerns the relation between relations and therefore requires a second-order specification.

Definition 7.192 (Second-order relation profile). A *second-order relation profile* identifies the focal relations, the conditioning relation between them, the direction and type of conditioning, evidential basis, temporal ordering, boundary and scale, and the observable consequences through which the second-order relation can be assessed.

Second-order relations can themselves be institutionalized. Legal systems, accounting standards, organizational governance, platform rules, professional accreditation, and scientific review procedures can establish repeatable rules governing other relations. Their effects may therefore extend across many local interactions. This creates a bridge between higher-order analysis and field-based analysis later in the chapter: some distributed conditions can be represented through repeated relations among

relations, while others are more adequately represented as field conditions.

Relations among relations are also relevant to methodological reflexivity. A measurement relation can alter the relation being measured; publication can change reputational relations; a classification relation can condition access relations. Research therefore can enter the higher-order configuration it studies. The reflexive analysis developed in Chapter 6 provides the praxis-level discipline for such cases.

7.20.6 Higher-Order Dependence

Higher-order dependence arises when a state, outcome, capacity, or transition depends on a relational configuration in a way that is inadequately represented by separate lower-order components. The relevant issue is joint dependence at the level of the research object. Several relations can each contribute information while their conjunction, ordering, or configuration carries additional explanatory significance.

An institutional approval may require several authorizations jointly. A collective project may proceed only when finance, technical capacity, legal permission, and organizational coordination are simultaneously available. An individual's access to a profession can depend jointly on credentialing, employer recognition, jurisdictional authorization, and network access. A financial arrangement can remain stable while several counterparties maintain commitments whose joint failure would produce a qualitatively different state. These are candidate higher-order dependencies because the configuration matters to the analytical target.

Formal models can represent such dependence through interaction terms, hypergraph dynamics, threshold rules, logical conditions, multilinear forms, or other structures. Higher-order network research demonstrates that group interactions can support collective dynamics that differ from pairwise approximations Battiston et al. 2020; Bick et al. 2023. Methodologically, the presence of a statistical interaction or nonlinear term is still insufficient to establish a substantive higher-order mechanism. The representation should be connected to an identified joint condition in the research object.

Definition 7.193 (Higher-order dependence profile). A *higher-order dependence profile* records the lower-order relations involved, the proposed joint condition, the target state or outcome, temporal ordering, evidence that the joint configuration adds substantively relevant information, plausible lower-order alternatives, and uncertainty concerning the order of dependence.

The profile supports comparison between structural and statistical accounts. A regression interaction can indicate conditional covariation. A historical reconstruction can show that several institutional relations became jointly necessary after a reform. An experiment can vary combinations of relational conditions. A simulation can test whether a specified higher-order rule generates observed macroscopic behavior. These methods perform different epistemic work and can be triangulated without being treated as equivalent evidence.

Higher-order dependence also connects to multiscale analysis. A jointly constituted local relation can generate organizational effects, while field-level conditions can determine whether the local configuration becomes consequential. The order of interaction and the scale of manifestation should therefore be specified separately. A three-party relation is higher in arity without necessarily being higher in scale.

7.20.7 Higher-Order Measurement

Higher-order analysis depends on measurement systems capable of preserving the relevant joint structure. Many data infrastructures are designed around rows, dyads, transactions, or sender–receiver events. Group interactions can therefore be projected into pairwise records during data production, before the researcher receives the data. Reconstructing higher-order structure requires attention to this measurement pathway.

Some sources preserve group structure directly. Meeting records identify a set of participants; contracts identify several parties and roles; authorship records preserve co-production groups; committee minutes link decisions to a deliberative body; project databases can identify consortia; household surveys can preserve household membership; and digital systems can log group conversations or multi-user events. Other sources preserve only pairwise traces from which a higher-order relation is inferred. The evidential status of these cases differs.

Measurement also faces an arity problem. A recorded group may contain peripheral attendees, observers, inactive members, or automated accounts. Conversely, a nominally dyadic record can be generated by a wider institutional arrangement. Participation should therefore be characterized according to the relation of interest, with presence in a group record treated as one evidential component.

Role differentiation creates another measurement problem. A dataset that preserves the participant set but discards roles can erase the difference between guarantor and debtor, regulator and regulated party, donor and recipient, chair and member, or platform administrator and ordinary user. Higher-order measurement should retain role information when role structure contributes to the claim.

Definition 7.194 (Higher-order measurement profile). A *higher-order measurement profile* records the source manifestation, rule by which joint participation is inferred or observed, participant and role definitions, temporal resolution, representation of repeated or nested group events, missingness and uncertainty, and transformations applied before the higher-order object enters analysis.

Projection should be documented as one such transformation. Turning an n -participant event into pairwise edges can be analytically useful for selected questions, while the projected graph acquires ties and path structure whose meaning derives from the projection rule. The original higher-order record should remain recoverable when later interpretation depends on joint participation.

AI-assisted extraction can increase the availability of higher-order data. Language models and information-extraction systems can identify candidate multi-party relations in contracts, correspondence, institutional documents, meeting records, or scientific texts. They can also infer relation types among several entities. These outputs enlarge the encounter surface of inquiry while adding model-mediated uncertainty. A machine-extracted hyperedge should therefore remain distinguishable from a directly recorded joint event, a participant-reported collective relation, or a legally constituted multilateral relation.

7.20.8 Limits of Pairwise Reduction

Pairwise reduction converts a higher-order object into dyadic relations. This transformation is often useful. Graph methods are mature, interpretable, and computation-

ally efficient; many research questions concern reachability, brokerage, pairwise exposure, or diffusion pathways for which a projected graph can provide an adequate representation. The methodological issue is therefore the adequacy of the reduction for the specific claim.

Information loss occurs when the higher-order object contains a property that the projection does not preserve. A group event projected into a clique no longer distinguishes whether pairwise interactions occurred separately or only through the group. Two different hypergraphs can produce the same pairwise projection while containing different group structures. Role-differentiated multilateral relations can become symmetric-looking ties. Collective decisions can become a dense network that obscures procedural rules. Relations among relations can disappear when conditioning structure is represented only as additional actor-to-actor edges.

Pairwise projection can also create information. A four-party event converted into a clique produces six pairwise edges. Those edges are computationally real in the projected graph, yet their substantive interpretation derives from co-participation in one event while the six pairwise edges are induced by projection. Path counts, clustering, centrality, and community structure computed from the projection can therefore reflect the projection rule as well as the empirical configuration.

A reduction can still be appropriate when the target property is preserved. If the question concerns whether two participants shared at least one group event, a co-participation graph can be directly relevant. If the question concerns the joint decision rule of the group, the same graph may be insufficient. Adequacy should therefore be evaluated against the inferential target and the information it requires.

Definition 7.195 (Pairwise reduction audit). *A pairwise reduction audit records the higher-order object, projection rule, properties preserved, properties lost or newly induced, sensitivity of substantive conclusions to alternative projections, and the claims for which the reduced representation remains adequate.*

Proposition 7.196 (Higher-order preservation principle). *When a substantive claim depends on joint participation, role-differentiated multilateral structure, a relation among relations, or another identifiable higher-order condition, the analytical representation should preserve that condition through the stage at which the claim is evaluated.*

Proposition 7.196 does not require maximal representational complexity. It requires preservation of the structure on which the claim depends. A later projection, summary, or visualization can remain useful when its relation to the higher-order object is documented and when the information relevant to the inference remains recoverable.

Higher-order analysis also illustrates the role of contingent encounter and aesthetic judgment in methodological development. A recurring triad, unusual co-occurrence, collective failure, unexpected group boundary, or mismatch between a pairwise graph and observed practice can make a higher-order structure salient before its significance is established. Subsequent inquiry can ask whether the pattern reflects a genuine joint relation, a measurement artifact, a boundary choice, an institutional rule, or chance. AI can generate many candidate higher-order patterns rapidly, which increases the value of preserving provenance, relation semantics, alternative representations, and explicit reduction audits.

The section therefore extends relational inquiry beyond pairwise graphs while re-

taining the same epistemic discipline developed throughout Chapter 7. Hypergraphs and simplicial structures preserve selected forms of joint interaction; multilateral and collective relations retain role and group constitution; second-order profiles represent relations among relations; dependence profiles connect joint structure to outcomes; and measurement profiles preserve the transformations through which higher-order objects become observable. Section 187 turns from these representational questions to statistical relational analysis, where dependence, covariation, hierarchy, longitudinal structure, latent relational models, and uncertainty become the primary analytical concerns.

7.21 Statistical Relational Analysis

Sections 7.18–7.20 developed three adjacent methodological layers: mainstream quantitative-empirical inference, pairwise network representation, and higher-order relational representation. The present section brings these layers together by asking how statistical inference changes when the observations themselves are relationally organized. Its role is to develop statistical treatment of relational data, dependence structures, relational covariation, hierarchical and longitudinal organization, latent relational models, uncertainty quantification, and limits of statistical identification. The objective is narrower than a general survey of quantitative methods. The concern here is the inferential consequence of the fact that dyads, repeated relations, network ties, group memberships, and relational configurations often violate the independence structures presupposed by simpler unit-centered analyses.

Statistical relational analysis therefore begins with the data-generating relation rather than with a preferred estimator. A dyadic observation involving positions i and j can share one position with observations involving i and k or j and k ; reciprocal observations can couple $i-j$ and $j-i$; triadic closure can connect the probability of one relation to surrounding relations; repeated observations can preserve dyad-specific history; and institutional or spatial organization can introduce dependence among many observations at once. Network methodology has long emphasized that relational data contain dependence structures that differ from independent-row data Wasserman and Faust 1994. Krackhardt's treatment of regression on dyadic data illustrates the inferential consequences of structural autocorrelation and the use of permutation procedures adapted to such dependence Krackhardt 1988. These examples motivate a broader principle: statistical models should represent the dependence structure that is relevant to the relational claim rather than treat dependence as a nuisance to be removed mechanically.

Within the ontology and epistemology developed earlier in the book, statistical relational models remain representations of manifestations. A fitted model can provide disciplined estimates of association, dependence, heterogeneity, persistence, or latent structure while leaving the underlying ontology underdetermined. A latent position is a model-based object; a random effect summarizes modeled heterogeneity; a dependence parameter captures a specified statistical pattern. These quantities can be substantively illuminating when their inferential bridge is explicit, yet their mathematical precision does not by itself establish the existence of a corresponding hidden social object.

Definition 7.197 (Statistical relational inquiry). *Statistical relational inquiry* is a fam-

Table 7.20: Components of statistical relational analysis

Component	Primary inferential task	Relational dependence represented	Characteristic caution
Relational data	Define the statistical observation and relational unit	Shared actors, dyads, group events, repeated relations	Row format can hide the relation that generated the observation
Dependence structures	Represent non-independent observations	Reciprocity, shared positions, triads, clustering, common institutions	Misspecified dependence can distort uncertainty and coefficient interpretation
Relational covariation	Estimate association between relational variables or matrices	Dyadic autocorrelation and common structural exposure	Covariation can arise from shared composition or third structures
Hierarchical models	Partition and partially pool heterogeneous relational variation	Sender, receiver, dyad, group, institutional, and cross-level variation	Statistical levels need substantive correspondence to relational scales
Longitudinal models	Characterize persistence and relational change through time	Repeated dyads, evolving ties, changing configurations	Temporal aggregation can alter the apparent sequence and mechanism
Latent relational models	Represent unobserved structure that organizes observed relations	Latent positions, classes, factors, or equivalence patterns	Latent variables remain model-dependent representations
Uncertainty quantification	Propagate inferential and measurement uncertainty	Parameter, edge, model, boundary, scale, and latent-structure uncertainty	Narrow parameter intervals can coexist with broad representational uncertainty
Statistical identification	Specify what the observed distribution and assumptions identify	Model-specific contrasts and relational parameters	Statistical identification does not settle substantive ontology or causality

ily of inferential strategies in which observations, parameters, or uncertainty structures are specified with explicit attention to relations among units, shared positions, repeated ties, relational configurations, temporal dependence, or latent relational structure.

Definition 7.197 allows relational statistics to include permutation methods, multilevel and crossed-effects models, longitudinal relational models, latent-space approaches, Bayesian or likelihood-based network models, and other designs whose inferential structure reflects relational dependence. The relevant criterion is not whether a method carries the label “network statistics,” but whether the model and uncertainty calculation correspond adequately to the relational organization of the data.

Table 7.20 summarizes the principal components developed below.

7.21.1 Relational Data

Relational data are generated when the observation refers to a relation, interaction, joint event, or relationally indexed state rather than to an isolated unit. A dyadic dataset may record communication from one person to another, trade between organizations, legal obligations between parties, citations between documents, migration between places, or evaluations made by one actor of another. Higher-order data can record meetings, teams, committees, households, contracts involving several parties, or jointly produced outputs. Longitudinal relational data add repeated observations of these structures through time.

The physical storage format can obscure this organization. A rectangular table may contain one row per dyad or event and therefore resemble ordinary independent-row data, yet rows sharing a sender, receiver, organization, group, or time period remain relationally connected. Conversely, an adjacency matrix can visually foreground rela-

tional structure while still hiding uncertainty about how the underlying relation was measured. Statistical relational analysis therefore distinguishes *data format* from *relational observation structure*.

Definition 7.198 (Relational observation profile). A *relational observation profile* records the statistical unit of observation, participating positions, direction and role structure, relation type, temporal index, boundary and scale, repeated-observation structure, measurement source, missingness process, and known forms of dependence with other observations.

This profile extends the edge and higher-order measurement profiles developed in Sections 7.19–7.20. It is especially useful when one empirical relation produces several statistical records. A directed relation can yield two ordered dyads. A long-standing relation can produce monthly observations. A group interaction can generate several projected dyads. The number of records can therefore exceed the number of substantively distinct relations.

Relational data can also combine unit attributes and relational attributes. A study of interorganizational exchange might include organizational size as a node-level variable, geographic distance as a dyadic variable, contract value as a relational variable, and institutional regime as a contextual variable. These levels of information should remain distinguished because their variation and dependence differ. A coefficient on geographic distance answers a different question from a coefficient on organizational size even when both enter the same statistical model.

The sampling process matters as well. Relational data can be censored by roster boundaries, missing actors, institutional access, digital-platform coverage, thresholding, or selective reporting. Butts demonstrates that uncertainty about informant accuracy and network measurement can be represented statistically rather than ignored Butts 2003. The broader methodological point is that relational statistics inherit the measurement and missingness problems developed in Sections 176, 185, and later Section 193. Statistical sophistication downstream does not erase uncertainty introduced during relational observation.

7.21.2 Dependence Structures

Dependence is a defining statistical feature of many relational datasets. Two dyadic observations can share one participant. Reciprocal relations can couple observations in opposite directions. Ties can be correlated because they occur within the same organization, locality, institutional regime, or higher-order event. Network structure can create dependence through reciprocity, triadic closure, clustering, brokerage, or repeated exposure. Longitudinal observations can also depend on their own relational history.

The inferential consequence is straightforward: standard errors and tests derived under independent observations can be poorly calibrated when the relevant dependence is substantial. Krackhardt's analysis of dyadic regression develops a permutation approach designed for this setting and illustrates how structural autocorrelation can make ordinary least squares tests misleading for network matrices Krackhardt 1988. The specific procedure is one option among several; the more general lesson is that the null distribution should respect the exchangeability or dependence structure justified by the research design.

Dependence should also be interpreted substantively. Reciprocity can indicate mu-

tual response, but reciprocal statistical dependence does not establish shared meaning. Triadic dependence can reflect closure, institutional rules, common environments, or measurement artifacts. Shared-node dependence can arise because actors differ in general activity, popularity, authority, or opportunity. Statistical dependence therefore identifies a patterned relation among observations; explanation requires an additional bridge.

Proposition 7.199 (Relational dependence discipline). *When observations share actors, dyads, groups, institutions, time periods, or relational configurations, uncertainty estimation and model interpretation gain credibility when the analysis specifies which forms of dependence are represented, which are left in the residual structure, and why that division is appropriate to the research question.*

Proposition 7.199 is intentionally broader than a requirement for one model family. Dependence can be addressed through permutation schemes, cluster-robust procedures, random effects, autoregressive structures, explicit network models, Bayesian hierarchical models, block resampling, or design-specific methods. The relevant choice depends on the source and form of dependence.

A further issue concerns dependence induced by preprocessing. Projecting a group event into dyads, aggregating repeated interactions, imputing missing ties, or thresholding a continuous relation can create or alter statistical dependence. Dependence diagnostics should therefore be interpreted in relation to the transformation chain that produced the analyzed data.

7.21.3 Relational Covariation

Relational covariation concerns association between relational variables. One matrix can record communication and another resource exchange; one dyadic variable can record geographic distance and another collaboration; one relation can record authority while another records advice seeking. The statistical question is whether variation in one relational structure is associated with variation in another under a stated comparison and dependence model.

Matrix correlation and dyadic regression can provide useful descriptive or conditional summaries. The difficulty is that dyadic entries commonly violate the exchangeability conditions assumed by unit-level regression. Quadratic assignment procedures address one version of this problem by permuting actor labels in a way that preserves substantial portions of the matrix dependence structure while generating a reference distribution for the association Krackhardt 1988. The interpretation remains design-dependent: a permutation result indicates that the observed covariation is unusual under the selected permutation scheme, not that one relation generates the other.

Relational covariation can arise through several pathways. Two relations can share a mechanism. One relation can condition another. Both can reflect actor composition, organizational membership, spatial proximity, or institutional rules. Measurement systems can also create common variation when two relational variables are derived from the same source. A high association between two matrices therefore warrants a question about common structure before a stronger substantive interpretation is adopted.

Definition 7.200 (Relational covariation profile). *A relational covariation profile records the relational variables compared, the unit and direction of comparison,*

boundary and scale, shared actors or contexts, temporal alignment, dependence-preserving inferential procedure, plausible common structures, and the scope of the association claim.

This profile is especially important when relation types have different time scales. Communication can vary daily while ownership changes rarely. Trust can adjust after repeated encounters while contractual status changes at discrete institutional moments. Aggregating these variables to the same time window can make them statistically comparable while obscuring their distinct dynamics. Temporal alignment should therefore be justified substantively as well as computationally.

Covariation analysis can also support exploratory discovery. An unexpected alignment between two relational structures can make a candidate mechanism or configuration salient. Consistent with the chapter's treatment of contingent encounter, that salience can guide subsequent inquiry without settling the meaning of the association. Documentary, historical, ethnographic, legal, or causal analysis may then determine whether the observed covariation corresponds to a substantive relational pathway.

7.21.4 Hierarchical Models

Relational datasets often contain several overlapping sources of heterogeneity. Some actors initiate relations frequently; some receive them frequently; some dyads have persistent histories; some organizations create common environments; some regions or institutional regimes shape several relations at once. Hierarchical and multilevel models provide one way to represent these variations and to partially pool estimates across related units Gelman and Hill 2007.

A relational model can include sender effects, receiver effects, dyad effects, organizational effects, regional effects, or time effects, depending on the research object. In directed relational data, sender and receiver heterogeneity should generally remain distinguishable when their substantive meanings differ. An actor that initiates many requests can occupy a different position from one that receives many requests. In repeated dyadic data, a dyad-specific component can represent persistent affinity or friction that is not captured by the separate attributes of the two participants.

Crossed structures can be more appropriate than simple nesting. Employees can interact across teams; organizations can operate in several jurisdictions; researchers can belong to overlapping collaborations; suppliers can serve several firms. A model that forces these relations into one hierarchy may simplify computation while altering the relational structure. The hierarchy should therefore follow the data-generating organization rather than a preference for tidy levels.

Definition 7.201 (Relational hierarchical specification). A *relational hierarchical specification* records the sources of grouped or crossed variation represented in the model, their substantive interpretation, the relations connecting statistical levels, the pooling assumptions, and the residual dependence expected after those components are included.

This definition connects directly to Section 171. Statistical levels are analytical devices; they need not correspond one-to-one with ontological scales. An organization-level random effect can summarize shared statistical variation without proving the existence of a unitary organizational mechanism. Conversely, a substantively important organizational relation can remain poorly represented by one random intercept. Scale-model correspondence should therefore be assessed rather than presumed.

Hierarchical models can also support partial pooling of sparse relational estimates. If some organizations or dyads are observed only a few times, estimates can borrow information through a population distribution while retaining local variation. This can improve estimation under the model while making the pooling assumption part of the inferential claim. Researchers should distinguish empirical stability gained through partial pooling from direct evidence that heterogeneous cases share the same underlying process.

7.21.5 Longitudinal Models

Longitudinal relational analysis studies persistence, formation, dissolution, reactivation, and transformation through time. The object can be a repeated dyad, an evolving network, a sequence of group events, or a time-indexed relational configuration. This connects statistical modeling to the identity and persistence questions developed in Section 174.

Panel-style relational models can include lagged relation states, time-varying covariates, unit or dyad effects, and changing institutional conditions. Time-series methods provide tools for dependence, persistence, structural change, and state evolution Hamilton 1994. Network-specific longitudinal models go further by representing tie change as dependent on current network structure and actor or dyadic characteristics. Stochastic actor-based models, for example, model directed-network evolution through stochastic opportunities for tie change and can incorporate reciprocity, transitivity, actor covariates, dyadic covariates, and coevolving behavior Snijders et al. 2010.

The substantive value of longitudinal models depends on temporal resolution. Annual data can represent institutional persistence while missing short-lived interactions. High-frequency event data can capture bursts and ordering while making slow institutional change appear nearly fixed. Section 171's multiscale principle therefore extends to time: the observation interval should correspond to the dynamics relevant to the research question.

Longitudinal dependence can also create ambiguity between persistence and repeated reconstitution. A tie recorded in consecutive periods can represent one continuous relation, repeated independent transactions, or a relation that has changed meaning while retaining the same identifier. Statistical persistence should therefore be connected to the relational identity profile from Section 174 when identity itself matters to the claim.

Definition 7.202 (Relational longitudinal profile). A *relational longitudinal profile* records the temporal unit, observation intervals, identity criteria for repeated relations, formation and dissolution rules, lag structure, time-varying covariates, institutional or historical regime changes, and the distinction between persistence of records and persistence of the substantive relation.

Dynamic models can support prediction and mechanism-oriented hypotheses, yet observed temporal order remains only one part of causal inference. Feedback, anticipation, common shocks, selective tie formation, and changing measurement systems can produce dynamic associations. Section 188 will address causal relational analysis more directly; the present section keeps longitudinal statistical dependence analytically distinct from causal identification.

7.21.6 Latent Relational Models

Observed relations can exhibit regularities that are parsimoniously represented through latent positions, classes, factors, or stochastic equivalence structures. Latent relational models introduce unobserved variables whose estimated configuration helps account for patterns in observed ties. Hoff, Raftery, and Handcock's latent-space model represents tie probabilities through positions in an unobserved social space and allows uncertainty about those positions to be estimated Hoff et al. 2002.

Latent representations can serve several purposes. They can summarize similarity in relational patterns, improve prediction, visualize modeled proximity, capture residual dependence, or suggest clusters and dimensions that deserve substantive investigation. Their inferential value is especially strong when the model is treated as a representation whose empirical consequences can be checked.

The principal epistemic caution is ontological. A latent coordinate, factor, or class is identified through the statistical model and the observed data. It need not correspond to a hidden entity that exists independently in the form specified by the model. Rotations, reflections, label switching, alternative dimensionalities, or different latent-model families can yield substantively similar fits while assigning different internal representations. The latent object therefore requires interpretive validation before it is given a strong social or institutional meaning.

Caution 7.203 (Latent relational representation). A latent relational variable can provide a useful statistical representation of patterned dependence while leaving the substantive ontology of the underlying relation underdetermined. Interpretation should therefore distinguish model-based latent structure from independently warranted social, institutional, psychological, or economic entities.

Caution 7.203 parallels the ontological suspension developed in Chapter 4. Latent relational models can be used productively without requiring premature metaphysical commitment. External evidence, historical interpretation, participant accounts, institutional records, or predictive behavior can then strengthen or weaken candidate substantive interpretations.

AI-assisted analysis can make latent modeling and representation search considerably cheaper. Many embeddings, clusterings, latent dimensions, and graph representations can be generated quickly. This abundance raises a model-selection problem: visually compelling latent spaces can invite interpretation before stability, identifiability, or external validity has been examined. Aesthetic judgment may make a latent pattern worth investigating, while statistical and substantive validation remain separate tasks.

7.21.7 Uncertainty Quantification

Uncertainty in statistical relational analysis extends beyond parameter standard errors. At least several layers can matter: uncertainty about measured relations, uncertainty about model parameters, uncertainty about dependence structure, uncertainty about boundary and scale, uncertainty about temporal identity, uncertainty about missing relations, and uncertainty about latent structure. Butts's Bayesian treatment of network measurement error provides one example in which uncertainty about observed ties and informant accuracy enters the inferential model directly Butts 2003.

Parameter uncertainty remains important. Likelihood, Bayesian posterior distribu-

tions, permutation distributions, bootstrap procedures, or design-based calculations can quantify uncertainty under their respective assumptions. The difficulty arises when a narrow interval is interpreted as if it covered upstream uncertainty about the research object. A coefficient can be estimated precisely conditional on a particular network boundary while the coefficient changes substantially under another plausible boundary. A latent position can have a concentrated posterior within one model while its substantive interpretation remains uncertain across model families.

Definition 7.204 (Relational uncertainty envelope). A *relational uncertainty envelope* records inferential uncertainty conditional on the fitted model together with substantively important uncertainty concerning measurement, missing relations, boundary, scale, temporal identity, dependence specification, latent representation, and alternative model structures when these materially affect the claim.

The envelope need not place heterogeneous uncertainty sources into one probability distribution. Some uncertainties are statistical; others are structural, historical, or interpretive. The methodological aim is visibility rather than forced commensurability. A study can report parameter intervals, sensitivity across boundaries, alternative latent solutions, and qualitative uncertainty about relation meaning in separate forms.

Uncertainty can also be relationally distributed. Some actors are measured more accurately than others; some organizations maintain richer records; some ties are visible because they pass through formal infrastructures; some populations remain weakly documented. Unequal measurement precision can therefore mirror institutional power or infrastructural access. Quantification should avoid allowing highly documented positions to dominate merely because their records are statistically convenient.

7.21.8 Limits of Statistical Identification

Statistical identification asks whether the probability model and its assumptions determine the parameter or contrast of interest from the distribution of observed data. This is a precise and valuable concept, but its scope should remain visible. A statistically identified parameter is identified relative to a model, observation process, boundary, measurement system, and set of assumptions. Substantive relational identification involves additional questions about what the parameter represents in the empirical field.

Several limits follow from this distinction. Different relational mechanisms can generate similar observed distributions. Unmeasured higher-order structure can appear as dyadic dependence. Boundary truncation can alter degree distributions and covariation. Latent models can provide alternative representations with comparable empirical fit. Time aggregation can make different sequences observationally similar. Measurement error and missingness can change apparent reciprocity, clustering, or persistence. Statistical fit therefore constrains interpretation without uniquely determining the relational ontology.

The same point applies to coefficients. A sender effect can capture general activity, access to opportunities, institutional authority, measurement visibility, or a mixture of these. A dyad effect can summarize persistent affinity while leaving its substantive source unresolved. A latent coordinate can predict ties without telling us whether the underlying mechanism is social similarity, geography, institutional sorting, or another

process. Statistical relational analysis is strongest when these quantities are treated as well-defined inferential objects whose substantive interpretation remains open to triangulation.

Definition 7.205 (Statistical relational warrant profile). A *statistical relational warrant profile* records the relational estimand or parameter, observation structure, dependence assumptions, measurement process, boundary and scale, temporal scope, model family, uncertainty procedure, alternative specifications, and the inferential bridge connecting the statistical quantity to the substantive relational claim.

Proposition 7.206 (Statistical relational identification principle). A *statistically well-identified relational parameter supports the substantive claim most clearly when the observation process, dependence structure, measurement semantics, boundary, scale, and interpretive bridge are sufficiently aligned with the relation the parameter is intended to represent.*

Proposition 7.206 preserves both the strength and the limits of statistical inference. Statistical modeling can distinguish patterns that informal inspection misses, quantify uncertainty, compare competing structures, and test whether observed regularities are compatible with explicit models. Its contribution becomes more reliable when the relation between mathematical object and empirical relation remains reconstructable.

This discipline becomes increasingly important under AI-assisted model generation. Automated systems can fit many dependence structures, latent representations, hierarchical specifications, and temporal models with low marginal cost. That abundance can improve exploratory reach while increasing multiplicity and interpretive flexibility. Provenance, held-out validation, sensitivity analysis, theory-guided specification, and explicit relational warrant profiles become correspondingly important. Contingent anomalies in residuals or model instability can still generate valuable questions; aesthetic recognition can orient attention toward an unusual relational pattern; subsequent inquiry determines whether that pattern is robust, substantively meaningful, or an artifact of representation.

Statistical relational analysis therefore provides a bridge between quantitative inference and relational structure without reducing one to the other. Relational data define the observation, dependence structures shape uncertainty, covariation maps patterned association, hierarchical models represent distributed heterogeneity, longitudinal models reconstruct change, latent models summarize unobserved structure, and uncertainty envelopes keep several forms of incompleteness visible. Section 188 turns from statistical relational dependence to causal relational analysis, where interference, mediation, network exposure, relational treatment, selection into relations, and causal transport require a more demanding set of identifying assumptions.

7.22 Causal Relational Analysis

Sections 7.18 and 7.21 established two adjacent foundations for causal relational inquiry. The first situated causal identification within the wider family of quantitative-empirical designs; the second showed how statistical inference changes when observations are relationally dependent. The present section develops the more demanding case in which causality itself is relationally structured. Treatments can be assigned to relations, groups, institutions, or network positions; outcomes can concern

relations and configurations; one position's treatment can alter another position's exposure or outcome; tie formation can be jointly related to treatment and outcome; and the relevant counterfactual may depend on a configuration of assignments rather than on one isolated unit. The section therefore examines relational treatments, relational outcomes, interference, spillover, network confounding, relational counterfactuals, causal graphs, and the limits of isolated-unit causal representations.

Causal relational analysis does not require a presumption that social causality is universally networked or that unit-centered causal designs are generally inadequate. A unit-centered estimand can be highly informative when cross-unit pathways are substantively negligible, controlled by design, or outside the defined claim. The methodological issue is alignment: the causal estimand, treatment definition, outcome definition, interference structure, boundary, scale, and assignment process should correspond sufficiently to the relational pathways through which the proposed effect could arise. This extends the claim-specific causal discipline developed in Section 7.18 into settings where treatments and outcomes are embedded in relational configurations.

The potential-outcomes tradition provides a disciplined vocabulary for treatment contrasts and assignment mechanisms Imbens and Rubin 2015. Interference complicates the familiar isolated-unit representation because the potential outcome for one position may depend on assignments received elsewhere. Hudgens and Halloran develop direct, indirect, total, and overall effects under interference in grouped settings Hudgens and Halloran 2008; Aronow and Samii formulate exposure mappings and estimands under more general interference Aronow and Samii 2017. Causal diagrams provide a complementary representation for distinguishing direct, contagion-mediated, and allocational forms of interference Ogburn and VanderWeele 2014. Together, these approaches support a relational causal framework in which the causal target is specified through pathways and exposure conditions rather than inferred from adjacency alone.

Definition 7.207 (Causal relational inquiry). *Causal relational inquiry* is a family of research designs in which treatment, exposure, outcome, assignment, confounding, mediation, interference, or transport is specified partly through relations among positions, relational configurations, or cross-position pathways relevant to the causal claim.

Definition 7.207 is intentionally broad. It includes randomized designs with spillovers, observational studies of relational exposure, interventions directed at dyads or groups, causal analysis of tie formation or dissolution, institutional interventions transmitted through organizational relations, and analyses in which a network or higher-order configuration mediates treatment effects. It also accommodates designs in which relational pathways are examined and found to be sufficiently weak for an isolated-unit approximation to remain useful.

Table 7.21 summarizes the principal components developed below.

7.22.1 Relational Treatments

A treatment becomes relational when its definition, assignment, delivery, or substantive effect depends on a relation or relational position. The familiar individual treatment indicator remains useful in many settings, yet several common interventions have a wider relational architecture. A contract changes obligations between par-

Table 7.21: Components of causal relational analysis

Component	Primary causal task	Relational feature	Characteristic caution
Relational treatment	Define the intervention and exposure domain	Treatment of ties, groups, positions, institutions, or relational opportunities	Similar labels can conceal different treatment versions and reach
Relational outcome	Define the causal response	Individual, dyadic, group, network, institutional, or cross-scale change	Unit-level outcomes can omit relational restructuring
Interference	Represent cross-position treatment–outcome pathways	One position's assignment contributes to another position's outcome	Exposure structure needs substantive and design-based justification
Spillover	Estimate effects transmitted beyond direct treatment	Relational reach, exposure intensity, pathway, and timing	Proximity or adjacency alone does not establish spillover
Network confounding	Separate exposure effects from selection and common causes	Homophily, shared context, tie formation, correlated histories	Observational similarity can be compatible with several causal processes
Relational counterfactual	Specify comparison worlds for relational exposure	Joint assignments, alternative ties, group configurations, institutional states	Counterfactuals depend on which surrounding relations are held fixed
Causal graph	Encode causal assumptions and identification pathways	Causal relations among treatments, exposures, outcomes, mediators, and selection	A social-network graph and a causal graph answer different questions
Isolated-unit approximation	Determine when unit-centered causality is adequate	Magnitude and relevance of cross-unit pathways relative to the estimand	Convenience of analysis is weaker evidence than pathway assessment

ties; a mentoring program creates or modifies a dyadic relation; a team intervention changes coordination among several participants; an institutional reform changes authority or access across roles; a platform policy changes the opportunities through which users can encounter one another; and a resource allocation can alter dependence, bargaining, or exchange relations beyond the direct recipient.

This variety makes treatment specification a substantive operation. A label such as “training,” “subsidy,” “information,” or “regulation” can hide differences in who receives the intervention, who observes it, which relations are altered, whether treatment changes opportunities for interaction, and whether the intervention is delivered through an existing relation. The causal estimand inherits those distinctions.

Definition 7.208 (Relational treatment specification). A *relational treatment specification* records the intervention object, treated positions or relations, assignment mechanism, delivery relation, treatment versions, temporal onset and duration, potential reach beyond directly assigned positions, boundary and scale, and the relational pathways through which exposure can occur.

The specification is especially important when the intervention modifies the network or institutional configuration through which later outcomes are measured. Consider an intervention intended to improve information access. Treatment can affect the content received by a focal participant, the participant’s propensity to communicate, the set of available communication partners, and the salience of certain ties. Treating the intervention as a single scalar exposure may remain appropriate for a narrowly defined direct effect, while broader claims about relational transformation require additional variables or representations.

Treatment can also be directed at a relation rather than at either endpoint separately. Mediation services, joint contracts, couple-based interventions, interorganizational agreements, collaborative grants, and bilateral regulatory arrangements are examples. Assigning the treatment to one endpoint for data-management conve-

nience can obscure the joint condition constituting the intervention. The higher-order preservation discipline developed in Section 7.20 applies when several parties jointly instantiate the treatment.

Relational treatment definitions should therefore preserve the intervention feature that carries the causal claim. The resulting design can still be simple. A binary treatment can be sufficient when treatment versions and relational reach are substantively stable within the intended domain. Greater detail becomes useful when the same treatment indicator corresponds to materially different relational exposures.

7.22.2 Relational Outcomes

Relational causal inquiry also broadens the outcome domain. Many studies retain an individual outcome even when the causal pathway is relational: health, income, learning, trust, behavior, or well-being may change partly through relations with others. Other research questions concern relations directly. An intervention may affect whether a tie forms, whether a contract persists, the reciprocity of exchange, the dependence of one organization on another, the distribution of authority, group cohesion, network fragmentation, or an institution's coordination structure.

The distinction matters because a stable individual outcome can coexist with substantial relational change. A workplace intervention might leave average productivity nearly unchanged while changing dependence, communication centralization, workload distribution, or the distribution of access to decision-makers. Conversely, a change in individual outcomes can occur with little evidence that the focal relation itself changed. The causal response should therefore be defined at the level relevant to the substantive question.

Definition 7.209 (Relational outcome profile). A *relational outcome profile* records the outcome object, participating positions, relational property or configuration measured, temporal horizon, boundary, scale, measurement interface, aggregation rule where applicable, and the distinction between focal outcome change and surrounding relational change.

Relational outcomes can be dyadic, higher-order, network-level, institutional, or cross-scale. A dyadic outcome might concern duration of collaboration. A higher-order outcome might concern formation of a functioning team. A network outcome might concern fragmentation, reachability, or concentration. An institutional outcome might concern the practical realization of authority or access. Cross-scale outcomes can connect local changes with organizational or field-level consequences, provided the mediating pathways are specified rather than inferred from simultaneous movement across levels.

Outcome definition also interacts with measurement timing. An intervention can produce an early change in interaction frequency, a later change in trust, and a still later organizational reconfiguration. Choosing one observation window can therefore privilege one layer of effect. The temporal methods developed later in this chapter provide tools for reconstructing such heterogeneity; causal relational analysis first requires that the relevant outcome horizon be stated.

7.22.3 Interference

Interference is present when the treatment assigned to one position contributes to the potential outcome of another position. In potential-outcomes notation, the outcome for position i can then depend on a vector of assignments $\mathbf{Z}$ rather than only on Z_i . This dependence changes both the estimand and the design. Hudgens and Halloran show how direct and indirect effects can be defined under grouped interference Hudgens and Halloran 2008; Aronow and Samii generalize the design logic through exposure mappings that translate an assignment vector into the exposure condition relevant to each unit Aronow and Samii 2017.

The relational interpretation of interference requires more than detecting correlated outcomes among connected positions. The researcher needs a proposed pathway through which one assignment reaches another outcome. That pathway can involve direct interaction, shared resources, competition, communication, institutional rules, common group membership, contagion, congestion, or changes in available partners. Ogburn and VanderWeele distinguish direct interference, interference through contagion, and allocational interference, illustrating how different pathways imply different causal structures and identification requirements Ogburn and VanderWeele 2014.

Definition 7.210 (Interference pathway profile). *An interference pathway profile records the source assignment, affected position, mediating relation or configuration, exposure mapping, temporal order, plausible reach, competing pathways, and the evidence supporting the proposed cross-position treatment–outcome connection.*

This profile prevents interference from becoming a generic synonym for dependence. Statistical dependence can arise through shared causes without a treatment-mediated pathway. Interference is a causal claim about how assignment at one position contributes to an outcome elsewhere. The distinction parallels Section 7.21: statistical relational dependence can motivate causal inquiry while remaining compatible with several causal explanations.

Interference can also be scale-specific. A policy assigned at the institutional level may affect organizations, dyads, and individuals through different channels. An individual-level treatment may aggregate into group norms only after sufficient adoption. A local treatment can alter field-level competition when treated positions occupy strategically consequential locations. These cross-scale effects require bridge mechanisms of the kind introduced in Section 7.5; the existence of several scales does not itself establish interference across them.

Proposition 7.211 (Interference specification discipline). *A causal claim involving interference is most clearly interpretable when the assignment mechanism, exposure mapping, relational pathway, temporal order, and causal contrast are specified together.*

Proposition 7.211 places the exposure mapping inside the substantive theory of the intervention. Different mappings—for example, presence of a treated neighbor, proportion of treated collaborators, weighted exposure through repeated interaction, or group-level treatment saturation—encode different causal questions. Their usefulness depends on the relations through which treatment can plausibly matter.

7.22.4 Spillover

Spillover refers to treatment effects that extend beyond the directly treated position or treatment object. In relational settings, spillover can travel through observed ties, shared institutions, spatial proximity, higher-order membership, resource competition, information diffusion, or other pathways. The concept is therefore broader than contagion and narrower than generic correlation. A spillover claim identifies a causal effect transmitted through a specified exposure relation or configuration.

The distinction between direct and spillover effects becomes especially useful when the intervention affects both the treated position and its surroundings. A scholarship can change one student's resources and also alter study collaboration; a subsidy to one firm can affect suppliers or competitors; a local infrastructure investment can change mobility and access for neighboring communities; an organizational reform can alter the workload of untreated roles. These effects can reinforce, attenuate, or reverse the directly measured effect depending on the configuration.

Aronow and Samii's exposure-mapping framework makes this issue explicit by linking assignment, exposure conditions, and estimands under interference Aronow and Samii 2017. From a relational perspective, the exposure mapping is also a representation of hypothesized causal reach. A binary indicator of having at least one treated neighbor preserves a different causal feature from a weighted measure of exposure, a threshold measure, or a group-saturation measure.

Definition 7.212 (Spillover profile). A *spillover profile* records the directly treated object, indirectly exposed positions, transmission relation, exposure intensity or threshold, temporal lag, boundary and scale, competing exposure pathways, and the estimand used to distinguish direct from indirect causal response.

Spillover can be beneficial, harmful, mixed, or domain-specific. The same intervention can improve information access while increasing congestion, or reduce one form of risk while shifting costs elsewhere. A single average spillover parameter can therefore hide heterogeneity across relation types and positions. Where such heterogeneity is substantively relevant, the design can preserve it through stratified exposure mappings, role-specific estimands, or multiscale analysis.

A further distinction concerns relational distance. Network path length can serve as one approximation of exposure reach, yet social, institutional, legal, spatial, and infrastructural distance need not coincide. A position two graph steps away may remain practically insulated, while a formally distant actor can receive strong exposure through a high-capacity institutional channel. Spillover analysis should therefore retain the semantics of the transmitting relation.

7.22.5 Network Confounding

Network confounding arises when relational exposure, tie formation, and outcomes share causes that make causal influence difficult to distinguish from selection or common context. Homophily provides the canonical example: positions with similar characteristics can form ties and later display similar outcomes even when direct influence is weak. Shared institutions, spatial environments, prior histories, common shocks, and selection into groups can produce related problems.

Shalizi and Thomas show that homophily and contagion are generically confounded in many observational social-network settings unless strong structural

or substantive assumptions are available Shalizi and Thomas 2011. Their result is especially relevant to relational epistemology because an observed similarity among connected positions is compatible with several generative histories. The manifestation—correlated outcomes along ties—therefore underdetermines the causal relation.

Definition 7.213 (Network-confounding profile). A *network-confounding profile* records the exposure relation, tie-formation process, measured common causes, plausible unmeasured common causes, temporal ordering, network evolution, shared contexts, selection processes, and assumptions used to separate influence from alternative relational explanations.

Confounding can enter through the network itself. If treatment changes tie formation, the post-treatment network can become a mediator or collider relative to some causal questions. Conditioning mechanically on the observed network can then alter the estimand or introduce selection. Conversely, treating a historically formed network as fixed can hide the processes that created exposure opportunities in the first place. The appropriate representation depends on whether network formation precedes treatment, co-evolves with treatment, or is partly caused by treatment.

The problem is not resolved simply by adding more covariates. Rich measurement can reduce plausible confounding, while unmeasured relational histories can remain. Design-based interventions, temporal ordering, negative controls, sensitivity analysis, natural experiments, and qualitative or historical reconstruction can provide complementary leverage. The methodological pluralism developed earlier in the chapter becomes particularly valuable here because causal ambiguity can arise from a missing relation rather than from insufficient statistical sophistication alone.

Network confounding can also be higher-order. Group formation, institutional sorting, or coalition membership may jointly shape ties and outcomes. Pairwise adjustment can miss such structure. The higher-order preservation principle from Section 7.20 therefore extends naturally to causal analysis when the confounding process is jointly constituted.

7.22.6 Relational Counterfactuals

Counterfactual reasoning asks how an outcome would differ under an alternative treatment or exposure condition. In relational settings, the comparison world needs additional specification because changing one assignment can alter another position's exposure, available relations, or institutional context. The counterfactual therefore concerns a relational configuration of assignments and exposures rather than a treatment label in isolation.

A useful distinction separates three kinds of intervention. The first changes an attribute or resource of a focal position while holding the surrounding relation structure approximately fixed. The second changes a relation—for example, creating access, removing a prohibition, or modifying a contractual obligation. The third changes the relational configuration itself, such as reorganizing teams, altering matching rules, or changing institutional authority. These interventions support different counterfactual questions even when they are described informally as acting on the same population.

Definition 7.214 (Relational counterfactual specification). A *relational counterfactual specification* records the focal intervention, assignment configuration, exposure

mapping, relations held fixed, relations permitted to change, temporal horizon, boundary, scale, and the outcome contrast used to define the causal estimand.

This specification helps clarify compound interventions. Suppose an employment program provides training and also creates new employer connections. A counterfactual that removes training while preserving the new connections asks a different question from a counterfactual that removes the entire program, including the relations generated through participation. Both can be meaningful, yet they estimate different causal contrasts.

Relational counterfactuals also make the consistency problem more visible. A treatment label can have several relational versions: receiving information from a close colleague, a distant authority, an automated system, or an anonymous source may generate different exposures. If those versions matter to the outcome, treatment definition should preserve the relevant relation rather than assume equivalence across delivery contexts.

The counterfactual world does not require exhaustive reproduction of surrounding detail. Claim-relative abstraction remains possible. The objective is to preserve the relational features that are causally relevant to the estimand and to state which surrounding conditions are treated as stable for the comparison. This discipline keeps counterfactual reasoning tractable without turning relational context into an unlimited list of dependencies.

7.22.7 Causal Graphs

Causal graphs provide a compact language for representing assumptions about causal direction, confounding, mediation, selection, and identification. In relational research, they require a particularly important representational distinction. A social-network graph records specified relations among positions. A causal directed acyclic graph records causal assumptions among variables, events, or states. The two graphs can be connected, but their edges have different semantics.

Ogburn and VanderWeele develop causal diagrams for interference and show how different interference mechanisms lead to distinct causal structures and identification problems Ogburn and VanderWeele 2014. Their approach illustrates the value of representing the treatment of one position, another position's outcome, intermediate outcomes, and allocation mechanisms within a causal graph. The observed social relation can enter that graph as an exposure pathway, selection variable, mediator, moderator, or part of the treatment definition depending on the research question.

Definition 7.215 (Dual-graph specification). A *dual-graph specification* records separately the graph or higher-order representation used to describe empirical relations among positions and the causal graph used to encode assumptions about causal pathways, together with an explicit mapping between the relational features and causal variables used in the analysis.

The distinction protects against several shortcuts. High centrality in an observed network does not by itself identify a causal mediator. An edge in a communication network does not establish a causal arrow from one participant's behavior to another's outcome. A causal edge between two variables does not imply that the corresponding actors are adjacent in the observed social network. Likewise, a cluster in a social graph need not map onto a causal block in the identification strategy.

Temporal structure deserves additional care. By construction, a static directed acyclic graph excludes simultaneous cycles. Time indexing can unfold a feedback process into an acyclic sequence when the temporal ordering is substantively defensible. The underlying social or institutional process may nevertheless contain repeated reciprocal influence over time. The temporal-relational methods later in the chapter provide complementary tools for reconstructing such processes.

Causal graphs also inherit the ontological restraint established earlier in the book. A graph is an explicit representation of a causal model, not a direct visualization of ultimate causal reality. Its value comes from making assumptions inspectable, testing implications where possible, and clarifying which unobserved or relational pathways threaten identification.

7.22.8 Limits of Isolated-Unit Causality

Isolated-unit causal analysis treats the focal unit's potential outcome as sufficiently determined by its own treatment and specified covariates for the estimand at hand. This approximation remains useful across many experiments, quasi-experiments, and observational studies. Causal relational analysis adds a diagnostic question: which cross-position pathways, if present, would materially alter the causal contrast or its interpretation?

The answer is claim-relative. Interference that is negligible for one outcome horizon can become important over a longer period. Spillovers can remain small within one organizational boundary while becoming consequential across institutions. A treatment can have little influence on neighbors' immediate outcomes while changing the network through which later opportunities are distributed. The adequacy of isolated-unit causality therefore depends on treatment reach, outcome horizon, boundary, scale, and the mechanism relevant to the claim.

Definition 7.216 (Relational causal warrant profile). *A relational causal warrant profile records the causal estimand, treatment specification, outcome profile, assignment mechanism, relational exposure pathways, interference assumptions, confounding structure, counterfactual specification, causal graph, boundary, scale, temporal horizon, uncertainty, and the conditions under which an isolated-unit approximation is considered adequate.*

Proposition 7.217 (Relational causal adequacy). *An isolated-unit causal representation is most defensible when plausible cross-position treatment–outcome pathways are weak relative to the stated estimand, controlled by design, or explicitly outside a bounded claim, and when those conditions are supported by substantive or empirical evidence.*

Proposition 7.217 avoids two symmetrical errors. One is to assume independence because the dataset is organized by individuals. The other is to presume that relational embedding makes isolated-unit causal inference unusable. Relational inquiry instead asks which relations are causally operative for the specific contrast and how strongly the design addresses them.

This perspective also changes sensitivity analysis. A sensitivity analysis can vary interference reach, exposure mapping, network boundary, tie uncertainty, treatment versions, or plausible selection mechanisms in addition to conventional unmeasured confounding parameters. When substantive conclusions remain stable across plausible relational specifications, confidence in the bounded claim can increase. When

they change sharply, the instability identifies a relational assumption that deserves direct investigation.

Contingent encounter and aesthetic judgment retain a methodological role at this stage. An unexpected untreated response, spatial cluster, secondary-group effect, temporal lag, or pattern concentrated around particular ties can make a neglected pathway salient. Such an encounter generates a candidate causal relation rather than immediate causal proof. Experimental redesign, exposure reconstruction, documentary evidence, interviews, temporal analysis, or alternative causal models can then evaluate the candidate pathway.

AI-assisted causal analysis can enlarge this exploratory space by generating candidate exposure mappings, graph structures, sensitivity scenarios, and heterogeneous-effect specifications. The same abundance increases the importance of provenance and constraint. A large search over causal graphs or exposure definitions can create convincing patterns through flexibility alone. Research designs therefore benefit from recording which relational assumptions were theory-driven, which emerged through exploration, which were externally validated, and which remain provisional.

Causal relational analysis thus extends causal inference without replacing its design discipline. Treatments and outcomes can be relational, interference and spillover can become part of the estimand, network formation can enter the confounding structure, counterfactuals can depend on assignment configurations, and causal graphs can encode pathways that cross positions and scales. The resulting framework remains selective: causal claims concern specified pathways within stated boundaries rather than a presumption of universal causal connectedness. Section 189 turns to spatial relational analysis, where distance, adjacency, mobility, spatial dependence, spatial boundaries, and geographically mediated relations introduce another family of structures that can shape both relational description and causal interpretation.

7.23 Spatial Relational Analysis

The preceding sections established methods for identifying, characterizing, comparing, statistically modeling, and causally analyzing relations. The present section adds spatial structure to that methodological architecture. Its role is to specify how location, distance, movement, accessibility, infrastructure, territory, distributed spatial conditions, and geographical scale enter relational inquiry. The objective is neither to reduce relations to geometry nor to treat space as a neutral container. Spatial relational analysis asks how spatial arrangements condition which relations can form, persist, intensify, weaken, or become practically consequential, while also examining how relations themselves produce and reorganize spatial configurations. The discussion proceeds through spatial proximity, relational distance, mobility, accessibility, infrastructure, territory, spatial fields, and multiscalar space.

This approach draws on several established lines of geographical and spatial analysis while preserving the ontological and epistemological restraints developed earlier in the book. Tobler's influential formulation concerning spatial proximity helped motivate a large family of spatial-dependence methods Tobler 1970, and spatial econometrics provides explicit tools for modeling spatial dependence and spatial heterogeneity Anselin 1988. At the same time, geographical proximity is only one possible

Table 7.22: Spatial-relational dimensions and characteristic methodological questions

Dimension	Primary analytical contribution	Specification requirement	Characteristic remainder
Spatial proximity	Represents geometric or topological nearness	Metric, coordinate system, adjacency rule, spatial unit, temporal reference	Nearness may differ from practical or institutional connection
Relational distance	Represents effective separation relevant to a relation	Cost, time, institutional, informational, legal, or network pathway	Several distance forms can coexist between the same positions
Mobility	Represents movement among locations and spatial positions	Trajectory, origin–destination semantics, temporal granularity, selection process	Observed movement omits constrained, unrealized, or unrecorded mobility
Accessibility	Represents feasible access to opportunities, resources, or positions	Target opportunity, mode, cost, time, eligibility, information, capacity	Geometric availability may differ from practical access
Infrastructure	Represents material and technical mediation of spatial relations	Infrastructure type, capacity, ownership, operation, reliability, access rule	Infrastructural presence may differ from usable connection
Territory	Represents area-based authority, jurisdiction, control, or membership	Boundary source, authority, enforcement, permeability, historical status	Formal territorial reach may differ from enacted reach
Spatial field	Represents distributed spatial conditions or gradients	Field variable, spatial support, reconstruction method, boundary, scale	Field representation may smooth localized discontinuities
Multiscalar space	Represents spatial organization across interacting resolutions	Scale definitions, cross-scale bridge, nesting, rescaling, temporal scope	Structure visible at one scale may be suppressed at another

condition of relational connection. Massey’s relational account of space emphasizes that places and spatial formations can be understood through intersecting social relations and historical processes Massey 1994. Spatial relational inquiry therefore treats geometry, infrastructure, mobility, jurisdiction, institutional access, and symbolic or historical attachments as analytically distinguishable contributors to spatial organization.

Definition 7.218 (Spatial relational inquiry). *Spatial relational inquiry* is a family of methods for reconstructing how spatial location, distance, mobility, accessibility, infrastructure, territorial organization, distributed spatial conditions, and geographical scale condition or express relations among analytical positions.

Definition 7.218 makes the spatial dimension claim-relative. A study can use coordinates, travel times, administrative boundaries, transport networks, service catchments, mobility traces, historical maps, ethnographic observation, legal jurisdictions, or other evidence depending on the relation being investigated. Spatial precision alone does not settle relational meaning. A pair of positions separated by a short Euclidean distance can remain institutionally disconnected, while geographically distant positions can be tightly coupled through transport, finance, law, communication, kinship, or organizational authority.

Table 7.22 summarizes the principal spatial dimensions developed below. The table is organized around methodological functions rather than a hierarchy of spatial representations.

7.23.1 Spatial Proximity

Spatial proximity is one of the most familiar ways in which geography enters social inquiry. Positions can be compared through Euclidean distance, travel distance, adjacency, contiguity, shared boundaries, co-location, neighborhood membership,

or other spatial metrics. Such measures can be substantively informative because communication costs, repeated encounter, local exposure, service availability, environmental conditions, and transport requirements often vary with spatial arrangement. The empirical regularity commonly associated with Tobler motivates attention to nearby observations while remaining a methodological tendency rather than a universal rule about social relations Tobler 1970.

The first methodological requirement is to specify which form of proximity is relevant to the research question. Straight-line distance can be appropriate for some exposure processes, while street-network distance can better represent travel, and shared administrative adjacency can matter for jurisdictional interaction. Vertical separation inside a building can be consequential despite small horizontal distance. A river, railway, border, security perimeter, or inaccessible terrain can make two geographically near locations practically distant. Coordinate precision therefore does not remove the need for substantive spatial specification.

Spatial units also matter. Neighborhoods, census areas, parcels, municipalities, service zones, ecological regions, and self-defined places partition space according to different criteria. Aggregating observations into one spatial unit can produce apparent similarity that disappears at a finer resolution. Conversely, extremely fine coordinates can obscure institutions, catchments, or territorial arrangements that operate at coarser spatial scales. Section 7.5 developed this problem as scale selection; spatial inquiry gives it geographical form.

Proximity can also change through time without a change in coordinates. A new bridge, transit line, border restriction, communication infrastructure, or service closure can alter effective nearness. Temporal indexing is therefore relevant when the study concerns changing spatial relations. Historical maps, timetables, transport records, legal boundaries, and infrastructure archives may be necessary for reconstructing earlier proximity conditions.

Definition 7.219 (Spatial proximity profile). A *spatial proximity profile* records the spatial positions being compared, the proximity metric or adjacency rule, coordinate or spatial reference system where relevant, boundary and scale, temporal reference, relevant barriers or connectors, and uncertainty in the underlying spatial observations.

The profile helps distinguish a measured spatial property from the relation inferred from it. Proximity can support opportunities for encounter or exposure, yet evidence of nearness does not by itself establish communication, trust, exchange, authority, dependence, or another substantive relation. Those relations require the identification procedures developed in Section 7.6.

7.23.2 Relational Distance

Relational distance extends spatial analysis beyond geometric separation. Two positions can be geographically close while remaining distant in travel time, cost, legal access, institutional eligibility, information, language, social connection, or organizational pathway. Conversely, geographically distant positions can become relationally close through high-capacity transport, digital communication, shared institutions, recurrent exchange, standardized legal arrangements, or dense organizational links.

The term *distance* therefore needs an explicit target. A commuting study can define distance through generalized travel cost. A study of public-service access can in-

clude waiting time, eligibility rules, opening hours, documentation, and information. A study of organizational coordination can use communication delay, authorization steps, or workflow separation. A study of financial integration can define effective distance through transaction costs, settlement infrastructure, or institutional connectivity. These forms of distance can coexist and can change differently over time.

Relational distance also interacts with meaning and position. A route that is practically short for a well-resourced actor can remain costly for a person with limited mobility, restricted legal status, caregiving obligations, language barriers, or weak information access. A border crossing can be routine for one category of traveler and highly uncertain for another. The same spatial arrangement can therefore generate heterogeneous relational distances across positions.

Definition 7.220 (Relational distance profile). A *relational distance profile* specifies the target relation, the dimensions through which separation is operationalized, the positions to which those dimensions apply, their spatial and temporal scope, and the evidence supporting the translation from geographic arrangement to effective relational separation.

Relational distance is especially useful for GRE because economic relations often depend on conversion between physical and institutional distance. A resource can be geographically present yet relationally inaccessible; a market can be physically remote yet institutionally integrated; a public service can be located nearby while remaining difficult to reach because of timing, documentation, language, or transport constraints. Later economic chapters can therefore treat distance as a heterogeneous relational condition rather than as a single metric.

7.23.3 Mobility

Mobility concerns movement among spatial positions and the relational conditions through which movement becomes possible, constrained, costly, encouraged, or consequential. Movement data can include migration histories, commuting trajectories, transport records, shipping flows, mobile-device traces, field observations, travel diaries, vehicle movements, or archival records. These sources can reveal connections that static maps leave weakly visible.

Observed mobility should be distinguished from mobility capacity. A person who remains in one location can possess broad mobility options, while another can remain spatially fixed because movement is costly or institutionally restricted. A low observed flow can therefore reflect preference, constraint, insufficient opportunity, legal exclusion, weak infrastructure, or measurement failure. Mobility analysis benefits from preserving these alternatives where the evidence does not yet discriminate among them.

Mobility can also generate relations. Repeated commuting can create workplace and neighborhood ties; migration can reorganize household, remittance, legal, and care relations; transport corridors can connect markets and institutions; tourism can reshape local economic configurations; forced displacement can dissolve some relations while creating others. Movement is therefore more than a response to pre-existing spatial structure. It can participate in producing new relational architectures.

Temporal granularity matters strongly. A daily commute, seasonal migration, occasional institutional visit, and one-time displacement involve different rhythms and

relational implications. Aggregating them into total movement can erase sequence and recurrence. Section 190 will treat temporal relations directly; spatial mobility analysis should retain enough temporal information for the relevant trajectory to remain interpretable.

Definition 7.221 (Mobility relation profile). A *mobility relation profile* records the moving positions or flows, origin and destination semantics, route or pathway where relevant, timing and recurrence, enabling and constraining conditions, observation process, and the relational claims inferred from the movement pattern.

The profile also helps discipline the use of large mobility datasets. Digital traces can provide high-resolution movement observations while omitting people, devices, periods, or movement modes unevenly. Precision in recorded trajectories should therefore remain separate from representativeness of the population or completeness of the mobility process.

7.23.4 Spatial Accessibility

Accessibility concerns the relation between a position and a set of opportunities, resources, services, destinations, or relational possibilities. Hansen's classic formulation made accessibility operational in metropolitan planning by linking locations to reachable opportunities Hansen 1959. Relational inquiry extends this idea by treating access as target-specific and position-sensitive.

A clinic, school, employment center, market, administrative office, archive, public space, or transport node can be geographically available while remaining inaccessible in practice. Travel time and cost matter, but so can operating hours, queueing, disability access, safety, language, legal eligibility, documentation, information, platform access, social recognition, and institutional discretion. The relevant accessibility measure therefore depends on the opportunity under study and the conditions through which a position can use it.

Accessibility is also directional. A service can be reachable from a household while the household remains poorly reachable by emergency providers, delivery systems, or public transport at another time of day. A rural community can have formal access to a regional institution while institutional staff rarely travel in the opposite direction. Directional accessibility can therefore be relevant when flows, authority, or service provision are asymmetric.

Accessibility can be relationally cumulative. Access to one resource can enable access to another: transport access can support employment access; digital access can support information and administrative access; legal status can support housing or financial access. Conversely, a bottleneck at one stage can reduce access across several downstream relations. GRE later analyzes these effects in terms of capacities, conversion, and generativity; the present section supplies the spatial methodology required to identify them.

Definition 7.222 (Spatial accessibility profile). A *spatial accessibility profile* records the target opportunity or resource, focal position, transport or connection modes, generalized costs, temporal conditions, eligibility and informational conditions, relevant capacities, boundary and scale, and uncertainty in both opportunity and access measurement.

This definition prevents a single accessibility score from standing in for heteroge-

neous access conditions whose consequences can differ across actors and contexts.

7.23.5 Infrastructure

Infrastructure mediates spatial relations by shaping movement, communication, circulation, settlement, service delivery, and connection among places. Roads, railways, ports, airports, water systems, energy grids, telecommunications networks, housing systems, logistics facilities, digital platforms, and administrative infrastructures can alter the practical distances and opportunities described above.

The presence of infrastructure and usable infrastructural connection should be distinguished. A railway can cross a locality without providing a station. Broadband can technically cover an area while pricing, equipment, reliability, or skills limit use. A road can exist while seasonal conditions make it unreliable. A public building can be physically accessible while institutional procedures prevent practical entry. Spatial-relational analysis therefore benefits from examining capacity, reliability, ownership, operation, maintenance, access rules, and connection points in addition to mapped presence.

Infrastructure can also redistribute relational possibilities. A new transit line can enlarge reachable employment or education; a port expansion can reorganize trade routes; an information system can centralize administrative coordination; a logistics platform can privilege some routes and actors; a border facility can accelerate one flow while intensifying control over another. Infrastructure is therefore relevant to both enablement and constraint.

Historical infrastructure deserves separate attention. Existing relational patterns can be shaped by systems built under earlier institutional, demographic, or political conditions. Their material persistence can carry past spatial decisions into present opportunity structures. Documentary and archival inquiry can help reconstruct these trajectories, while spatial analysis can examine how current relations remain conditioned by inherited layouts.

Definition 7.223 (Infrastructural mediation profile). An *infrastructural mediation profile* records the infrastructure relevant to a target relation, its spatial extent, connection points, capacity, reliability, ownership or authority, access conditions, temporal status, and the pathway through which it is proposed to enable, constrain, redirect, or redistribute relations.

This profile keeps infrastructure analytically connected to the relation under study. Infrastructure can then be modeled as a spatial network, institutional arrangement, field condition, historical object, or combination of these, depending on the research question.

7.23.6 Territory

Territory introduces spatially organized authority, jurisdiction, control, membership, and exclusion. Sack's analysis of territoriality emphasizes area-based strategies through which access to people and things can be influenced or controlled Sack 1986. For relational methodology, territory is therefore more than bounded geometry. A territorial boundary can alter rights, obligations, taxation, mobility, regulation, service eligibility, political membership, property, security, or administrative competence.

Formal territorial boundaries can be reconstructed from law, maps, registries, administrative records, treaties, organizational rules, or other authoritative documents. Their enacted reach can differ. Enforcement capacity, overlapping jurisdiction, informal practice, contested boundaries, extraterritorial rules, cross-border institutions, and practical mobility can create relational configurations that do not coincide exactly with the formal line.

Territory can also be multiplex. The same physical area can fall within municipal, regional, national, electoral, school, health, police, environmental, utility, customary, and organizational jurisdictions. These boundaries can overlap or diverge. A study that uses one territorial partition as its analytical frame should therefore identify which form of authority or membership makes that partition relevant to the claim.

Territorial permeability is equally important. Borders can permit some flows while restricting others. Goods, capital, information, people, legal claims, environmental effects, and institutional authority can cross territorial boundaries under different conditions. The boundary methods developed in Section 7.4 therefore apply directly to territorial analysis.

Definition 7.224 (Territorial relation profile). A *territorial relation profile* records the relevant area, boundary source, authority or jurisdiction, membership or access conditions, enforcement and practical reach, permeability by relation type, temporal status, and contested or overlapping territorial claims.

The profile is especially important when spatial units are used as if they were naturally coherent social units. Administrative territory can be substantively meaningful, yet its relevance should derive from the authority, resource, membership, or institutional relations that the boundary organizes.

7.23.7 Spatial Fields

Some spatial phenomena are better reconstructed through distributed conditions than through isolated pairwise relations. Pollution exposure, land values, policing intensity, service density, climatic risk, linguistic environment, infrastructure quality, market pressure, or institutional influence can vary across space and condition actors according to location. Section 122 developed relational fields epistemologically; spatial inquiry provides methods for reconstructing geographically distributed instances of such conditions.

Spatial statistics and spatial econometrics offer one family of tools for detecting and modeling dependence associated with geographical arrangement. Anselin's spatial econometric framework distinguishes spatial dependence and spatial heterogeneity as features that can require explicit specification in quantitative models Anselin 1988. The relevant spatial weights, neighborhood definitions, or distance functions remain analytical choices. A spatial-lag or spatial-error structure is therefore a statistical representation of dependence under specified spatial relations rather than a direct statement about the substantive mechanism generating the pattern.

Field representations can be useful when influence is gradual, distributed, or locally varying. Interpolation, kernel surfaces, spatial smoothing, exposure maps, accessibility surfaces, or model-based spatial effects can reveal gradients that are difficult to summarize through discrete boundaries. At the same time, smoothing can suppress discontinuities caused by borders, infrastructure, segregation, institutional thresholds, or abrupt environmental change. Field reconstruction should therefore

preserve evidence about discontinuities where they matter to the research object.

A spatial field can also overlap with network or territorial structure. A labor-market pressure field can be shaped by transport networks and jurisdictional rules; an environmental field can cross political boundaries; a digital-service field can depend on infrastructure nodes and pricing zones. These overlaps support multi-method reconstruction rather than a requirement that one spatial representation replace the others.

Definition 7.225 (Spatial field profile). A *spatial field profile* records the distributed condition being represented, spatial support, observation and interpolation process, boundary and scale, temporal reference, identified gradients or discontinuities, uncertainty, and the pathway through which field position is proposed to matter for the target relation.

This definition preserves the distinction between a spatially patterned variable and a substantively meaningful field. Pattern can motivate field inquiry; field attribution requires an account of how distributed spatial conditions become consequential for the positions located within them.

7.23.8 Multiscalar Space

Spatial relations frequently operate across several geographical resolutions. Household mobility can depend on neighborhood infrastructure, municipal services, regional labor markets, national law, and transnational transport or migration regimes. A firm's local production site can be connected to regional logistics, national regulation, and global finance. An environmental process can operate across ecological scales that intersect imperfectly with administrative territories. Multiscalar spatial analysis asks how these resolutions are distinguished, connected, and transformed.

Scale should remain analytically distinct from place, territory, and space. Brenner's methodological discussion emphasizes the value of distinguishing geographical scale from related sociospatial concepts and examining processes of scaling and rescaling directly Brenner 2001. The scale-selection principles of Section 7.5 therefore apply geographically: local, regional, national, and transnational scales are useful only when their boundaries and relational relevance are specified for the object under study.

Massey's relational treatment of space also helps resist the assumption that places are internally self-contained units Massey 1994. A locality can be constituted partly through relations extending elsewhere: migration, supply chains, finance, media, legal authority, environmental flows, kinship, tourism, or institutional networks. Spatial relational inquiry can therefore reconstruct a place through both internal organization and external relational reach.

Cross-scale inference requires an explicit bridge. A neighborhood-level pattern does not automatically identify an individual-level mechanism; a national average can conceal local spatial heterogeneity; an individual trajectory can reveal one cross-scale pathway without establishing its prevalence. The cross-scale bridge developed in Section 7.5 remains appropriate here: the researcher specifies how a process at one spatial resolution conditions or is generated through another.

Spatial aggregation can also create scale-induced distortion. The apparent concentration, segregation, accessibility, exposure, or dependence of a phenomenon can

change when spatial units or resolution change. Sensitivity analysis can therefore compare substantively plausible spatial partitions, neighborhood definitions, travel thresholds, or field resolutions. The purpose is not to search indefinitely for a preferred map, but to identify whether the substantive conclusion depends strongly on one spatial construction.

Definition 7.226 (Multiscalar spatial profile). A *multiscalar spatial profile* records the spatial resolutions relevant to a research object, the processes represented at each resolution, cross-scale bridges, nesting or overlap relations, rescaling processes, temporal scope, and conclusions that change under plausible alternative spatial resolutions.

The multiscalar profile also supports later economic analysis. Allocation can occur at one geographical scale while access is realized at another; value can be generated locally and captured elsewhere; infrastructure can be financed nationally while its effects vary by neighborhood; regulation can be territorial while economic networks extend transnationally. These are substantive questions about cross-scale relations rather than reasons to privilege a single geographical resolution.

Definition 7.227 (Spatial relational warrant profile). A *spatial relational warrant profile* records the spatial object, proximity or distance specification, mobility and accessibility conditions where relevant, infrastructural and territorial mediators, field assumptions, boundary and scale choices, temporal reference, spatial uncertainty, and the inferential bridge connecting spatial structure to the relational claim.

The profile provides a common reporting structure across the methods developed in this section. It also makes visible which spatial components have been directly measured and which remain theoretical, inferred, or provisional.

Contingent encounter and aesthetic judgment retain a methodological role in spatial inquiry. An unexpected cluster on a map, a route that appears anomalously indirect, a neighborhood separated by a seemingly minor barrier, a discontinuity at an institutional border, or an unfamiliar spatial juxtaposition can make a candidate relation salient. Visual salience does not establish substantive significance. Documentary, ethnographic, mobility, institutional, causal, or statistical analysis can then test whether the apparent spatial structure reflects a consequential relation, a measurement artifact, an aggregation effect, or a transient pattern.

AI-assisted spatial analysis can enlarge this encounter surface through geocoding, map comparison, image interpretation, trajectory clustering, route generation, spatial interpolation, and rapid comparison across geographical scales. The same abundance increases the importance of provenance and spatial semantics. Geocoding errors, changing place names, uncertain boundaries, inaccessible routes, biased location traces, and model-generated spatial similarities can create persuasive visual structures that are weakly connected to the target relation. Human judgment remains particularly important when the significance of place depends on legal, historical, cultural, institutional, or lived meanings poorly captured by coordinates alone.

Spatial relational analysis therefore complements network, statistical, and causal methods by making geographical organization explicit. Proximity can condition encounter without determining relation; relational distance can diverge from geometry; mobility can both express and produce relations; accessibility depends on opportunities and capacities; infrastructure mediates connection; territory organizes spatial authority; fields represent distributed conditions; and multiscalar analysis reconstructs relations across geographical resolutions. Section 190 extends this methodology into temporal relational analysis, where formation, persistence, transformation,

sequence, duration, rhythm, gaps, and historical continuity become the primary dimensions of reconstruction.

7.24 Temporal Relational Analysis

The preceding sections developed relational inquiry through object specification, boundary and scale selection, relation identification and characterization, historical persistence, configurations, documentary and field-based evidence, quantitative inference, network structure, causal analysis, and spatial organization. The present section adds an explicitly temporal methodology. Its role is to specify how relations form, persist, transform, dissolve, become ordered in sequence, acquire duration and rhythm, pass through gaps, and remain historically connected across changing manifestations. The objective is to make temporal structure available for relational inference without reducing time to a neutral index attached after the analysis. The discussion therefore treats timing, order, interval, recurrence, interruption, and continuity as properties that can condition what a relation is and what it can generate.

This approach is consistent with process-sensitive traditions in social science. Abbott emphasizes that temporal ordering, events, cases, and turning points can alter the theoretical meaning of social-science observations Abbott 2001. Pierson similarly shows how timing and sequence can become consequential under mechanisms of increasing returns and path dependence Pierson 2000. Sewell's treatment of historical events provides a related account in which events can transform the structures that condition subsequent action Sewell 1996. Temporal-network analysis adds a formal perspective in which the ordering and duration of relational contacts can change reachability and dynamical consequences even when the aggregated graph remains similar Holme and Saramäki 2012. These traditions motivate a temporal relational methodology in which chronology, process, and historical interpretation remain analytically connected while retaining distinct evidential demands.

Definition 7.228 (Temporal relational inquiry). *Temporal relational inquiry* is a family of methods for reconstructing how the formation, persistence, transformation, dissolution, ordering, duration, rhythm, interruption, and historical continuity of relations condition their meaning, organization, and consequences.

Definition 7.228 treats time as more than a coordinate. A relation recorded at two dates can differ in identity, meaning, intensity, institutional basis, or surrounding configuration. Conversely, a relation can remain historically continuous while its manifestations change substantially. Temporal inference therefore requires explicit criteria for which changes count as persistence, transformation, interruption, succession, or dissolution. Section 7.8 established the identity problem for relations through time; the present section extends that problem into a broader methodology of temporal organization.

Table 7.23 summarizes the principal temporal dimensions developed below. The table separates temporal operations that are often compressed into a single chronological variable.

Table 7.23: Temporal-relational dimensions and characteristic methodological questions

Dimension	Primary analytical contribution	Specification requirement	Characteristic remainder
Formation	Reconstructs how a relation becomes sufficiently established for the target claim	Initiating conditions, precursor relations, first manifestations, recognition criteria	Precursors can precede the date at which the relation becomes observable
Persistence	Reconstructs continued relational identity or functioning across time	Identity-bearing dimensions, continuity carriers, observation intervals	Stable labels can coexist with substantive change
Transformation	Reconstructs change within a historically connected relation	Changed properties, mechanism, timing, continuity evidence, alternative succession account	Transformation thresholds can remain contestable
Dissolution	Reconstructs cessation of a relation and persistence of residues	Ending criteria, last manifestations, residual obligations, memory, infrastructure	Consequences can continue after the relation ends
Sequence	Represents the order in which relational events or changes occur	Event definitions, ordering resolution, simultaneity rule, competing sequences	Similar endpoints can arise through different temporal pathways
Duration	Represents how long a relation or state remains operative	Start and end criteria, censoring, dormancy, observation window	Observed duration can differ from substantive duration
Rhythm	Represents recurrence, periodicity, pacing, and temporal regularity	Event granularity, cycle definition, phase, cadence, temporal baseline	Aggregation can create or suppress apparent regularity
Temporal gaps	Represents interruption, missing observation, latency, dormancy, or discontinuity	Gap type, detection conditions, evidence before and after the gap	Missing records need not indicate relational absence
Historical continuity	Reconstructs lineage across changing periods and temporal semantics	Continuity carriers, category change, periodization, historical context	Lineage can remain while relational identity changes

7.24.1 Relation Formation

Relation formation concerns the process through which a candidate relation becomes sufficiently established to support the claim under investigation. A formation date can sometimes be identified through a contract, registration, first transaction, first recorded interaction, appointment, legal decision, organizational entry, or other discrete manifestation. In other settings formation is gradual. Trust, dependence, informal authority, collaboration, rivalry, or institutional alignment can develop through repeated encounters before a researcher can justify treating the relation as established.

The methodological problem therefore involves more than locating the earliest trace. The earliest surviving record can postdate the practical beginning of the relation, while an early encounter can precede the formation of the relation later attributed to it. A first email between two researchers, for example, does not by itself establish collaboration; a first transfer does not necessarily establish a durable financial relation; a first public statement can precede the institutionalization of an alliance. Formation should be indexed to the substantive relation being claimed.

Formation can be reconstructed through precursor conditions. Shared organizational membership, spatial proximity, prior third-party ties, legal eligibility, technological compatibility, repeated exposure, resource complementarity, or a triggering event can increase the plausibility of later relational formation. These conditions remain analytically distinct from the relation itself. Treating precursors as already constituting the relation would compress formation into its antecedents and weaken

the temporal claim.

Formation can also depend on recognition. Some legal or institutional relations begin when an authorized act occurs; some informal relations become practically consequential only after participants recognize reciprocal expectations; some market or organizational relations form when repeated exchange creates dependence or routinization. The relevant threshold therefore depends on the research object and should be specified before later causal or generative analysis.

Definition 7.229 (Relation formation profile). A *relation formation profile* records the target relation, relevant precursors, earliest observed manifestations, proposed formation interval, formation criterion, recognition or authorization conditions where relevant, boundary and scale, evidential uncertainty, and competing formation accounts.

The interval formulation in Definition 7.229 is useful when the evidence supports a period more clearly than a single date. Historical records often justify claims such as “formed during this phase” more strongly than a precise day of origin. This form of temporal humility also reduces the temptation to convert an archive’s first surviving record into an ontological beginning.

7.24.2 Relation Persistence

Persistence concerns continued relational identity, functioning, or recognized relevance across time. Section 7.8 distinguished identity-bearing dimensions from historical lineage. Temporal relational analysis adds observation intervals, continuity evidence, dormancy, and changing temporal resolution to that framework.

A persistent relation can change in intensity, frequency, medium, location, or practical enactment. A long-standing contractual relation can become rarely activated; an organizational role can persist through changes in personnel; a friendship can survive intervals of sparse interaction; an institutional authority relation can remain legally valid while enforcement varies. Persistence therefore requires criteria tied to the substantive relation rather than a fixed demand for continuous visible interaction.

Continuity carriers are especially important. Obligations, shared memory, institutional records, infrastructure, recognized status, routines, expectations, unresolved claims, symbolic markers, or recurrent coordination can connect observations across periods in which direct manifestations are sparse. These carriers can support persistence while remaining subject to interpretation and counterevidence.

Temporal sampling can distort persistence claims. Monthly observation can make intermittent relations appear continuous, while high-frequency data can fragment one enduring relation into many short episodes. Historical records can produce the reverse problem: a relation may appear discontinuous because only occasional traces survive. Researchers should therefore state the temporal grain at which persistence is being assessed.

Definition 7.230 (Relational persistence interval). A *relational persistence interval* is a bounded period during which the available evidence supports continued identity or functioning of a specified relation under stated continuity criteria, while preserving uncertainty about unobserved subintervals and changing manifestations.

Persistence intervals can overlap with periods of transformation. This is method-

ologically useful because the persistence question and the stability question differ. A relation can persist through significant change, and a statistically stable pattern can represent a succession of relations whose identities differ historically.

7.24.3 Relation Transformation

Transformation concerns substantive change within a historically connected relation. Relevant changes can involve direction, intensity, reciprocity, dependence, authority, meaning, institutional basis, technological mediation, scale, or position within a broader configuration. Sewell's analysis of events as potentially structure-transforming is helpful here because it directs attention toward moments in which linked actions and interpretations reorganize subsequent possibilities Sewell 1996.

Transformation is often gradual. Repeated small adjustments can accumulate until an earlier characterization no longer supports the target claim. In other cases change is concentrated around a legal reform, organizational crisis, technological introduction, conflict, merger, migration, leadership transition, or other temporally localized episode. The methodology should allow both trajectories rather than privileging dramatic events as the default model of change.

A transformation claim should identify which relational dimensions changed and which continuity carriers justify treating the later relation as historically connected to the earlier one. This distinction protects the analysis from two opposite errors: preserving identity through a change that effectively created a successor relation, and declaring replacement whenever a persistent relation undergoes substantial adaptation.

Timing can also affect the meaning of transformation. The same formal reform can have different consequences when introduced before or after organizational consolidation, during crisis, after a technological shift, or within a sequence of earlier reforms. Pierson's work on path dependence emphasizes how timing and sequence can become causally consequential under specified self-reinforcing processes Pierson 2000. Temporal relational analysis uses this insight without assuming that path dependence characterizes historical trajectories generally.

Definition 7.231 (Relation transformation profile). A *relation transformation profile* records the pre-change relational characterization, altered dimensions, temporal interval or event sequence, proposed transformation mechanism, continuity carriers, associated boundary or scale changes, alternative succession interpretation, and uncertainty concerning the transformation threshold.

The profile allows transformation to be compared across cases without assuming that formally similar changes possess equivalent historical significance. A change in legal status, for example, can reorganize one relation profoundly while producing limited practical change in another because institutional enactment, resources, or surrounding relations differ.

7.24.4 Relation Dissolution

Dissolution concerns the cessation of the relation specified by the research design. Termination can be formal, practical, gradual, contested, or retrospectively reconstructed. A contract can expire on a known date, while an informal dependency can

weaken over a longer interval. An organization can cease operation while legal liabilities remain. A political or economic relation can lose active interaction while preserving obligations, reputational effects, infrastructures, or historical memory.

The end of observation should therefore remain distinct from the end of the relation. Dataset closure, participant dropout, archival silence, platform deletion, organizational exit, or the end of fieldwork can truncate evidence without establishing dissolution. The absent-relation discipline of Section 7.6 applies directly: a credible dissolution claim requires conditions under which continued relation would have been reasonably detectable or alternative evidence supporting cessation.

Dissolution also has residues. Debt, legal precedent, institutional memory, infrastructure, learned routines, mistrust, reputation, ownership claims, records, and symbolic associations can continue to condition later relations. These residues are particularly important for generative analysis because an ended relation can remain causally relevant to trajectories that unfold afterward.

Definition 7.232 (Relation dissolution profile). A *relation dissolution profile* records the relation-ending criterion, last supported manifestations, formal termination where relevant, practical cessation evidence, residual obligations or effects, successor relations, detection conditions, and uncertainty concerning the timing or completeness of dissolution.

Dissolution can also be partial. One channel of a multiplex relation can end while others persist. Economic exchange can cease while legal liability remains; formal authority can end while informal influence persists; organizational membership can terminate while professional or epistemic relations continue. This makes relation-type disaggregation important when reconstructing endings.

7.24.5 Sequence

Sequence concerns the ordering of events, relational changes, and interventions. Temporal order can matter even when the same elements are present. Collaboration followed by formalization can differ from formal assignment followed by collaboration; infrastructure built before population growth can have different relational consequences from infrastructure added after spatial settlement; an intervention introduced before institutional trust forms can operate differently from the same intervention introduced after a stable relation exists.

Abbott's methodological emphasis on temporal order supports treating sequences as analytical objects rather than as background chronology Abbott 2001. A sequence specification should identify which events are substantively distinguishable, the temporal resolution at which order is observed, and how simultaneous or uncertain ordering is represented. Fine-grained timestamps can be useful, while their precision does not guarantee substantive temporal resolution. Several events recorded seconds apart can belong to one decision episode; historical events recorded by year can conceal consequential ordering within the interval.

Sequence comparison can reveal path-dependent divergence. Two cases can contain similar events yet reach different configurations because the events occurred in a different order. Conversely, different sequences can converge on similar observed states while retaining different histories, commitments, or latent dependencies. End-state comparison alone can therefore hide temporal structure that remains relevant to later behavior.

Definition 7.233 (Relational sequence specification). A *relational sequence specification* records the event or state-transition units, ordering rule, temporal resolution, treatment of simultaneity and uncertain order, relevant precursor conditions, competing sequences, and the relational claim proposed to depend on that ordering.

Sequence inference benefits from documentary, archival, interview, process-tracing, event-history, and digital-record evidence. Computational sequence methods can support comparison across many trajectories, while coding decisions concerning event identity and temporal granularity remain substantively consequential.

7.24.6 Duration

Duration concerns the length of time during which a relation, state, exposure, obligation, or relational configuration remains operative under a specified criterion. Duration can matter because repeated exposure, accumulated learning, institutionalization, fatigue, trust, depreciation, adaptation, or resource depletion can depend on how long a relation persists rather than solely on whether it occurs.

The beginning and ending criteria determine the duration being measured. A legal relation can begin at authorization, a practical relation at first enactment, and a perceived relation when participants recognize an expectation. The resulting durations can differ while each remains meaningful for a particular question. Researchers should therefore avoid presenting one duration measure as if it exhausts the temporal life of the relation.

Censoring and incomplete observation also matter. A study beginning after relation formation observes an already ongoing relation; a study ending while the relation continues provides only a lower bound on its duration. Archival records can have analogous truncation when earlier or later materials are missing. Statistical duration and event-history methods can address some forms of censoring, while substantive uncertainty about relational identity still requires the historical criteria developed in Section 7.8.

Duration can also interact with intensity. A brief high-intensity relation and a long low-intensity relation can produce different consequences even when cumulative volume is similar. Temporal relational analysis therefore benefits from retaining duration and intensity as separate dimensions before constructing combined exposure measures.

Definition 7.234 (Relational duration profile). A *relational duration profile* records the relation or state being timed, start and end criteria, observation window, censoring or truncation, dormant intervals, temporal resolution, relevant intensity changes, and uncertainty concerning the substantive duration represented by the observed interval.

Duration is also scale-sensitive. An interpersonal relation can change over days while an institutional relation persists for decades; a market episode can unfold rapidly within a longer regulatory regime. Comparing durations therefore requires clarity about the relational object and scale rather than a common clock alone.

7.24.7 Rhythm

Rhythm concerns recurrence, cadence, pacing, periodicity, and patterned variation in relational activity. Payroll cycles, legislative sessions, school calendars, market hours, maintenance routines, seasonal migration, reporting deadlines, weekly meetings, electoral cycles, religious observances, and platform-use patterns can generate temporally structured relations. These rhythms can coordinate actors, create windows of access, synchronize expectations, or generate repeated bottlenecks.

Rhythm is broader than strict periodicity. Some relations recur with approximate regularity, while others involve alternating phases, bursts, pauses, or event-dependent pacing. Time-series and spectral methods can help identify periodic components, and temporal-network methods can reconstruct burstiness or time-respecting paths Hamilton 1994; Holme and Saramäki 2012. The substantive interpretation still depends on the institutional, economic, social, or infrastructural process producing the pattern.

Temporal aggregation can create artificial rhythm. Monthly reporting can impose apparent monthly regularity on events that occur continuously; business hours can constrain observation of processes continuing informally outside the recorded window. Conversely, sparse sampling can suppress a meaningful weekly or seasonal pattern. Rhythm analysis therefore requires a baseline against which recurrence is being evaluated and attention to the recording infrastructure that produces timestamps.

Rhythms can also interact across scales. A daily operational cycle can be nested within monthly financial reporting, annual budgeting, multi-year strategic planning, and longer institutional change. Synchronization or desynchronization among these rhythms can become substantively important. A funding cycle that is poorly aligned with an ecological, educational, or organizational process can generate delays or distortions even when each cycle appears regular in isolation.

Definition 7.235 (Relational rhythm profile). A *relational rhythm profile* records the recurring process, temporal unit, cadence or periodicity, phase structure, variation around the pattern, recording schedule, interacting rhythms, and the proposed pathway through which temporal regularity becomes consequential for the relation.

Rhythm is particularly relevant to later generative and economic analysis because the timing of resource arrival, renewal, coordination, or interruption can affect the capacities a relation is able to sustain. The same total resource delivered under different temporal patterns can therefore support different trajectories.

7.24.8 Temporal Gaps

Temporal gaps arise when observed relational activity, documentation, or measurement is interrupted. A gap can reflect substantive dormancy, strategic silence, seasonal inactivity, temporary suspension, broken infrastructure, organizational closure, unavailable records, sampling intervals, failed measurement, or a relation that has ended. These possibilities require separation because a gap in manifestation is not equivalent to a gap in relational existence.

Section 7.10 developed documentary silence and Section 7.11 developed archival absence. Temporal relational analysis generalizes those ideas to gaps between observations. Evidence before and after a gap can support continuity, reconstitution, or succession depending on identity-bearing dimensions and continuity carriers. A

renewed transaction after a long interval might reactivate an existing obligation, resume a dormant relation, or constitute a newly formed relation between historically connected parties.

Temporal gaps also affect causal inference. Unobserved changes inside a gap can weaken claims about sequence or mechanism. A measured pre-state and post-state do not identify what happened in between. Process tracing, interviews, administrative records, digital traces, or comparative evidence can sometimes narrow the set of plausible intervening trajectories, while the remaining uncertainty should remain visible.

Definition 7.236 (Temporal gap profile). A *temporal gap profile* records the interval with reduced or absent observation, the relevant relation, expected detection process, plausible substantive and evidential explanations, continuity evidence on each side of the interval, possible intervening changes, and the implications of the gap for persistence, sequence, and causal claims.

The profile helps distinguish missingness from dormancy and dormancy from dissolution. It also protects longitudinal AI-assisted reconstruction from filling evidential gaps with plausible but unsupported narratives. Model-generated interpolation can be useful for sensitivity analysis or forecasting, while reconstructed values should remain visibly distinct from observed historical traces.

7.24.9 Historical Continuity

Historical continuity concerns the relation between temporally separated configurations when both the relation and the categories through which it is described can change. This problem is broader than persistence. A relation can belong to a continuous historical lineage while undergoing enough transformation that the later configuration should not be treated as substantively identical to the earlier one. Section 7.8 introduced this distinction; the present subsection develops its methodological implications for longer historical horizons.

Historical periodization is part of the analysis. Political, economic, legal, technological, demographic, environmental, and cultural processes can operate on different timescales, and period boundaries selected for one process may fit another poorly. Abbott's process-sensitive methodology and Pierson's analysis of timing and path dependence both encourage attention to trajectories whose explanatory structure changes across periods Abbott 2001; Pierson 2000. Koselleck's work on historical time further reminds us that the temporal concepts through which actors understand past, present, and future can themselves change historically Koselleck 2004.

This creates a category problem. Terms such as household, employment, citizenship, market, organization, education, property, platform, or work can retain lexical continuity while their institutional and relational content changes. Long-run datasets or historical comparisons should therefore preserve category history rather than assuming semantic invariance from identical labels. Conversely, different historical labels can refer to partially comparable relational functions. Section 7.16 developed this as comparative equivalence; temporal inquiry adds diachronic category transformation.

Historical continuity can be reconstructed through overlapping carriers: records, institutions, obligations, infrastructures, legal succession, organizational lineage, routines, symbolic references, inherited resources, and remembered events. The eviden-

tial burden grows when fewer carriers remain or when the later relation is connected mainly through retrospective narrative. Lineage can still be analytically important under such conditions, while the claim should be scoped accordingly.

Definition 7.237 (Historical continuity profile). *A historical continuity profile records the relational lineage, periodization, continuity carriers, transformations in relation properties, changes in relevant categories or temporal semantics, evidential gaps, successor configurations, and the scope within which continuity is being claimed.*

Proposition 7.238 (Temporal relational warrant). *A temporal relational claim is most clearly supported when the relevant relational identity, temporal unit, formation and ending criteria, ordering assumptions, observation process, gaps, boundary and scale, and historical category changes are specified at a level adequate to the claim being made.*

Proposition 7.238 is a methodological discipline rather than a demand for complete historical reconstruction. Different questions require different temporal resolutions. A study of rapid communication can require seconds or minutes; an institutional study can work with months or years; a historical political-economy analysis can require decades or generations. Temporal adequacy depends on whether the chosen representation preserves the differences on which the substantive inference rests.

Contingent encounter and aesthetic judgment remain important in temporal inquiry. An unexpected recurrence, a strangely timed interruption, an archival date that fails to align with an institutional narrative, a long period of apparent inactivity, or a sudden change in cadence can make a possible temporal structure salient before its significance is understood. Subsequent documentary, statistical, ethnographic, causal, or historical inquiry determines whether the pattern represents a meaningful relation, a recording artifact, a boundary effect, or coincidence. AI-assisted temporal analysis can enlarge this encounter surface through timeline extraction, event clustering, sequence comparison, change-point detection, temporal-network reconstruction, and comparison across long archives. The increased abundance of candidate temporal patterns reinforces the need to preserve source provenance, distinguish observed from reconstructed intervals, and keep aesthetic salience separate from evidential warrant.

Temporal relational analysis therefore complements the spatial, network, causal, and historical methods developed earlier in this chapter. Formation specifies how relations begin; persistence reconstructs continuity; transformation captures change within lineage; dissolution identifies endings and residues; sequence preserves ordering; duration represents temporal extent; rhythm captures recurring organization; temporal-gap analysis preserves uncertainty across interruptions; and historical continuity connects changing relations across longer horizons. Section 191 extends this methodological architecture from temporal organization to field-based relational analysis, where distributed influence, local conditions, field position, gradients, overlap, and field boundaries become the primary objects of reconstruction.

7.25 Field-Based Relational Analysis

The preceding sections developed relational inquiry through explicit ties, higher-order configurations, statistical dependence, causal pathways, spatial organization, and temporal trajectories. The present section introduces a complementary method-

ology for cases in which the target of inquiry depends on distributed conditions that are only partly localized in identifiable pairwise relations. Its role is to operationalize the epistemology of relational fields developed in Section 122 of Chapter 5. The objective is to specify how distributed influence, local conditions, field position, gradients, overlapping fields, boundaries, and field reconstruction can be investigated without allowing field language to become a residual label for unexplained context. The discussion therefore treats a field as a target-relative analytical reconstruction whose warrant depends on the evidence that distributed relational organization contributes to the claim under investigation.

Several established traditions motivate this problem while using field language in different ways. Bourdieu and Wacquant develop a relational sociology in which positions, forms of capital, structured struggle, and field-specific stakes become central to explanation Bourdieu and Wacquant 1992. Martin surveys field theory more generally and emphasizes explanatory approaches in which regularities in action depend on position relative to others within an organized domain Martin 2003. Fligstein and McAdam develop strategic action fields as mesolevel social orders embedded in wider fields and connected through actors, governance units, and episodes of stability and change Fligstein and McAdam 2012. Organizational-field analysis likewise shows how organizations can be conditioned by coercive, mimetic, and normative pressures extending beyond direct exchange relations DiMaggio and Powell 1983. Field-based relational analysis can draw on these traditions while retaining the ontological suspension, evidential discipline, boundary sensitivity, and methodological pluralism developed earlier in this book.

Definition 7.239 (Field-based relational inquiry). *Field-based relational inquiry* is a family of methods for reconstructing distributed relational conditions in which the position, possibilities, constraints, expectations, or responses of relevant analytical positions depend materially on an organized environment whose target-relevant significance is only partly represented by isolated local ties.

Definition 7.239 does not privilege one formal representation. A field can be reconstructed through qualitative accounts of position and practice, institutional rules, historical trajectories, resource distributions, network structure, spatial gradients, legal categories, classifications, latent statistical structure, or combinations of these. The methodological question is whether the chosen reconstruction preserves the distributed organization required by the substantive claim. A field representation is therefore evaluated through its evidential fit and inferential contribution rather than through the sophistication of its formal vocabulary.

Table 7.24 summarizes the principal methodological dimensions developed below. The table also indicates the characteristic remainder that can survive each mode of field reconstruction.

7.25.1 Distributed Influence

Distributed influence concerns target-relevant conditioning that is difficult to assign cleanly to one observed dyad or one localized event. A firm's financing possibilities can depend on regulatory expectations, liquidity conditions, risk classifications, professional conventions, and the practices of several institutions whose effects converge without appearing as one direct tie. A researcher's publication strategy can be conditioned by journal hierarchies, funding expectations, disciplinary norms, evaluation

Table 7.24: Field-based relational dimensions and characteristic methodological requirements

Dimension	Primary analytical contribution	Specification requirement	Characteristic remainder
Distributed influence	Reconstructs conditioning that is dispersed across relations, positions, rules, resources, or expectations	Target, candidate carriers, propagation or conditioning pathway, alternative common causes	Distributed association can remain compatible with several mechanisms
Local conditions	Specifies the field conditions encountered from a particular position or site	Position, local neighborhood, relevant field variables, temporal reference, access conditions	Local manifestation may only partially reveal wider organization
Field position	Represents location within an organized relational environment	Positional criteria, relevant relations/resources, boundary, scale, historical interval	Similar positions can support heterogeneous action or interpretation
Field gradient	Represents directional or differential change across a reconstructed field	Relational coordinate, ordering or metric, field variable, uncertainty, discontinuities	Smooth representation can obscure thresholds and categorical breaks
Overlapping fields	Represents simultaneous conditioning by partially distinct fields	Field definitions, cross-field carriers, translation rules, joint positions, temporal scope	Observed effects can remain difficult to attribute among interacting fields
Field boundary	Delimits the domain within which distributed conditioning is reconstructed	Relevance criterion, entry/exit conditions, permeability, external dependencies, sensitivity analysis	Boundary exclusions can remain consequential to the focal field
Field reconstruction	Integrates heterogeneous evidence into a revisable distributed representation	Evidence sources, transformation chain, positional logic, comparison set, uncertainty	Different reconstructions can preserve different dimensions of the same domain
Limits of field language	Tests whether field terminology adds discriminating structure to the inquiry	Competing representations, simpler explanations, scale, agency, mechanism, ontological status	Some distributed patterns may be better represented without a field construct

systems, and peer communities. A household’s practical opportunity set can depend on labor-market structure, service accessibility, credit availability, legal status, transport, and prevailing classifications. In each example, the target is locally experienced while some of its conditioning is distributed.

The methodological task is to identify the carriers through which distributed influence becomes consequential. Such carriers can include rules, prices, classifications, resource concentrations, expectations, reputations, technical standards, organizational templates, spatial infrastructures, legal permissions, network positions, or repeated signals. Calling these conditions a field adds epistemic value only when their organization and target relevance are specified more precisely than a generic reference to “context.”

Distributed influence can also arise through patterned absence or scarcity. A peripheral actor can face restricted alternatives because potential partners are concentrated elsewhere; a profession can impose expectations through widely reproduced credentialing practices; a platform can condition behavior through algorithmic visibility rules applied across a large population. These effects may be weakly localized in individual interactions while remaining relationally structured at the level of the broader environment.

The first inferential challenge is alternative explanation. A distributed pattern can reflect field conditioning, common exposure to an external cause, compositional differences, selection into positions, network diffusion, institutional rules, or several interacting mechanisms. Field analysis should therefore preserve a comparison set rather than treating spatial or social regularity as sufficient evidence for a field ef-

fect. Section 7.22 developed a similar discipline for causal relational analysis; field-based inquiry extends it to distributed conditioning whose mechanism can be heterogeneous or only partially observed.

Definition 7.240 (Distributed influence profile). A *distributed influence profile* records the target outcome or relational condition, candidate distributed carriers, relevant positions, proposed conditioning or propagation pathways, spatial and temporal scope, competing explanations, and the evidence supporting the claim that distributed organization contributes to the target.

The profile does not require that influence be represented as a physical force. The term refers to structured conditioning whose effects vary with position in the reconstructed environment. This restraint is important because field metaphors can otherwise suggest continuity, direction, or determinacy that the evidence does not support.

7.25.2 Local Conditions

Field-based inquiry becomes empirically tractable through local conditions. A field is distributed, yet researchers encounter it through situated manifestations: a firm's borrowing terms, an organization's reporting requirements, a worker's available alternatives, a researcher's evaluation environment, a household's service options, or a participant's practical expectations. Local conditions therefore provide an interface between distributed organization and position-specific experience.

Local conditions should be specified at the position and time relevant to the claim. The same nominal field can present very different conditions to actors with different legal status, resources, organizational affiliation, geographic location, category membership, network position, or historical trajectory. An institutional field can appear permissive to one organization and restrictive to another because the organizations occupy different positions relative to regulators, funders, competitors, and professional communities. A credit environment can generate different effective constraints for households facing different collateral rules, income classifications, or documentation requirements.

This positional heterogeneity connects field analysis to the scale and boundary problems developed in Sections 7.4–7.5. A local condition can be defined at the level of a person, dyad, organization, neighborhood, institution, or other analytical position. Its field relevance depends on the wider distributed structure that makes the local condition informative. Fine-grained observation can reveal variation within an aggregate field, while a broader reconstruction can show why apparently local constraints recur across sites.

Local evidence can include interviews, ethnography, contracts, administrative decisions, prices, waiting times, legal classifications, organizational routines, transaction terms, network neighborhoods, spatial access, or repeated behavioral responses. The evidence should retain the distinction between the local manifestation and the wider field reconstructed from it. A difficult borrowing experience can be consistent with field-level credit constraints, yet a single case does not establish the distributed pattern. Conversely, aggregate field measures can obscure how the same environment is encountered differently across positions.

Definition 7.241 (Local field condition profile). A *local field condition profile* records the focal position or site, the field dimensions relevant to that position, observed manifestations, neighboring relations, institutional and spatial conditions, temporal refer-

ence, and the inferential bridge connecting the local observations to the wider field reconstruction.

This profile helps preserve the bidirectional movement of field analysis. Local observations contribute to field reconstruction, and field reconstruction changes the interpretation of local observations. Neither direction removes the need for evidential justification.

7.25.3 Field Position

Field position refers to an analytical location within a distributed relational organization. Position can be defined through access to resources, authority, recognition, dependence, network relations, legal status, classification, market role, organizational function, symbolic standing, or combinations of these dimensions. Bourdieu and Wacquant emphasize positions within structured distributions of capital and struggle Bourdieu and Wacquant 1992; Fligstein and McAdam distinguish incumbents, challengers, governance units, and other positions within strategic action fields Fligstein and McAdam 2012. Field-based relational inquiry treats these as established conceptual resources while allowing positional criteria to vary with the research target.

A field position differs from an attribute when its meaning depends materially on the surrounding relational organization. “Large firm” is partly an attribute description, while “dominant supplier in a concentrated procurement field” is positional because dominance depends on the distribution of alternatives, buyer dependence, institutional rules, and the positions of other suppliers. Likewise, legal authority is positional when it derives from a structured relation among offices, subjects, procedures, and jurisdictions.

Positions can be categorical, ordinal, metric, latent, or historically reconstructed. A legal regime can create explicit categories; a network can support structural equivalence classes; a correspondence analysis can recover relational dimensions; qualitative inquiry can reconstruct recognized incumbents and challengers; archival evidence can reveal changing positions across historical periods. Formal precision should remain proportional to the evidence. A latent coordinate can summarize relational regularities while leaving its substantive meaning open to interpretation, as Section 7.21 emphasized.

Field position can condition possibilities without determining action. Actors in similar positions can adopt different strategies because of histories, capabilities, identities, interpretations, cross-field affiliations, or contingent encounters. Positional analysis therefore supports claims about structured opportunities, constraints, exposure, or likely interaction patterns more readily than categorical predictions of behavior.

Definition 7.242 (Field position profile). A *field position profile* specifies the analytical position, the relational dimensions through which it is located, relevant resources or classifications, neighboring or counterpart positions, boundary and scale, temporal interval, and the evidence supporting the positional interpretation.

The profile also permits multiple position systems to coexist. An organization can occupy a strong market position, a weak regulatory position, and a peripheral symbolic position within overlapping domains. Later GRE analysis can use this plurality to study conversion power among economic, institutional, epistemic, and symbolic resources without assuming a single hierarchy.

7.25.4 Field Gradient

A field gradient represents systematic variation in a target-relevant condition across positions in a reconstructed field. The condition can concern access, expected return, constraint, legitimacy, visibility, exposure, bargaining possibility, information, recognition, or another relationally meaningful quantity. Gradient language becomes useful when the inquiry needs to describe how a condition changes across an ordered relational space rather than merely classify positions into discrete categories.

The underlying coordinate should be specified explicitly. A spatial field can use geographic coordinates; an organizational field can use authority or dependency position; a market field can use price, access, concentration, or substitutability; an epistemic field can use recognized standing, institutional access, or visibility; a network representation can use structural position. Several coordinates can coexist, and their relationship need not be linear or metrically uniform.

Gradients can be smooth, discontinuous, thresholded, or locally irregular. A legal eligibility rule can create a sharp discontinuity. A transport network can produce pockets of high accessibility inside a broader low-access region. An evaluation system can produce nonlinear returns around a categorical threshold. Treating these structures with a smooth field model can be useful for approximation while also hiding the discontinuities most relevant to institutional interpretation.

Field gradients are therefore representation-dependent. Interpolation, smoothing, dimensionality reduction, latent embedding, or statistical estimation can produce a visually coherent surface even when the underlying evidence is sparse. The resulting gradient should remain distinguishable from direct observation. Uncertainty can vary across the field, especially near boundaries, underrepresented positions, or periods of institutional change.

Definition 7.243 (Field gradient profile). A *field gradient profile* records the target-relevant condition, the coordinate or ordering over which variation is represented, measurement or reconstruction method, discontinuities and thresholds, temporal reference, local uncertainty, and the substantive pathway through which the gradient is expected to matter.

The concept also creates a bridge to later generative analysis. A gradient can describe differential conditions for possible change, while Chapter 8 will ask the stronger question of whether and how those conditions participate in generating trajectories. Description of a field gradient therefore precedes generative attribution.

7.25.5 Overlapping Fields

Positions frequently participate in several fields whose organizing principles, resources, classifications, and temporal rhythms differ. A university can simultaneously occupy educational, scientific, labor, legal, financial, and reputational fields. A firm can be situated within product markets, credit systems, regulatory regimes, professional communities, supply networks, and technological standards. A household can encounter labor, housing, welfare, educational, legal, and care fields at the same time. Field overlap is therefore a central methodological problem rather than an exceptional complication.

The first task is to preserve field differentiation. Two fields can include many of the same actors while organizing them through different relations and stakes. A bank and

a firm can interact through credit, regulation, ownership, payment infrastructure, and information disclosure. Collapsing these into one broad field can obscure the specific pathway through which one domain conditions another.

The second task is to reconstruct cross-field carriers. Resources, classifications, credentials, standards, narratives, technologies, people, and legal statuses can move between fields. Their meaning can change during transfer. Academic prestige can influence funding access; financial resources can purchase technical capacity; regulatory status can enable market participation; professional certification can alter organizational authority. These conversions are especially important for GRE because later chapters will study heterogeneous value and conversion among value forms.

Field overlap can also generate conflict. A practice rewarded within one field can be constrained by another; temporal rhythms can be misaligned; categories can be incompatible; authority can be divided. An organization may face market incentives that conflict with professional norms, or legal authorization that fails to generate practical legitimacy. Such tensions can be analytically informative because they reveal which field conditions are active at a particular site or moment.

Definition 7.244 (Overlapping field profile). An *overlapping field profile* records the candidate fields relevant to a target, their organizing relations and positional criteria, shared and field-specific participants, cross-field carriers or conversion pathways, points of conflict or reinforcement, temporal scope, and uncertainty about attribution among fields.

Field overlap also creates a methodological warning for AI-assisted analysis. Embedding or clustering methods can combine several relational dimensions into one representation because doing so improves predictive compression. The resulting latent space can be useful while obscuring the distinction among fields that matter substantively. Field differentiation should therefore be preserved when the research question depends on distinct organizing logics.

7.25.6 Field Boundary

Field boundaries delimit the domain within which distributed relational conditioning is reconstructed. Section 7.4 treated boundary construction generally; field analysis requires additional attention because the field can extend beyond formal organizational, legal, spatial, or categorical borders. A regulator outside a market can shape market behavior; a transnational standard can condition domestic organizations; a funding body can influence research institutions without direct membership; external suppliers can alter bargaining possibilities inside a regional economy.

Some fields have explicit entry conditions. Licensing, membership, accreditation, platform access, professional certification, legal jurisdiction, or participation rules can create institutionally recognized boundaries. Other fields have graded or permeable edges. Information, resources, standards, reputations, labor, and classifications can travel across nominal domains. The effective field boundary should therefore be indexed to the target-relevant conditioning process rather than assumed from formal membership alone.

Boundary construction can use nested specifications. A narrow field can capture immediate actors and relations, while a wider field includes upstream institutions or external dependencies. Comparing the resulting reconstructions reveals whether positional conclusions, gradients, or inferred constraints are stable. When plausible

boundary alternatives materially alter the claim, that dependence should remain visible in the final interpretation.

The boundary remainder introduced in Section 7.4 is especially useful here. External actors, institutions, or processes can be excluded from the focal field for tractability while remaining documented as potentially consequential. This allows field analysis to remain bounded without converting methodological exclusion into substantive non-existence.

Definition 7.245 (Field boundary profile). A *field boundary profile* records the focal field, target-relevance criterion, entry and exit conditions where identifiable, permeability, external dependencies, nested or alternative boundaries, temporal reference, and boundary remainders that may affect interpretation.

Field boundaries can also change historically. A profession can expand jurisdiction, a market can integrate across regions, a platform can alter eligibility, or a legal reform can change membership and authority. Boundary sensitivity should therefore be temporal as well as spatial and institutional.

7.25.7 Field Reconstruction

Field reconstruction integrates heterogeneous evidence into a revisable account of distributed relational organization. The task is an inverse problem: researchers observe documents, classifications, local conditions, network ties, prices, narratives, spatial patterns, legal statuses, organizational routines, or behavioral responses and infer a wider field whose structure is only partially manifest. The epistemology of Chapter 5 therefore remains active at each stage of the reconstruction.

A practical reconstruction can proceed through several linked operations. The researcher first specifies the target and provisional field dimensions. Evidence is then gathered from sources capable of observing different parts of the field. Positions, local conditions, boundaries, gradients, and cross-field relations are reconstructed with explicit provenance. Competing representations are compared. The resulting field model is revised when new evidence exposes omitted positions, changed boundaries, alternative mechanisms, or historical discontinuities.

Methodological plurality is particularly valuable here. Network analysis can identify relational position; archival inquiry can reconstruct field formation; ethnography can reveal how positions are locally experienced; interviews can recover participant interpretations; legal analysis can specify authority and membership; spatial methods can reconstruct geographic gradients; quantitative models can estimate position-dependent variation; comparative inquiry can test whether field patterns travel across contexts. These contributions can converge without being translated into a single metric.

A field reconstruction should also distinguish observed components from inferred structure. A network edge, administrative category, legal status, interview account, or spatial coordinate can be directly observed under specified conditions. The field position or gradient inferred from those observations is a higher-level analytical construction. Preserving this transformation chain makes the reconstruction contestable and allows later researchers to re-epistemize the field under alternative concepts or methods.

Definition 7.246 (Field reconstruction profile). A *field reconstruction profile* records

the target, provisional field dimensions, evidence sources and provenance, reconstructed positions and local conditions, boundary and scale, temporal interval, gradients or distributed regularities where relevant, competing representations, uncertainty, and the transformations connecting observed manifestations to the field claim.

Contingent encounter and aesthetic judgment can contribute to field reconstruction by making distributed structure perceptible before its mechanism is known. A repeated phrase across institutions, a surprising similarity among distant organizations, an anomalous local constraint, an unexpected gradient, or a cluster of documentary classifications can suggest that several observations belong to a common field problem. Subsequent inquiry determines whether the apparent pattern reflects distributed relational organization, shared external causes, measurement structure, selection, or coincidence. AI-assisted retrieval, embedding, clustering, network reconstruction, and spatial visualization can enlarge this encounter surface while increasing the importance of provenance, alternative representations, and source-level validation.

7.25.8 Limits of Field Language

Field language is analytically useful when it contributes discriminating structure to a research question. Its usefulness weakens when the term merely substitutes for environment, context, culture, system, market, institution, or unexplained residual variation without identifying the distributed organization relevant to the claim. A methodological field analysis should therefore make clear what becomes more intelligible through the field representation than through simpler descriptions of local ties, aggregate attributes, shared exposure, or institutional rules.

One limit concerns observational equivalence. Network structure, common external causes, selection into positions, legal constraints, spatial clustering, and genuine field conditioning can generate similar patterns. Field attribution therefore benefits from comparison with alternative representations and from evidence showing that position within the proposed field changes interpretation or expected conditions in a target-relevant way.

A second limit concerns determinism. Position can structure possibilities without fixing action. Actors can interpret, resist, strategically exploit, or transform field conditions. Similar field positions can therefore yield heterogeneous trajectories. Field-based explanations should preserve agency, local histories, capabilities, and contingent encounters when those differences affect the target.

A third limit concerns scale. A field identified at one analytical resolution can decompose into several mechanisms at a finer scale or appear as one component of a broader field at a coarser scale. The multiscale discipline developed in Section 7.5 therefore applies directly: field claims should identify the scale at which distributed organization is reconstructed and the bridge required for claims that travel across scales.

A fourth limit concerns formal representation. Spatial surfaces, networks, latent embeddings, correspondence maps, statistical random effects, and dynamical models can represent field-like structure. Predictive success can strengthen confidence in a representation while leaving the substantive ontology open. A formally smooth field can conceal discontinuities; a latent space can combine distinct organizing logics; a network can omit distributed rules or classifications; a qualitative field map can

understate quantitative variation. Representation choice should follow the research object and preserve known remainders.

A fifth limit concerns generative and causal claims. Reconstructing a field and locating positions within it does not by itself establish that the field generated a particular outcome. Causal relational analysis in Section 7.22 requires pathways and counterfactual structure; Chapter 8 will impose an additional burden for generative claims concerning capacities, relations, structures, and future possibility. Field-based analysis can provide the distributed conditions within which those mechanisms operate while remaining analytically prior to stronger attribution.

Proposition 7.247 (Field-language adequacy). *Field language contributes methodological value when the inquiry specifies a target-relevant distributed organization, reconstructs meaningful positional or local variation, states boundary, scale, and temporal scope, compares plausible alternative representations, and preserves uncertainty arising from partial observation and representation choice.*

Proposition 7.247 is intentionally graded. A historical case study, ethnography, legal-institutional analysis, spatial model, network analysis, latent statistical model, or mixed-method design can each support a field claim when the evidence and representation are aligned with the target. The proposition asks for discriminating warrant rather than a single canonical field method.

Field-based relational analysis therefore complements the methodological sequence developed across this chapter. Explicit ties identify local relations; higher-order methods preserve jointly constituted structures; statistical methods model dependence; causal analysis reconstructs pathways; spatial and temporal inquiry locate relations across geography and history; field-based inquiry addresses distributed conditions in which position within an organized environment changes what local relations mean or make possible. Section 192 turns next to the measurement of relations, where these distinctions become operational through indicators, scales, composite measures, proxy variables, relational intensity, and measurement uncertainty.

7.26 Measurement of Relations

The preceding sections established how relational inquiry can specify objects, construct boundaries, select scales, identify and characterize relations, reconstruct configurations, and examine statistical, causal, spatial, temporal, and field-based structure. The present section addresses the measurement problem that follows from those operations. Its role is to specify how properties of relations become observable, codable, comparable, and quantitatively or qualitatively assessable without collapsing a relation into the indicators through which it is measured. The objective is to distinguish indicators from proxies, composite measures, relation strength, relation quality, stability, accessibility, measurement error, and invariance. The discussion treats measurement as a transformation from manifestations into claim-relevant representations whose adequacy depends on the target relation, boundary, scale, temporal interval, and intended inference.

Measurement theory has long distinguished observed responses from the constructs they are intended to support. Cronbach and Meehl frame construct validity as an inferential problem concerning the relation between observations and theoret-

ically specified constructs Cronbach and Meehl 1955. Messick later emphasizes validity as a property of interpretations and uses of scores rather than a simple intrinsic property of the observed score itself Messick 1995. Contemporary scale-development guidance similarly distinguishes constructs, indicators, indices, reliability, and validity DeVellis and Thorpe 2021. Relational inquiry inherits these concerns while adding several complications: the target can be a relation rather than an individual attribute; measurement can depend on both or several positions; the measurement operation can alter the relation; and the meaning of a score can change across relational configurations, scales, and historical settings.

Definition 7.248 (Relational measurement). *Relational measurement* is the documented transformation through which manifestations associated with a specified relation are converted into indicators, categories, scores, comparisons, or other representations intended to support a claim about one or more properties of that relation.

Definition 7.248 keeps three objects separate: the target relation, the manifestations through which researchers gain access to it, and the measurement representation produced from those manifestations. A count of messages, a legal classification, an interview-coded trust score, a transaction volume, a network weight, or an accessibility index can each become a relational measure. Their usefulness depends on the inferential bridge connecting the observed manifestation to the property under study.

Table 7.25 summarizes the principal measurement dimensions developed below. The table emphasizes that stronger measurement requires both technical discipline and substantive alignment with the relation being represented.

7.26.1 Indicators

An indicator is an observable or codable manifestation used to represent a specified relational property. Message frequency can indicate communication activity; contract duration can indicate one aspect of continuity; repayment regularity can indicate one aspect of financial performance; reported reliance can indicate perceived dependence; reciprocal nominations can indicate recognized affiliation; and observed queue position can indicate one aspect of institutional access. The indicator does not become the relation merely because it is numerically precise.

Relational indicators are often generated jointly. A dyadic response can depend on who is asked, who is named, the direction of the relation, the institutional context, and the observation period. A relation between an organization and a regulator can be indicated by inspections, filings, sanctions, licenses, or correspondence, while each indicator reveals a different manifestation of the relation. A measurement design should therefore state which relational property an indicator is intended to represent and which manifestations remain outside the measure.

The same manifestation can also support several candidate interpretations. Frequent communication can indicate coordination, conflict, supervision, dependence, intimacy, or administrative burden. A high transaction volume can reflect trust, contractual lock-in, market concentration, or temporary necessity. Indicator interpretation therefore requires the relational characterization work developed in Section 7.7 and the institutional, legal, historical, or qualitative context relevant to the claim.

Definition 7.249 (Relational indicator profile). *A relational indicator profile* records

Table 7.25: Relational measurement dimensions and characteristic methodological requirements

Dimension	Primary contribution	Specification requirement	Characteristic remainder
Indicator	Links an observable manifestation to a target relational property	Target property, observation rule, coding rule, temporal window, direction of interpretation	Similar indicator values can arise from different relational processes
Proxy	Uses an accessible variable to represent a less directly observed relational property	Proxy rationale, expected correspondence, failure conditions, alternative pathways	Proxy variation can reflect processes unrelated to the target
Composite measure	Combines several indicators into a multidimensional representation	Component semantics, weighting rule, aggregation logic, missing-data rule, validation	Aggregation can conceal internal heterogeneity and compensating components
Relation strength	Represents magnitude of a specified relational dimension	Dimension of strength, unit, direction, normalization, scale and time	Frequency, volume, salience, dependence, and enforceability may diverge
Relation quality	Represents evaluative properties of a relation	Quality dimensions, standpoint, normative or experiential criteria, aggregation rule	Different participants can experience the same relation differently
Relation stability	Represents persistence or variability of relational properties through time	Identity criterion, observation interval, expected variability, transformation threshold	Stable observation can coexist with changing relational meaning
Relation accessibility	Represents practical ability to activate, reach, or use a relation or relational resource	Focal position, target relation/resource, barriers, costs, permissions, temporal conditions	Formal availability can coexist with low practical accessibility
Measurement error	Represents divergence between recorded measure and target-relevant manifestation or property	Error source, direction, dependence, missingness, validation data, sensitivity analysis	Several error sources can coexist and propagate through later inference
Measurement invariance	Tests whether measurement meaning is sufficiently comparable across groups, times, scales, or contexts	Comparison domain, invariance criterion, model or coding stability, substantive interpretation	Apparent change can reflect changing measurement relations rather than target change

the target relational property, observed manifestation, observation and coding rule, unit, direction, temporal window, boundary and scale, expected interpretation, plausible alternative interpretations, and known conditions under which the indicator can become misleading.

The profile preserves provenance from manifestation to measure. It is particularly useful when AI-assisted pipelines generate indicators automatically from text, logs, images, or administrative records. Automated extraction can enlarge coverage while adding classification error, version dependence, and model-specific transformation steps. The resulting indicator should remain linked to the source manifestation and extraction procedure.

7.26.2 Proxies

A proxy is used when a target relational property is difficult to observe directly and another observable quantity is expected to covary with it sufficiently for the intended analysis. Geographic distance can proxy interaction cost in some settings; transaction repetition can proxy continuing exchange; shared membership can proxy opportunity for contact; response latency can proxy one aspect of accessibility or attention; and contractual concentration can proxy one dimension of dependence. Proxy use can be valuable when direct measurement is expensive, unavailable, invasive, or historically impossible.

The methodological burden is greater than simple association. A proxy requires an account of why variation in the proxy is expected to track the target relation and under which conditions that correspondence weakens. Geographic distance becomes a poor proxy for accessibility when transport, border controls, digital communication, or institutional permissions dominate physical distance. Communication frequency becomes a poor proxy for trust when supervision or conflict produces repeated contact. Organizational co-membership becomes a weak proxy for interaction when the institution is large or internally segmented.

Proxy validity can also change historically. A landline call record may have represented communication differently before widespread mobile messaging. Formal employment status can become a weaker proxy for economic dependence when subcontracting or platform work expands. A proxy therefore has a temporal domain in addition to a substantive domain.

Proposition 7.250 (Proxy-scope discipline). *A proxy supports a relational inference most clearly when the proposed correspondence between proxy and target property is specified for a bounded population, context, scale, and historical interval, together with plausible processes that can weaken that correspondence.*

Proposition 7.250 does not require direct access to the target in each application. Historical and archival research often depends on indirect traces. It requires the indirectness to remain visible so that later evidence can strengthen, revise, or reject the proxy relation.

7.26.3 Composite Measures

Some relational properties are difficult to represent with one indicator. Accessibility can involve travel time, monetary cost, eligibility, documentation, opening hours, information, language, safety, and institutional discretion. Dependence can involve concentration of alternatives, switching costs, substitutability, legal obligations, and time needed to reorganize. Relation quality can involve trust, fairness, responsiveness, recognition, reliability, and perceived respect. Composite measures combine several indicators to represent such multidimensional properties.

Composite construction introduces substantive choices. Components can be added, averaged, weighted, multiplied, thresholded, normalized, or modeled as indicators of a latent construct. Each operation implies something about substitutability. An additive index can permit a high value on one component to compensate for a low value on another. A minimum-based measure treats the weakest component as limiting. A multiplicative structure makes severe weakness in one component reduce the whole score sharply. These differences are analytical assumptions and should be justified by the relation being studied.

DeVellis and Thorpe emphasize that scale construction requires theoretical specification, item development, reliability assessment, and validation rather than mechanical aggregation DeVellis and Thorpe 2021. Relational inquiry adds the need to identify whose standpoint each component represents. A relation can appear high-quality to an organization because it is efficient while being experienced as inaccessible or coercive by another participant. Combining these perspectives into one score can obscure asymmetry.

Definition 7.251 (Composite relational measure profile). *A composite relational measure profile records the target property, component indicators, component prove-*

nance, scaling and normalization rules, weighting or aggregation logic, treatment of missing components, participant standpoint where relevant, validation evidence, and sensitivity to alternative constructions.

Sensitivity analysis is especially important for composite measures. If a substantive conclusion changes when a plausible alternative weighting or aggregation rule is used, the instability belongs in the evidential record. A robust composite does not require identical numerical values across specifications; it requires clarity about which conclusions persist and which depend on the chosen construction.

7.26.4 Relation Strength

Relation strength is often treated as if it were one scalar property. Section 7.7 established a broader characterization: intensity, duration, dependence, enforceability, salience, frequency, reciprocity, and consequence can vary independently. Measurement should therefore state which dimension is being represented before assigning a value described as “strength.”

A financial relation can have high monetary volume and low duration. A professional tie can involve infrequent communication yet high consequence because access to a rare resource depends on it. A legal relation can be rarely activated while remaining strongly enforceable. A caregiving relation can involve intense time commitment without large monetary flows. A platform relation can be frequent yet easily substitutable. These examples show why generic tie-strength scores can conceal substantively important differences.

For some research questions, a one-dimensional measure is appropriate. Transaction volume can be the relevant dimension when studying liquidity exposure; contact frequency can be relevant when studying information opportunities. The methodological issue is not scalar measurement itself, but the extension of a dimension-specific measure into a broader claim about the relation.

Proposition 7.252 (Dimension-indexed strength). *A measure of relational strength supports interpretation most clearly when the dimension of strength is named explicitly and when evidence is provided before the measure is generalized to other dimensions of the relation.*

This proposition is particularly relevant to network weights. Section 7.19 distinguished frequency, volume, duration, distance, exposure, and confidence as different edge weights. The present section extends that discipline to relational measurement more generally.

7.26.5 Relation Quality

Relation quality concerns evaluative properties of a relation. These can include trust, fairness, responsiveness, respect, reliability, recognition, procedural clarity, mutuality, safety, or perceived legitimacy. Unlike frequency or duration, quality often depends partly on participant interpretation and normative criteria. The measurement design should therefore identify the standpoint and dimension from which quality is being assessed.

A relation can be evaluated differently by its participants. An employer can assess an employment relation as efficient while a worker assesses it as insecure. An institu-

tion can classify an interaction as procedurally compliant while the affected person experiences it as inaccessible. A service relationship can be reliable in delivery while weak in recognition or voice. These differences are not necessarily measurement failures; they can reveal asymmetry in the relation itself.

Quality measures can use surveys, interviews, behavioral indicators, complaints, response times, observed practices, legal compliance, or composite indices. Each source supports different claims. Self-reports provide direct access to participant experience while remaining sensitive to framing, memory, incentives, and expectations. Behavioral indicators can capture enacted practice while leaving meaning underdetermined. Institutional measures can describe compliance while underrepresenting informal experience. Triangulation becomes valuable when the dimensions are expected to converge or when their divergence is substantively meaningful.

Cronbach and Meehl's construct-validity framework is useful here because quality concepts such as trust or legitimacy are not validated by one indicator alone Cronbach and Meehl 1955. Messick's emphasis on the interpretation of scores likewise cautions against treating a numerical quality score as self-interpreting Messick 1995. In relational inquiry, validation asks whether the score supports the specific claim being made about the relation under the stated conditions.

Definition 7.253 (Relational quality profile). A *relational quality profile* records the quality dimensions, participant or institutional standpoint, indicators and elicitation conditions, aggregation rule, relevant normative criteria, disagreement among perspectives, and the inferential scope supported by the measure.

This profile allows disagreement to remain visible. A study can report high procedural reliability and low perceived recognition without forcing the two into one average. Preserving that multidimensionality can be analytically more informative than producing a single quality rank.

7.26.6 Relation Stability

Relation stability concerns the variability of a relation or one of its properties through time. It should be distinguished from relational persistence. A relation can persist while its intensity varies substantially; it can remain statistically stable while its institutional meaning changes; and repeated manifestations can remain similar even after the underlying relation has been reconstituted. The identity discipline of Section 7.8 therefore precedes stability measurement.

Stability can be operationalized through variability in contact frequency, transaction volume, network position, role occupancy, response time, legal status, reported trust, or other relation-specific indicators. Different time windows can generate different conclusions. A relation can be stable over weeks while transforming over years. Seasonal relations can show predictable periodic variation that should not be confused with instability. Institutional relations can remain formally stable while practical enactment varies across administrations or local sites.

A stability measure should therefore state the temporal resolution, observation window, expected rhythm, and identity criterion. Section 7.24 developed relation formation, persistence, transformation, dissolution, sequence, rhythm, and gaps; stability measurement becomes meaningful when situated within that temporal architecture.

Definition 7.254 (Relational stability profile). A *relational stability profile* records the focal relational property, identity criterion, observation interval, temporal resolution, expected or institutionalized rhythms, variability measure, transformation thresholds, missing intervals, and historical conditions relevant to interpreting observed change.

The profile also helps distinguish measurement instability from relational instability. Changes in survey wording, administrative definitions, logging systems, sampling frames, or data-linkage rules can create apparent variation even when the target relation changes little.

7.26.7 Relation Accessibility

Relation accessibility concerns the practical possibility of reaching, activating, using, entering, or maintaining a relation or relational resource from a specified position. It extends the spatial accessibility discussion in Section 7.23 beyond geography. A service relation can be formally available yet difficult to activate because of documentation, cost, language, information, queueing, eligibility, opening hours, digital requirements, safety concerns, or discretionary gatekeeping. A professional network can exist while remaining inaccessible to newcomers. A legal remedy can be formally established while difficult to invoke because of procedural burden or representation costs.

Accessibility is therefore focal-position dependent. The same institution can be highly accessible to one actor and difficult to access for another. It is also target-specific: access to information, decision makers, credit, legal remedy, care, employment, or organizational participation can involve different barriers. A useful measure should specify what relation is being accessed, by whom, for what purpose, and under which temporal conditions.

Accessibility can be measured through travel time, monetary cost, waiting time, documentation requirements, success rates, number of intermediaries, network path constraints, eligibility, digital friction, observed dropout, or participant reports. A composite measure can be appropriate when several barriers jointly determine practical access, but the aggregation assumptions should remain visible.

Definition 7.255 (Relational accessibility profile). A *relational accessibility profile* records the focal position, target relation or relational resource, activation requirements, material and institutional barriers, permissions, intermediaries, temporal conditions, alternative routes, observed success or failure, and uncertainty concerning unobserved barriers.

Accessibility can itself be relationally generated. Gatekeepers, brokers, credentials, reputation, prior relations, legal status, and institutional classifications can change the cost of entering another relation. Measuring accessibility therefore often requires reconstructing a small relational configuration rather than one distance or cost variable.

7.26.8 Measurement Error

Measurement error arises when the recorded representation differs from the manifestation or relational property relevant to the intended claim. In relational data,

error can enter through node identity, edge detection, direction, weight, timing, participant recall, administrative coding, survey response, missing records, entity resolution, extraction models, or researcher interpretation. Butts demonstrates how network reconstruction can be affected by informant accuracy, measurement error, and missing data Butts 2003. The relational case therefore extends familiar measurement-error problems into multiple linked dimensions.

Error can be random, systematic, position-dependent, institutionally generated, or historically changing. A platform can record interactions of one type more completely than another. Powerful organizations can have more extensive documentary traces than informal groups. Survey respondents can recall salient relations more readily than routine ones. Administrative systems can systematically exclude relations that fall outside recognized categories. AI extraction systems can perform differently across languages, document types, or historical formats.

Measurement error can also be dependent across observations. If one institution changes its reporting system, several relations can be affected simultaneously. If a name-resolution algorithm merges two organizations, many edges can be misclassified. If a participant systematically omits one category of relationship, the resulting errors share a source. Standard error models that assume independent measurement noise may then be insufficient.

Definition 7.256 (Relational measurement-error profile). A *relational measurement-error profile* records plausible error sources, affected entities or relations, direction and dependence of error where known, temporal and institutional origin, validation evidence, missingness interactions, transformation steps, and sensitivity of substantive conclusions to plausible error structures.

Validation subsamples, repeated measurements, multiple informants, administrative cross-checks, source inspection, manual annotation, and sensitivity analysis can help characterize error. The goal is calibrated inference rather than the assumption of error-free relational data.

7.26.9 Measurement Invariance

Measurement invariance concerns whether a measure retains sufficiently comparable meaning across groups, times, institutions, languages, scales, or relational configurations. Meredith's formal treatment distinguishes several levels of factorial invariance and shows why comparability depends on the stability of the measurement relation rather than merely on use of the same instrument Meredith 1993. Relational inquiry extends this problem beyond psychometric scales because the relation between manifestation and target property can itself vary across contexts.

The same number of messages can represent different degrees of relational engagement across communication cultures or organizational roles. A complaint rate can represent different levels of dissatisfaction when reporting costs differ. A legal-status category can have different practical consequences across jurisdictions. A trust scale can function differently across languages or institutional settings. A network weight based on transaction volume can change meaning under inflation, market restructuring, or organizational growth. Reusing the same coding rule therefore does not establish comparable measurement.

Invariance can be considered across several dimensions. *Semantic invariance* concerns whether the measured category retains a sufficiently similar meaning. *pro-*

cedural invariance concerns whether the observation and coding process operates comparably. *scale invariance* concerns whether changes in analytical resolution preserve the interpretation of the measure. *temporal invariance* concerns whether the manifestation-to-property relation remains sufficiently stable through time. *positional invariance* concerns whether the measure functions comparably for actors occupying different relational positions.

These forms of invariance need not hold simultaneously. A measure can be semantically comparable while the data-collection process changes, or procedurally stable while the social meaning of the indicator shifts. In such cases, the comparison can sometimes be repaired through recalibration, stratification, reweighting, revised coding, bridge studies, or a narrower inferential claim.

Definition 7.257 (Measurement invariance profile). A *relational measurement-invariance profile* records the comparison domains, target property, indicator semantics, measurement procedure, scaling and coding rules, relevant relational positions, temporal and institutional conditions, evidence for comparability, detected non-invariance, and the adjustments or scope restrictions used in response.

Measurement invariance is particularly important for longitudinal, cross-cultural, cross-institutional, and AI-assisted research. Automated models can create apparent uniformity by mapping heterogeneous expressions into a shared embedding or category system. That common representation can improve comparability while also concealing context-specific meaning or unequal error rates. A shared numerical space should therefore be evaluated for the relational distinctions it preserves before cross-context comparisons are interpreted substantively.

The measurement architecture developed in this section can be summarized through a final warrant principle.

Proposition 7.258 (Relational measurement warrant). A *relational measure supports its intended inference most clearly when the target property, manifestation, transformation rule, standpoint, boundary, scale, temporal scope, error structure, and comparability conditions are documented sufficiently to reconstruct how the measure acquires its meaning.*

Proposition 7.258 preserves the distinction among measurement precision, construct interpretation, and substantive relational warrant. A highly reliable score can still represent the wrong property; a valid measure in one setting can lose comparability in another; and a noisy measure can sometimes support a bounded conclusion when its uncertainty is well characterized. Measurement therefore remains part of the epistemic relation between researcher and object rather than a neutral step that precedes interpretation.

The section also preserves the role of contingent encounter and aesthetic judgment developed earlier in the book. A strangely inconsistent indicator, unexpected disagreement between measures, sudden loss of invariance, or anomalous mismatch between formal accessibility and lived access can first make a measurement problem salient. Subsequent inquiry can determine whether the discrepancy reflects error, changing relational meaning, hidden heterogeneity, institutional transformation, or a limitation in the original object specification. As AI lowers the cost of producing scores, embeddings, classifications, and composite indices, the ability to inspect these measurement relations and revise them responsibly becomes increasingly consequential.

The next section turns to one of the most persistent consequences of incomplete measurement: missingness in relational data. Missingness can occur not only because values are unrecorded, but because actors, ties, events, or entire categories of relation fail to enter the evidential system. Section 193 therefore develops missingness as both a statistical problem and a potentially relationally generated phenomenon.

7.27 Missingness in Relational Data

Section 7.26 treated measurement as a transformation from relational manifestations into an analytical representation. The present section examines a closely related problem: some actors, relations, events, documents, attributes, or relational categories fail to enter the evidential system from which that representation is constructed. Its role is to develop missingness as a relational methodological problem rather than a generic absence of values. The objective is to distinguish several mechanisms of missingness, identify the inferential risks associated with each, and specify when patterned non-observation can itself become substantively informative. The discussion proceeds through missing actors, missing relations, hidden relations, strategic concealment, unequal observability, archival missingness, digital missingness, and missingness as substantive evidence.

Conventional missing-data analysis distinguishes mechanisms according to how the probability of missingness relates to observed and unobserved variables Little and Rubin 2019. Those distinctions remain useful, but relational inquiry introduces additional structure. An actor can be missing because the sampling frame excludes a relevant population; a relation can be missing because one endpoint does not report it; an edge can disappear because a platform does not log a particular interaction; a legal or economic relation can remain hidden because it is informal, confidential, or strategically concealed; and an archival relation can become unobservable because the relevant records were not produced, were poorly preserved, were weakly described, remained undigitized, or were not made accessible. Missingness can therefore be generated by the same relational field that the study is trying to reconstruct.

Network research provides a concrete illustration. Kossinets shows that boundary specification, actor nonresponse, and fixed-choice censoring can alter observed network statistics in different directions, so incomplete relational data need not behave like independent missing entries in an otherwise intact table Kossinets 2006. Butts likewise demonstrates that network inference can be sensitive to informant accuracy, measurement error, and incomplete relational reports Butts 2003. These results motivate a broader methodological principle: missingness should be attached to a specified observation process and relational position before the researcher decides how to repair, model, or interpret it.

Definition 7.259 (Relational missingness). *Relational missingness* is a condition in which a potentially relevant actor, relation, event, attribute, trace, or category is absent from the available evidential representation because of the processes through which the research object is bounded, observed, recorded, preserved, accessed, transformed, or disclosed.

Definition 7.259 keeps missingness distinct from substantive absence. A relation can be absent in the field yet completely observed as absent; it can exist in the field

Table 7.26: Forms of relational missingness and characteristic inferential risks

Form	Typical source	Primary inferential risk	Methodological response
Missing actors	Sampling-frame exclusion, nonresponse, identifier failure, hidden population, boundary choice	Distorted composition, topology, prevalence, or exposure	Reconstruct frame, compare inclusion mechanisms, preserve actor-level uncertainty
Missing relations	Nonreporting, censoring, incomplete logging, failed linkage, temporal aggregation	False sparsity, altered dependence, biased topology or exposure	Specify edge-generation process, validate subsets, perform sensitivity analysis
Hidden relations	Informality, privacy, weak manifestation, off-record practice, category mismatch	Treating weak visibility as weak relational importance	Triangulate indirect traces and competing relational explanations
Strategic concealment	Secrecy, evasion, reputational protection, legal or economic incentives	Endogenous missingness correlated with the target relation	Model concealment incentives and preserve alternative explanations
Unequal observability	Position, power, infrastructure, language, institutional capacity, surveillance	Visibility becomes confounded with importance, legitimacy, or prevalence	Compare observation regimes and map observability by position
Archival missingness	Non-creation, destruction, retention rules, access, description, digitization	Historical reconstruction inherits survival and custody biases	Reconstruct provenance, preservation pathway, and archival silence
Digital missingness	Platform ontology, deletion, API limits, encryption, moderation, offline activity	Recorded interaction is mistaken for the complete relational field	Audit logging architecture, platform boundaries, and extraction transformations
Substantive missingness	Exclusion, secrecy, informality, fear, nonrecognition, unequal recordability	Missingness is treated only as nuisance rather than possible evidence	Test whether missingness mechanism is itself relationally generated

yet remain missing from the data; or its status can remain uncertain because the observation process provides weak detection conditions. Section 7.6 established this distinction for relation identification. The present section extends it to the broader architecture of relational data production.

Table 7.26 summarizes the principal forms of missingness developed below and the characteristic inferential problem associated with each.

7.27.1 Missing Actors

Missing actors arise when relevant positions fail to enter the analytical population. The source can be an incomplete sampling frame, nonresponse, weak institutional registration, migration, informal participation, account deletion, entity-resolution failure, organizational opacity, or a boundary specification that excludes actors who remain relationally consequential. The resulting problem is more than a smaller sample. Missing actors can change the composition of the observed field and alter the relations among the actors who remain visible.

The effect depends on where missing actors are located. Omission of peripheral actors may affect prevalence estimates while leaving some central structures comparatively stable. Omission of brokers, gatekeepers, highly connected actors, marginalized populations, or entire categories of participant can alter reachability, community structure, exposure pathways, centrality, and the interpretation of institutional boundaries. Kossinets' simulations show that actor nonresponse and boundary specification can affect network-level statistics differently Kossinets 2006. Relational missingness should therefore preserve the mechanism of actor omission rather than treating a common percentage of missing cases as equivalent across studies.

The boundary problem is especially important. An actor can be absent because the study deliberately defined the field without that position. That methodological exclu-

sion is different from failed observation within an accepted boundary. Section 7.4 introduced boundary remainders precisely for such cases. A funder, regulator, supplier, informal intermediary, or external household member can remain outside the focal dataset while still being documented as potentially relevant to the relations observed inside it.

Actor identity also matters. Longitudinal data can lose an actor because an identifier changes, two identities are merged, one organization splits, or a digital account ceases to represent the same analytical entity. Such cases connect missingness to the relational-identity problem developed in Section 7.8. Apparent actor disappearance can therefore reflect substantive exit, measurement failure, reconstitution, or identifier discontinuity.

Definition 7.260 (Missing-actor profile). A *missing-actor profile* records the target population or relational field, inclusion criteria, sampling or registration frame, known or suspected omitted positions, mechanism of omission, identity uncertainty, boundary status, temporal interval, and plausible effects of actor omission on the substantive claim.

The profile can remain useful even when recovery of omitted actors is incomplete. Its purpose is to make composition uncertainty visible and to indicate which conclusions remain sensitive to plausible actor-level incompleteness.

7.27.2 Missing Relations

Missing relations occur when relevant actors are observed but one or more relations among them fail to enter the data. Survey respondents can omit routine or sensitive ties; administrative systems can record transactions while missing informal obligations; communication platforms can log messages while excluding face-to-face interaction; fixed-choice surveys can censor nominations after a preset number; linkage procedures can fail to connect records that belong to the same dyad; and temporal aggregation can erase brief or intermittent relations.

This form of missingness can be structurally dependent. If one respondent systematically underreports conflict relations, several edges sharing that actor can be missing together. If one institution changes its reporting software, many relations can disappear simultaneously. If a platform excludes one message type from an API, omission can follow interaction mode across the network. Missing-edge processes therefore often violate the convenient idea that each relation has an independent probability of being absent.

The inferential consequences depend on the target. Missing weak ties can affect reachability and bridging; missing high-volume ties can alter weighted centrality; missing directed ties can distort reciprocity; missing negative relations can create an unrealistically cooperative configuration; missing cross-group ties can exaggerate segregation; and missing temporal episodes can change apparent sequence or duration. Section 7.19 therefore treated network uncertainty as uncertainty in the graph specification itself rather than only in parameters estimated after a graph has been fixed.

Definition 7.261 (Missing-relation profile). A *missing-relation profile* records the candidate relation type, observation and reporting process, relation endpoints, censoring or linkage rules, temporal coverage, direction and weight where relevant, known validation evidence, likely dependence among missing relations, and sensitivity of the

substantive conclusion to plausible unobserved ties.

A useful response can include validation subsamples, repeated elicitation, multiple informants, documentary cross-checking, administrative linkage, alternative graph reconstructions, or sensitivity analysis. Imputation can be appropriate in some settings, but an imputed edge should remain distinguishable from an observed one when the substantive interpretation depends on source and provenance.

7.27.3 Hidden Relations

Some relations are difficult to observe because their ordinary manifestations are weak, private, informal, episodic, or poorly aligned with recognized categories. Informal caregiving, undocumented work, off-record advice, tacit brokerage, confidential negotiation, unregistered debt, reputational influence, and unofficial authority can remain consequential while leaving comparatively sparse formal traces. Calling such relations *hidden* describes an observation problem; it does not by itself establish secrecy or deliberate concealment.

Hidden relations often become visible indirectly. Repeated co-occurrence, correlated decisions, unexplained resource flows, references in correspondence, third-party testimony, spatial co-presence, legal disputes, institutional workarounds, or sudden coordination can support a candidate relation. Yet several mechanisms can generate similar traces. A pair of organizations can make similar decisions because of direct coordination, shared regulation, common professional norms, or a common external shock. The inference from indirect trace to hidden relation therefore requires an explicit bridge and competing explanations.

Category systems can also hide relations by making them difficult to name. Bowker and Star show how classifications organize visibility and action while leaving some cases awkwardly positioned or excluded Bowker and Star 1999. A relation that lacks an administrative category, formal contract type, recognized kinship label, or platform event type can become weakly recordable even when participants experience it as consequential. Hiddenness can thus emerge from the ontology of the recording system rather than from the intentions of the actors involved.

Definition 7.262 (Hidden-relation profile). A *hidden-relation profile* records the candidate relation, reasons for weak direct observability, indirect manifestations, competing explanations, relevant classification or recording systems, participant or third-party accounts, boundary and scale, temporal scope, and uncertainty concerning the relation's existence or characterization.

The profile encourages cautious inference. A hidden relation can be a strong explanatory candidate while remaining less directly evidenced than a formally documented relation. That difference in evidential access should remain visible in the final claim.

7.27.4 Strategic Concealment

Strategic concealment is a narrower process in which actors or institutions have incentives to reduce, redirect, fragment, or manipulate the traces through which a relation could be observed. The relevant incentives can involve legal exposure, taxation, competition, organizational reputation, privacy, contractual restrictions, political sensitivity, market strategy, professional sanctions, or protection of vulnerable

participants. Concealment can operate through non-disclosure, indirect intermediaries, off-record communication, record fragmentation, selective reporting, classification changes, deletion, or movement into channels with weaker observability.

The existence of an incentive does not establish that concealment occurred. Researchers should therefore distinguish *concealment opportunity*, *concealment incentive*, *concealment behavior*, and *observed missingness*. A confidential negotiation can be poorly visible because confidentiality is institutionally routine; a missing transaction can reflect technical failure; a sparse archive can result from weak preservation rather than purposeful destruction. Strategic concealment becomes a warranted explanation only when the evidential pathway supports more than the mere possibility of secrecy.

Concealment can itself be relationally structured. An actor may possess the authority to classify records, the resources to hire intermediaries, the technical capacity to move communication into private channels, or the institutional standing to resist disclosure. Another actor may be highly observable because participation requires reporting. Missingness can therefore reflect unequal capacities to manage visibility.

Definition 7.263 (Strategic-concealment profile). A *strategic-concealment profile* records the relation potentially concealed, actors able to affect observability, relevant incentives and constraints, available concealment mechanisms, observed trace anomalies, alternative non-strategic explanations, temporal scope, and the evidential basis for attributing missingness to deliberate action.

This profile is particularly important for ethical writing. Strong claims of concealment can imply intention or wrongdoing. The level of attribution should therefore remain proportionate to the evidence, consistent with the epistemic-humility principle adopted across the book.

7.27.5 Unequal Observability

Relations are often observed under unequal conditions. Some organizations produce extensive auditable records because law, professional standards, or administrative systems require them. Informal groups can leave fewer records. Digitally mediated actors can generate dense traces while offline participants remain comparatively invisible. Powerful institutions can be highly documented in some domains while retaining greater capacity to control access in others. Marginalized participants can be simultaneously subject to intense surveillance and poorly represented in records relevant to their own experience.

These differences create an *observability structure*. Visibility can vary with institutional capacity, language, legal status, technology, geography, organizational form, research access, documentation norms, surveillance, and archival preservation. The resulting dataset can therefore overrepresent relations that are easy to record and underrepresent relations that are socially consequential but weakly institutionalized.

A common inferential risk is to equate documentary or digital density with relational importance. A formally regulated financial relation can produce thousands of records, while a short informal conversation can alter access to employment or legal protection. Conversely, a dense digital trace can correspond to low relational commitment. Visibility and substantive importance should therefore remain separate dimensions.

Definition 7.264 (Relational observability profile). A *relational observability profile* records how observation opportunities vary across positions, relation types, institutions, languages, technologies, locations, and times; which mechanisms generate those differences; and how unequal observability can affect the composition and interpretation of the available evidence.

Unequal observability also has implications for epistemic justice. If some positions systematically enter research through official categories while others appear only through external classification, missingness can reproduce asymmetries in whose relations become recognizable. Triangulation and participatory source development can sometimes widen the evidential field, while privacy and safety can appropriately limit visibility in other cases.

7.27.6 Archival Missingness

Archival missingness concerns historical traces that fail to become available for present reconstruction. Section 7.11 treated the archive as a relational infrastructure of production, custody, arrangement, preservation, description, access, and encounter. Missingness can arise at each stage. A record may not have been created in the relevant form; it may also have been destroyed, lost, dispersed, reclassified, restricted, poorly catalogued, left undigitized, or rendered difficult to retrieve by language, format, or institutional arrangement.

Trouillot emphasizes that silences can enter historical production at several moments, including fact creation, assembly, retrieval, and retrospective significance Trouillot 1995. That insight is directly relevant to relational reconstruction. If an actor's relations were rarely recorded, later network or institutional histories can appear sparser around that actor even when the underlying field was not. If one organization preserves correspondence while another destroys routine records, apparent asymmetry in influence can partly reflect archival survival.

The absence of a record therefore needs an archival detection model. The researcher should ask whether the institution normally generated this kind of record, whether retention was expected, whether access is complete, whether cataloguing would make it discoverable, and whether the search strategy was capable of finding it. Only under sufficiently strong detection conditions can archival non-observation contribute substantially to an absence claim.

Definition 7.265 (Archival missingness profile). An *archival missingness profile* records the expected record type, production conditions, custody and retention pathway, known destruction or dispersal, access restrictions, description and digitization status, retrieval strategy, comparison archives, and the consequences of missing traces for the relational reconstruction.

The profile preserves the distinction between a missing archive and an archive of absence. The former concerns incomplete evidence; the latter can sometimes document that an expected relation, authorization, transaction, or institutional act did not occur under conditions where such events were reliably recorded.

7.27.7 Digital Missingness

Digital systems can generate very large relational datasets while still producing systematic missingness. Platform logs reflect a technical ontology of accounts, events,

sessions, transactions, permissions, and interfaces. Interactions occurring outside that ontology can remain unrecorded. Deleted content, private channels, encrypted communication, offline meetings, API restrictions, rate limits, moderation, data-retention policies, account suspension, identifier changes, device loss, and platform migration can further alter what is observable.

Digital missingness can also be produced by research access. A platform can expose a public API that returns a subset of fields, apply ranking or sampling before retrieval, limit historical depth, or change access policies during a project. The researcher can then possess a technically complete extract of an interface that is substantively incomplete relative to the platform's internal data and still more incomplete relative to the wider relational field.

Automated processing introduces additional gaps. Entity-resolution systems can fail to match names across documents; language models can miss low-frequency relation types; optical or speech recognition can perform unevenly across formats and languages; classification thresholds can suppress uncertain cases; and deduplication can merge distinct actors. These transformations can make missingness appear after the original record was successfully captured.

Definition 7.266 (Digital missingness profile). A *digital missingness profile* records the platform or system ontology, logging rules, retention and deletion policies, public or researcher access channel, API or retrieval limits, identifier changes, offline or private interaction channels, transformation and extraction steps, known performance variation, and the temporal interval over which these conditions apply.

The profile is particularly important for AI-assisted research because automated systems can produce a persuasive sense of completeness. High retrieval volume and fluent synthesis do not establish corpus completeness. Provenance should preserve which repositories, interfaces, time windows, languages, and extraction methods were actually searched.

7.27.8 Missingness as Substantive Evidence

Missingness is sometimes generated by the relational phenomenon under investigation. Informal work can be missing from official employment records because institutional recognition is part of the substantive issue. People facing retaliation may avoid reporting a relation. Excluded populations may lack the documentation required to enter administrative systems. Confidential relations can leave fewer public traces because privacy is constitutive of their organization. Illicit or stigmatized exchange can be weakly documented because participants manage visibility. Unequal institutional recognition can determine which forms of care, labor, ownership, or participation become recordable.

Such cases create a methodological opportunity and a risk. The opportunity is that patterned missingness can reveal something about access, recognition, power, secrecy, informality, or institutional classification. The risk is circular inference: researchers can explain missing evidence by the very hidden relation they seek to prove. Missingness therefore becomes substantive evidence only when the proposed mechanism is independently supported and competing observation-process explanations are considered.

A useful procedure is to reconstruct the *missingness pathway*. The researcher identifies where the trace would normally be generated, which actor or institution con-

trols that stage, what incentives or constraints affect recording, how the pattern differs across positions or times, and which alternative mechanisms could produce a similar gap. Comparative cases can be especially helpful. If one legal reform changes reporting incentives and missingness changes selectively for the relations affected by the reform, the pattern can strengthen a relational explanation while still requiring attention to concurrent changes.

Definition 7.267 (Relational missingness mechanism profile). A *relational missingness mechanism profile* records the missing object, stage of the observation or record-production process at which missingness arises, actors or institutions affecting that stage, candidate relational mechanism, alternative explanations, comparison evidence, boundary, scale, temporal scope, and uncertainty concerning whether the missingness is substantively generated.

The profile supports a final warrant principle.

Proposition 7.268 (Relational missingness warrant). A *substantive inference from missing relational data becomes more credible when the missing object, observation process, missingness mechanism, relational position, boundary, scale, temporal scope, alternative explanations, and sensitivity of the conclusion to plausible unseen evidence are documented sufficiently to reconstruct the inferential pathway.*

Proposition 7.268 preserves several levels of uncertainty. Statistical uncertainty about unobserved values is one component. Uncertainty can also concern which actors belong to the field, which relation types were recordable, whether nonresponse was strategic, whether archival loss was selective, whether digital retrieval omitted a class of event, and whether the proposed substantive mechanism actually generated the missingness. These forms need not be collapsed into one probability estimate.

Contingent encounter and aesthetic judgment remain relevant here. A strangely empty region in a relational map, repeated absence of one category from records, an unexpected discontinuity after a platform change, or a conspicuous archival silence can first become salient before the researcher knows whether the pattern is meaningful. Subsequent inquiry should distinguish ordinary data loss, boundary error, classification mismatch, strategic concealment, unequal observability, and genuinely substantive missingness. In AI-assisted research, large-scale retrieval can make missingness harder to perceive because the returned corpus can feel abundant. The methodological task therefore includes asking which relations had little chance to enter the searchable corpus in the first place.

The next section turns from incomplete evidence to the integration of heterogeneous evidence. Section 194 develops triangulation across heterogeneous sources.

7.28 Triangulation of Relational Evidence

The preceding sections developed several distinct evidential interfaces for relational inquiry: documents, archives, ethnographic encounters, interviews, legal and institutional materials, comparative designs, quantitative models, networks, spatial and temporal representations, field reconstruction, measurement systems, and missingness analysis. The role of the present section is to specify how evidence from such interfaces can be combined without treating methodological plurality as simple accumulation. Its objective is to distinguish convergence, complementarity, inconsistency, and contradiction across evidential pathways; to identify the conditions under

which cross-source agreement strengthens a relational claim; and to preserve disagreements that reveal genuine differences of position, scale, time, representation, or meaning. The discussion proceeds through documentary, interview, observational, quantitative, historical, and cross-scale triangulation before addressing contradictory evidence and irreducible disagreement.

Triangulation has a long methodological history in social inquiry. Jick describes triangulation as the use of multiple qualitative and quantitative methods to examine a common research problem and emphasizes the complementary strengths of different methods Jick 1979. Mixed-method research develops this problem more systematically by treating integration as a design choice involving distinct forms of evidence and inference Creswell and Plano Clark 2018. Mathison adds an especially important caution: triangulation can yield convergence, inconsistency, and contradiction, and the latter two outcomes require interpretation rather than being treated as failed convergence Mathison 1988. Relational inquiry extends this insight because different methods frequently observe different manifestations, positions, temporal intervals, and scales of the same relational field.

Definition 7.269 (Relational triangulation). *Relational triangulation* is the structured comparison of partially distinct evidential pathways concerning a relational claim, with explicit attention to the object, manifestation, standpoint, boundary, scale, temporal scope, transformation process, and uncertainty carried by each pathway.

Definition 7.269 makes independence and alignment separate questions. Two sources can be methodologically different while sharing the same administrative classification, archive, sampling frame, platform log, interview population, or institutional narrative. Their agreement may then reflect a common upstream source. Conversely, two sources can appear inconsistent because they describe different scales or periods. Triangulation therefore requires reconstruction of the pathways through which evidence became available before evidential agreement or disagreement is interpreted.

Table 7.27 summarizes the principal triangulation forms developed below.

A useful starting point is to distinguish four outcomes of triangulation. *Convergence* occurs when distinct evidential pathways support sufficiently compatible claims. *Complementarity* occurs when the pathways illuminate different dimensions of a relation without requiring identical results. *Tension* occurs when results differ in ways that may be explained by scale, time, standpoint, measurement, or boundary. *Contradiction* occurs when the available interpretations remain materially incompatible within the same stated scope. These outcomes can coexist within one study. A legal record and an organizational chart can converge on formal authority, interviews can complement that evidence with accounts of practical dependence, ethnography can reveal tension between prescribed and enacted coordination, and quantitative analysis can expose subgroup differences that contradict an aggregate institutional narrative.

Definition 7.270 (Triangulation profile). A *triangulation profile* records the focal relational claim, evidential pathways, degree of pathway independence, manifestations accessed, standpoints represented, boundary and scale, temporal scope, transformations applied to the evidence, observed convergence or divergence, alternative explanations, and the consequences of unresolved disagreement for the claim.

The profile prevents triangulation from becoming a rhetorical statement that “multiple sources agree.” It asks which sources agree, why their agreement is informative,

Table 7.27: Forms of relational triangulation and characteristic inferential contributions

Form	Evidential pathways	Potential contribution	Characteristic caution
Documentary	Administrative, organizational, legal, archival, public, digital records	Source cross-checking, provenance reconstruction, formal-enacted comparison	Shared record-production system can create correlated evidence
Interview	Participants in different positions, repeated interviews, interview-document comparison	Positional knowledge, meaning, experience, contradiction, temporal reinterpretation	Agreement can reflect common narratives or shared institutional exposure
Observational	Field observation, participant observation, repeated sites, observer perspectives	Enacted practice, tacit coordination, informal relation, breakdown and repair	Observer access and field position condition visibility
Quantitative	Measures, datasets, estimators, model families, sampling frames, validation subsets	Pattern stability, measurement comparison, sensitivity, distributional scope	Specification agreement can share the same measurement or boundary assumptions
Historical	Archives, contemporary records, later testimony, period comparison, category history	Sequence, continuity, transformation, provenance, changing meaning	Surviving traces can share preservation and archival-selection biases
Cross-scale	Individual, dyadic, organizational, institutional, field, spatial, temporal scales	Cross-scale consistency, bridge identification, scale-specific mechanisms	Apparent disagreement can reflect legitimate scale dependence
Contradictory	Evidential pathways supporting incompatible interpretations	Boundary revision, mechanism differentiation, uncertainty localization	Premature averaging can erase informative conflict
Preserved disagreement	Competing interpretations retained after reasonable inquiry	Reopenability, plural reconstruction, future re-epistemization	Requires explicit account of the unresolved locus and its consequences

where they may share upstream dependence, and which parts of the claim remain weakly supported.

7.28.1 Documentary Triangulation

Documentary triangulation compares records produced through different documentary pathways. Section 7.10 distinguished administrative, institutional, organizational, correspondence, public, and digital records, while Section 7.11 examined archives as infrastructures of selection, preservation, arrangement, and access. These differences matter because documents that appear independent can originate from the same reporting system or classification regime.

A legal filing, annual report, administrative database, and public statement may contain the same organizational category because each inherits it from a common institutional source. Counting four documents would overstate evidential independence. Documentary triangulation therefore begins with provenance. The researcher asks who produced the record, for what operational purpose, under which categories, through which custody and transformation chain, and whether the document reproduces another source.

Documentary convergence is especially informative when distinct production systems generate compatible traces. A formal contract can establish a legal relation; payment records can indicate enactment; correspondence can reveal interpretation or renegotiation; meeting minutes can document institutional recognition; and later archival records can show persistence or dissolution. These sources contribute differently to the relational claim. Agreement across them can strengthen confidence because each is vulnerable to different errors and incentives.

Documentary triangulation can also expose divergence between formal representation and enacted relation. A policy may assign responsibility to one office while correspondence repeatedly routes practical decisions through another. An organizational chart may preserve a reporting line that transactional records show has become marginal. A registry can classify an organization as active while financial or operational records show prolonged inactivity. Such discrepancies should be treated as candidate evidence concerning institutional transformation, documentary lag, category mismatch, or uneven enactment.

Definition 7.271 (Documentary triangulation chain). A *documentary triangulation chain* records the provenance and transformation pathway of each documentary source, the relational dimension each source bears on, shared upstream dependencies among sources, and the inferential contribution of convergence or divergence across those sources.

This chain complements the documentary provenance chain developed in Section 7.10. Its purpose is comparative: provenance is reconstructed across sources so that documentary multiplicity can be distinguished from evidential independence.

7.28.2 Interview Triangulation

Interview triangulation compares accounts across relational positions, temporal moments, interview formats, and other evidential pathways. Section 7.13 treated interviews as relationally produced evidence whose meaning depends on participant position, memory, elicitation conditions, and interviewer–participant interaction. Triangulation therefore requires more than repeated questioning.

Participants can possess asymmetrical access to the same relation. A manager may know formal decision procedures, a frontline worker may know everyday implementation, a client may know practical accessibility, and an external regulator may know compliance history. Their accounts can converge on one dimension while diverging on another. Such positional divergence can be analytically valuable because it helps reconstruct how the relation appears and operates from different locations within the configuration.

Repeated interviews with the same participant can also triangulate temporal interpretation. A participant may reinterpret an earlier event after later institutional change. The later account does not automatically invalidate the earlier one; the difference can reveal changing meaning, memory, or relational position. Maintaining date, context, and elicitation conditions makes temporal reinterpretation itself researchable.

Interview triangulation becomes stronger when it crosses evidence types. A participant's account of informal authority can be compared with observed practice, documentary decision trails, network position, or institutional outcomes. The purpose is not to make interviews pass an external "truth test." Participant accounts can provide distinctive evidence about experience, meaning, perceived constraint, and practical knowledge even when formal records differ. Cross-source comparison helps specify what kind of claim each source can support.

Shared narratives require caution. Several participants can repeat the same institutional explanation because they were trained through the same professional discourse, rely on the same official account, or occupy similar positions. Convergence then demonstrates the circulation or institutionalization of that narrative more di-

rectly than it demonstrates the historical accuracy of the narrative's content.

Definition 7.272 (Positional interview triangulation). *Positional interview triangulation* compares accounts from participants occupying substantively different relational positions while preserving differences in access, role, dependence, authority, temporal standpoint, and exposure to shared narratives.

The definition supports comparison without assigning automatic epistemic priority to one position. The relevant question is which relational dimension each position is comparatively well placed to observe and where its access remains limited.

7.28.3 Observational Triangulation

Observational triangulation compares observations across sites, times, observers, modes of participation, and supporting sources. Ethnographic inquiry in Section 7.12 showed that observation is situated: researcher presence, access, attributed role, and participation can alter what becomes visible. Triangulation can make some of these conditions explicit.

Repeated observation across different temporal periods can distinguish routine practice from exceptional events. Observation across sites can reveal whether an apparently local pattern travels with an organizational rule, depends on one team, or varies with local infrastructure. Several observers can notice different aspects of the same interaction because of disciplinary training, language competence, social position, or practical access. The differences among observations can therefore become data about the observation process as well as about the field.

Observation can also be triangulated with formal and reported relations. A documented procedure may describe how coordination is expected to occur; interviews may describe how participants believe it occurs; observation can show how it is enacted under ordinary or stressful conditions. Divergence among these pathways can indicate informal repair, symbolic compliance, undocumented discretion, changing routines, or misalignment between formal and practical organization.

The observational record itself requires provenance. Field notes, audio or video, coding schemes, researcher memos, and later analytic summaries represent different transformations of an encounter. Agreement among several coded variables extracted from the same recording provides less evidential independence than agreement between that recording, independent documentary traces, and observations conducted under another access condition.

Definition 7.273 (Observational triangulation profile). An *observational triangulation profile* records observation sites, temporal intervals, observer positions, participation modes, recording transformations, focal relational dimensions, supporting evidence, and the extent to which convergent observations arise from independent or shared observational conditions.

Observational triangulation can be especially useful when tacit coordination, informal authority, routine repair, or embodied practice is central to the research object. It remains bounded by where and when observation was possible.

7.28.4 Quantitative Triangulation

Quantitative triangulation examines whether a relational conclusion remains supported across substantively relevant measurements, datasets, sampling frames, model families, estimators, temporal windows, or validation designs. Sections 7.18, 7.21, 7.22, and 7.26 developed the corresponding problems of estimation, dependence, causal identification, and measurement. Triangulation draws these elements together while preserving the difference between robustness within one representation and corroboration across different representations.

A finding can remain stable across several regression specifications because the specifications share the same measurement system, sample exclusions, boundary, and temporal aggregation. This form of robustness is useful, yet its evidential reach differs from convergence between independent administrative data, survey measures, observational records, and a separately designed validation sample. Quantitative triangulation should therefore classify which dimensions are actually varied.

Measurement triangulation compares indicators that operationalize the same target property through different manifestations. Sampling triangulation compares conclusions across frames or populations. Model triangulation compares alternative dependence or functional specifications. Temporal triangulation compares intervals or aggregation windows. Design triangulation compares observational, quasi-experimental, experimental, or other identification strategies where available. These forms can produce different patterns of convergence and disagreement.

Cross-validation and out-of-sample prediction provide another useful form of evidence, especially for predictive relational models. Predictive stability can show that a pattern travels to held-out observations under a specified data-generating setting. It does not by itself establish the substantive relational interpretation assigned to that pattern. A latent-space model, for example, can predict ties well while several social mechanisms remain compatible with the latent positions.

Definition 7.274 (Quantitative triangulation matrix). A *quantitative triangulation matrix* records which elements of a quantitative inference are varied across analyses—measurement, sample, boundary, scale, time, model family, estimator, dependence structure, or identification design—and which elements remain shared.

This matrix makes robustness claims more informative. It allows the researcher to say that a result is stable across model families while remaining dependent on one measurement system, or stable across two datasets while sensitive to boundary definition. Such statements preserve the actual scope of quantitative convergence.

7.28.5 Historical Triangulation

Historical triangulation compares traces produced at different times, by different institutions, for different purposes, and from different positions in relation to the events under study. Its objective is to reconstruct sequence, continuity, transformation, and category change while accounting for survival, archival selection, retrospective interpretation, and unequal recordability.

Contemporary records and retrospective testimony often perform different epistemic functions. A contemporaneous ledger can establish that a transaction was recorded at a particular time; a later interview can explain how participants un-

derstood the transaction or how its significance changed. An official report can document institutional classification; correspondence can reveal disagreement around that classification; later archival arrangement can shape which traces become readily discoverable. Historical triangulation therefore combines evidential forms while keeping their temporal positions visible.

Triangulation across periods can also test continuity claims. A relation described with the same institutional name across decades may show changes in authority, membership, legal basis, or practical enactment. Conversely, terminology can change while a recognizable relational lineage persists. Sections 7.8 and 7.24 developed identity and temporal profiles for these cases. Historical triangulation supplies the heterogeneous traces needed to evaluate those profiles.

Archival survival creates correlated gaps. Several sources can be missing because the same institution destroyed records, failed to preserve informal communications, restricted access, or adopted a classification system that excluded certain actors. Apparent historical convergence among surviving sources should therefore be interpreted together with the archival visibility architecture developed in Section 7.11 and the missingness mechanisms of Section 7.27.

Definition 7.275 (Historical triangulation profile). A *historical triangulation profile* records the temporal position, provenance, category system, survival pathway, retrospective distance, relational standpoint, and inferential role of each historical source used to reconstruct a relational trajectory.

Historical triangulation can strengthen a sequence or continuity claim even when sources differ in meaning. Complementarity across traces is often more important than literal agreement because different historical sources were created to record different aspects of the relational field.

7.28.6 Cross-Scale Triangulation

Cross-scale triangulation examines how evidence concerning a relational phenomenon changes when represented at different analytical scales. Section 7.5 developed individual, dyadic, organizational, community, institutional, field, and multiscale inquiry. Triangulation across these resolutions can reveal whether an observed relation is scale-stable, scale-specific, or connected through identifiable cross-scale bridges.

An individual-level account of constrained access can coexist with organization-level evidence of high average service provision. A firm-level analysis can show stable output while team-level observations reveal substantial internal reorganization. A national indicator can improve while a regional or subgroup distribution becomes more unequal. These results can appear contradictory when scale is left implicit. Once scale is specified, they may describe different aspects of the same configuration.

Cross-scale convergence becomes especially informative when an explicit bridge connects the scales. A legal reform can alter organizational procedures; changed procedures can affect frontline interactions; those interactions can influence individual access. Evidence at each scale can corroborate different stages of the pathway. The presence of similar trends across scales provides weaker support when the bridge itself remains unspecified.

Scale transformation can also generate discrepancies mechanically. Aggregation

can suppress heterogeneity; disaggregation can dissolve institutional organization; spatial averaging can hide boundary discontinuities; temporal aggregation can erase sequence. Cross-scale triangulation therefore includes a representation audit asking which relational distinctions are preserved or lost when moving between scales.

Definition 7.276 (Cross-scale triangulation profile). *A cross-scale triangulation profile records the relational object at each scale, the representation used at that scale, proposed cross-scale bridges, aggregation or disaggregation transformations, scale remainders, observed convergence or divergence, and the scope of cross-scale inference.*

The profile helps distinguish evidence that supports a cross-scale mechanism from evidence that merely shows patterns at several resolutions.

7.28.7 Contradictory Evidence

Contradictory evidence deserves explicit analysis because methodological diversity frequently produces results that cannot be reconciled through simple averaging. Mathison's account of triangulation emphasizes that contradiction and inconsistency can be legitimate outcomes requiring explanatory work Mathison 1988. Relational inquiry provides several candidate sources for such contradiction.

First, evidence can concern different manifestations of the proposed relation. A formal record can indicate legal authority while ethnography shows weak practical compliance. Second, standpoints can differ. An institution can experience a process as efficient while participants experience it as inaccessible. Third, scales can differ. Aggregate stability can coexist with local disruption. Fourth, temporal scopes can differ. Short-term gains can coexist with long-term deterioration. Fifth, measurement systems can encode different definitions. Sixth, evidence can genuinely support competing substantive explanations within the same scope.

Contradiction analysis should therefore begin by localizing the disagreement. The researcher asks whether the conflicting results concern the same object, relational property, boundary, scale, temporal interval, standpoint, and inferential target. Apparent contradiction often weakens after these dimensions are separated. Remaining contradiction becomes more informative because the locus of incompatibility is clearer.

Definition 7.277 (Contradiction localization). *Contradiction localization identifies the smallest analytically relevant set of object, manifestation, standpoint, boundary, scale, time, measurement, or inferential assumptions on which two evidential claims remain incompatible.*

Localization supports proportionate revision. If contradiction arises from one measurement definition, the measurement layer may require revision. If it persists across multiple measurements but changes with scale, scale specification becomes the likely target. If several partially independent pathways support incompatible mechanisms within the same scope, theoretical or causal revision may be warranted.

Contradictory evidence can also expose unequal epistemic authority. Institutional records can dominate an inquiry because they are easier to quantify or cite, while experiential evidence remains weakly represented. The reverse can also occur when a vivid narrative receives disproportionate weight relative to broader evidence. Triangulation should preserve the provenance and warrant of each pathway rather than

resolving disagreement through prestige or rhetorical salience alone.

Proposition 7.278 (Contradiction diagnostic). *When materially contradictory evidential claims concern sufficiently aligned objects, boundaries, scales, temporal scopes, and relational properties, the contradiction provides a reason to examine measurement, access, mechanism, theory, or object specification before forcing synthesis.*

Proposition 7.278 treats contradiction as a possible diagnostic resource. The appropriate response depends on where the disagreement is localized and on the strength and independence of the competing evidential pathways.

7.28.8 Preserving Irreducible Disagreement

Some disagreements can remain after reasonable efforts at clarification, additional evidence collection, remeasurement, boundary revision, and theoretical reconstruction. Preserving such disagreement can be epistemically preferable to producing a synthetic statement whose apparent unity exceeds the available warrant. This follows the broader GRE principle of preserving translation remainders and failed syntheses when heterogeneous representations do not support complete equivalence.

Irreducible disagreement can take several forms. Participants can sustain incompatible interpretations of the same institutional relation. Legal doctrine and lived practice can remain normatively and descriptively misaligned. Historical sources can support more than one plausible reconstruction because crucial traces are missing. Quantitative models can fit the observed data similarly while implying different mechanisms. Cross-cultural concepts can resist complete translation. Competing scales can disclose structures that cannot be compressed into one scalar summary without substantial loss.

Preservation requires structure. Merely listing several interpretations can obscure which parts are shared and where the disagreement begins. A useful record identifies the common evidence, competing inferential bridges, divergent assumptions, evidence that would discriminate among them, practical consequences of adopting one interpretation, and the conditions under which the disagreement should be reopened.

Definition 7.279 (Irreducible disagreement record). *An irreducible disagreement record preserves competing relational interpretations together with their shared evidence, divergent evidence, assumptions, inferential bridges, unresolved uncertainties, consequences for downstream claims, and possible conditions for future re-evaluation.*

This record supports the open and cumulative research practice developed in Section 164. Future researchers may encounter new archives, methods, scales, or conceptual resources that reorganize the disagreement. Preservation therefore retains future epistemic option value rather than converting present underdetermination into artificial closure.

AI-assisted research strengthens the practical importance of this discipline. Large language models and automated synthesis systems can rapidly produce reconciled summaries from heterogeneous sources. Such synthesis can be useful for orientation, yet it can also smooth over evidential conflict, minority interpretations, scale dependence, missingness, and source asymmetry. A triangulation workflow should therefore preserve source-level disagreement before generating an integrated narrative. AI can help search for corroborating and disconfirming evidence, compare

formulations, or detect recurrent discrepancies; responsibility for deciding whether apparent convergence is epistemically warranted remains attached to the research process and its accountable human and institutional participants.

Contingent encounter and aesthetic judgment also have a distinctive role in triangulation. A researcher may notice that two sources “fit too neatly,” that one small observation disrupts an otherwise coherent narrative, or that several methods disagree in a patterned way. Such salience can motivate renewed inquiry without serving as proof. The subsequent task is to reconstruct source dependence, missingness, boundary, scale, measurement, and alternative explanations sufficiently to determine whether the perceived pattern survives disciplined comparison.

Proposition 7.280 (Relational triangulation warrant). *A relational claim gains support from triangulation to the extent that the contributing evidential pathways are sufficiently aligned with the target claim, their shared dependencies are understood, relevant differences in standpoint, boundary, scale, and time are preserved, and convergence or disagreement remains traceable to the evidence that generated it.*

Proposition 7.280 provides the section’s transition to the next methodological problem. Once heterogeneous evidence has been compared and disagreements have been localized or preserved, relational inquiry still requires criteria for deciding how strongly a claim is warranted. Section 195 therefore turns from triangulation to the validation of relational claims.

7.29 Validation of Relational Claims

The preceding sections developed procedures for specifying relational objects, constructing boundaries and scales, identifying and characterizing relations, reconstructing configurations, working with heterogeneous evidence, measuring relations, analyzing missingness, and triangulating evidential pathways. The role of the present section is to specify how such work supports claims that remain credible under relevant tests, alternative specifications, and changes of evidential standpoint. Its objective is to distinguish several forms of validity and robustness that bear on relational inquiry, to clarify the relation between validation and scope, and to prevent “validated” from becoming a global label attached to a claim after one successful test. The discussion proceeds through construct, historical, and relational validity; boundary, scale, representation, and cross-method robustness; external validity; and the limits of validation.

Validity is treated here as a property of an inference or interpretation within a specified evidential and theoretical configuration. Cronbach and Meehl’s classic account of construct validity emphasizes that validation concerns the network of relations connecting theoretical constructs, observations, and expected empirical consequences rather than one isolated correlation Cronbach and Meehl 1955. Messick similarly treats validity as evaluation of the meaning and use of interpretations built from observed performances or measurements Messick 1995. Relational inquiry extends this inferential view because the meaning of a relational claim depends additionally on object specification, boundary, scale, temporal scope, representation, standpoint, and the pathways through which evidence became observable.

Definition 7.281 (Relational validation profile). *A relational validation profile records a focal relational claim, its evidential basis, construct and historical interpretation,*

Table 7.28: Validation dimensions for relational claims

Dimension	Primary question	Typical test	Characteristic caution
Construct validity	Does the representation bear on the intended relational property?	Indicator convergence, discriminant evidence, theoretical consequences	Shared manifestations can create apparent convergence
Historical validity	Does the claim preserve period-specific categories, sequence, and temporal conditions?	Source comparison, periodization sensitivity, category-history reconstruction	Present categories can be projected backward
Relational validity	Does the evidence warrant the proposed relation and its stated properties?	Alternative relation models, source/standpoint comparison, identification audit	Manifestation can be mistaken for relation
Boundary robustness	Does the claim survive plausible changes in the analytical domain?	Boundary expansion/contraction, omitted-relation audit	Stability can depend on excluding consequential external relations
Scale robustness	How does the claim change across relational resolutions?	Multiscale reconstruction, aggregation/disaggregation sensitivity	Scale dependence can be substantive rather than a flaw
Representation robustness	Does the claim depend on one encoding or model family?	Alternative graph, spatial, field, statistical, qualitative, or higher-order representations	Similar outputs can share upstream assumptions
Cross-method robustness	Do heterogeneous methods support compatible dimensions of the claim?	Triangulation, contradiction localization, independent replication	Method agreement can reflect shared sources or categories
External validity	Under which conditions does the claim travel beyond the studied configuration?	Comparative transfer, replication, transportability analysis	Transfer can fail when relational conditions change
Limits of validation	Which uncertainties remain after reasonable testing?	Counterevidence review, scope statement, reopenability criteria	Validation can become rhetorical closure if limits disappear

boundary, scale, temporal scope, representation, alternative specifications, disconfirming evidence, cross-method comparisons, transfer domain, remaining uncertainties, and the conditions under which the claim should be revised or reopened.

Definition 7.281 makes validation claim-relative. A relation may be well validated as legally constituted yet weakly validated as practically enacted. A network position may be robust under several graph specifications while the substantive interpretation assigned to that position remains uncertain. A historical continuity claim may be well supported within one periodization while cross-cultural transfer remains weak. The validation profile therefore preserves which dimension of the claim has actually been tested.

Table 7.28 summarizes the validation dimensions developed below.

A relational claim can therefore accumulate support along several dimensions without becoming unrestricted. Validation narrows uncertainty relative to stated alternatives and conditions. It can also expose where a claim remains dependent on a particular boundary, scale, representation, or historical context. Such dependence is often informative because it specifies the domain in which the claim is meaningful.

7.29.1 Construct Validity

Construct validity concerns the relation between the theoretical property invoked by a claim and the manifestations or measures used to represent that property. Section 7.26 distinguished indicators, proxies, composites, relational strength, quality, stability, accessibility, measurement error, and invariance. Validation asks whether the inferential bridge connecting these manifestations to the target property is sufficiently supported for the intended claim.

The problem is especially important in relational inquiry because many relational constructs are multidimensional. Trust, dependence, accessibility, authority, recognition, reciprocity, integration, and relational quality can be manifested through behavior, testimony, legal status, resource flows, institutional routines, or network position. Agreement among several indicators can support a construct interpretation when those indicators arise through sufficiently distinct manifestations. Agreement becomes less informative when several indicators are transformations of the same source or share the same institutional classification.

Construct validation also requires discriminant work. A measure interpreted as authority should be examined against plausible alternatives such as expertise, popularity, formal role, dependence, or communication frequency. A measure interpreted as trust can be compared with compliance, familiarity, repeated interaction, or constrained dependence. This does not require a unique indicator for each concept. It requires a sufficiently explicit account of why the observed manifestation supports one relational interpretation more strongly than relevant alternatives.

Definition 7.282 (Relational construct map). A *relational construct map* records the target relational property, candidate manifestations, indicators or proxies, theoretical expectations, competing constructs, discriminating evidence, measurement transformations, and the boundary, scale, time, and standpoint within which the construct interpretation is intended to hold.

The construct map extends the construct-validity logic of Cronbach and Meehl Cronbach and Meehl 1955 by making relational scope explicit. A behavioral indicator of dependence can have one meaning within a closed organization and another when exit options exist outside the observed boundary. A communication frequency measure can indicate coordination in one institutional setting and surveillance in another. Construct validity therefore depends partly on the surrounding relational configuration.

Messick's emphasis on the interpretation and use of scores also matters here Messick 1995. A construct measure can have adequate descriptive meaning while becoming problematic when used for classification, intervention, or institutional ranking. Chapter 11 will return to this issue in application-dominant praxis. At the research stage, the relevant discipline is to preserve the inferential steps from manifestation to construct and to avoid treating measurement convenience as conceptual adequacy.

7.29.2 Historical Validity

Historical validity concerns whether a relational claim preserves the temporal conditions under which its categories, meanings, institutions, and evidence were produced. Sections 7.8, 7.11, 7.17, and 7.24 showed that relational identity, archival survival, interpretive categories, and temporal sequence can each change through time. A historically valid claim therefore requires more than attaching dates to observations.

One problem is category projection. Terms such as household, employment, citizenship, market, profession, organization, ownership, or welfare can have different institutional meanings across periods. Even when a label persists, the relations organized under that label may change. Conversely, terminology can change while a recognizable relational lineage remains. Historical validation asks whether the categories used in the analysis preserve these changes or silently impose a later classification on earlier evidence.

Periodization is another source of validation pressure. A conclusion can depend on where a historical interval begins or ends. The apparent formation of a relation can move when earlier records are recovered; the apparent stability of an institution can disappear when a longer period is considered; a short reform episode can look discontinuous while a longer trajectory reveals substantial continuity. Historical robustness therefore benefits from plausible alternative periodizations and explicit criteria for selecting among them.

Historical validity also depends on evidential survival. Documentary convergence among surviving sources can reflect a shared archival selection process. Section 7.27 developed missingness profiles for such cases. Validation should therefore distinguish evidence about the historical relation from evidence about the archive through which that relation becomes visible.

Definition 7.283 (Historical validation profile). A *historical validation profile* records periodization, category meanings, temporal identity criteria, source-production dates, survival and archival pathways, alternative historical reconstructions, relevant discontinuities, and the effect of plausible temporal re-specification on the focal relational claim.

Historical validity can remain strong within a bounded period even when longer-term transfer is uncertain. The objective is not to make claims timeless across periods. It is to align the temporal scope of the claim with the temporal organization of the evidence and the categories used to interpret it.

7.29.3 Relational Validity

Relational validity concerns whether the evidence supports the existence, identity, properties, and configuration of the relation actually claimed. This dimension synthesizes the identification and characterization work of Sections 7.6 and 7.7. It is especially important because many datasets record events or co-occurrences that can be represented as edges without establishing the substantive relation attributed to those edges.

A transfer can indicate payment, gift, repayment, redistribution, reimbursement, extortion, or another relation depending on legal, institutional, and interpretive context. A message can indicate collaboration, instruction, reporting, conflict, monitoring, or routine communication. A shared organizational membership can create a potential relation without demonstrating direct interaction. Relational validity therefore asks whether the inferential bridge from manifestation to relation has been tested against plausible alternatives.

The same issue applies to relational properties. Direction, reciprocity, dependence, authority, constraint, enablement, multiplexity, and meaning require distinct evidence. A relation can be securely identified while one of its properties remains uncertain. Validation should preserve that asymmetry rather than assigning a single credibility label to the entire relational profile.

Definition 7.284 (Relational validity matrix). A *relational validity matrix* records, for each claimed relational property, the evidential manifestations, inferential bridge, competing interpretations, supporting and disconfirming evidence, positional and temporal scope, and remaining uncertainty.

The matrix supports differentiated claims. Researchers may conclude that a con-

tractual relation is well established, practical authority is moderately supported, and experiential trust remains uncertain. Such differentiated validation is often more informative than a binary claim that the “relationship” has been validated.

Relational validity also includes negative and absent relations. Section 7.6 distinguished structured prohibition, avoidance, blocking, or exclusion from mere non-observation. Validation of absence requires credible detection conditions, while validation of a negative relation requires evidence for the mechanism organizing the non-connection or opposition.

Proposition 7.285 (Relational claim decomposition). *A relational claim is more amenable to validation when existence, identity, properties, configuration, temporal scope, and substantive meaning are evaluated as distinguishable components whose evidential support can differ.*

Proposition 7.285 favors analytical decomposition without assuming that the components are independent. Their interactions can become part of the relational explanation.

7.29.4 Boundary Robustness

Boundary robustness examines how a relational claim changes under substantively plausible modifications of the analytical domain. Section 7.4 treated boundaries as question-relative hypotheses about relevance and tractability. Validation therefore asks whether the focal inference depends materially on one boundary choice.

Boundary sensitivity can be tested by expanding the domain to include adjacent actors, external institutions, cross-border flows, informal participants, or infrastructure providers; by contracting the domain to the most directly involved positions; or by altering inclusion rules for uncertain cases. The purpose is not to reward invariance for its own sake. A claim can be boundary-dependent because the underlying phenomenon is genuinely open to external relations.

For example, an organization can appear internally centralized when suppliers, regulators, parent organizations, or digital infrastructures are excluded. A local service network can appear sparse until informal providers are added. A community can appear cohesive under a membership boundary while showing substantial brokerage through nonmembers. Boundary sensitivity can therefore reveal constitutive external relations rather than methodological weakness.

Definition 7.286 (Boundary robustness profile). *A boundary robustness profile records the baseline boundary, plausible alternative boundaries, newly included or excluded relations, boundary remainders, changes in the focal estimate or interpretation, and the substantive explanation for observed boundary sensitivity or stability.*

Boundary robustness supports scoped inference. If a conclusion remains stable across several plausible boundaries, confidence in that conclusion can increase within the tested domain. If the conclusion changes, validation shifts toward explaining which external relations make the difference. Both outcomes can contribute knowledge.

7.29.5 Scale Robustness

Scale robustness asks how a relational claim changes when the phenomenon is represented at different analytical resolutions. Section 7.5 distinguished individual, dyadic, organizational, community, institutional, field, and multiscale inquiry. A claim may remain broadly stable across these resolutions, become more precise at one scale, or reverse when aggregation suppresses heterogeneity.

Scale sensitivity can therefore be evidentially meaningful. An organization can appear stable while team-level relations reorganize rapidly. A national indicator can improve while particular regions deteriorate. An aggregate network can become more connected while some local neighborhoods become more isolated. Such divergence should not be treated automatically as failed validation. It can reveal scale-specific organization.

Validation requires clarity about which scale carries the claim. A claim about institutional authority may be well supported at the organizational or legal scale even when individual experiences vary. A claim about accessibility can require individual and spatial resolutions because aggregate service provision leaves practical access unresolved. Cross-scale generalization becomes stronger when explicit bridges connect the scales.

Definition 7.287 (Scale robustness profile). A *scale robustness profile* records the focal claim at each examined scale, transformations used to move among scales, cross-scale bridges, scale remainders, convergent and divergent results, and the interpretation assigned to scale dependence.

Scale robustness therefore differs from demanding numerical invariance. The validation question is whether scale dependence is understood sufficiently to support the stated scope of the claim.

7.29.6 Representation Robustness

Representation robustness examines whether a relational conclusion depends on one encoding, model family, measurement system, or formalization. Chapter 4 emphasized that formal or geometric representations can be analytically useful without establishing ultimate ontology. Sections 7.19, 7.20, 7.21, and 7.25 extended this discipline to graphs, higher-order structures, statistical models, and field representations.

The same relational material can be represented as a graph, hypergraph, spatial surface, event sequence, hierarchical model, field map, legal relation, institutional configuration, qualitative process narrative, or mixed representation. These representations preserve different properties. Validation therefore benefits from asking whether the substantive conclusion survives changes in representation that preserve the relational dimensions relevant to the claim.

A pairwise graph can suggest a central broker, while a higher-order representation shows that several apparent dyadic ties belong to one jointly constituted group relation. A latent-space model can reveal stable proximity, while an institutional reconstruction suggests that the proximity arises from a shared administrative constraint. A spatial surface can show a gradient that disappears once accessibility is represented through transport networks rather than Euclidean distance. Such differences are not merely model-selection problems; they can reveal which relational properties the original representation obscured.

Definition 7.288 (Representation robustness audit). A *representation robustness audit* records alternative representations of the focal relational object, the properties each representation preserves or loses, shared assumptions, transformations among representations, changes in the focal claim, and the substantive interpretation of representation-sensitive results.

Representation robustness is strongest when alternative encodings provide genuinely different access to the claim. Running several algorithms on the same graph can be useful, yet the comparison remains narrower than moving between graph, documentary, spatial, and institutional representations whose error structures and assumptions differ more substantially.

7.29.7 Cross-Method Robustness

Cross-method robustness asks whether a relational claim remains credible when examined through methods with partially distinct access conditions and failure modes. Section 7.28 developed triangulation as structured comparison among documentary, interview, observational, quantitative, historical, and cross-scale evidence. Validation adds a further question: after convergence, complementarity, tension, or contradiction has been identified, what degree of warrant does the combined evidence support?

Cross-method agreement is especially informative when methods differ in source production, measurement, standpoint, and inferential route. A legal record can establish formal authority, ethnography can show its enactment, interviews can reveal perceived dependence, and quantitative records can show patterned decision flows. These methods need not produce identical observations to support compatible parts of a relational claim.

Shared bias remains a central concern. Several methods can rely on the same administrative classifications or population frame. Interview participants can share one institutional narrative. Documentary and quantitative records can both inherit the same reporting rule. Cross-method validation therefore requires the pathway-independence analysis introduced in Section 7.28.

Contradiction can also strengthen validation indirectly by narrowing alternatives. If one interpretation fails under independent observational evidence while another remains compatible with documents, interviews, and temporal sequence, the set of plausible explanations contracts. Conversely, persistent contradiction within aligned scopes can identify a claim that should remain provisional.

Definition 7.289 (Cross-method validation matrix). A *cross-method validation matrix* records the relational dimension examined by each method, evidential pathway, source dependence, principal failure modes, observed convergence or contradiction, alternative explanations, and the effect of each method on the warranted scope of the focal claim.

This matrix gives methodological plurality a cumulative structure while preserving irreducible disagreement where synthesis remains weakly supported.

7.29.8 External Validity

External validity concerns whether a relational claim travels beyond the configuration in which it was initially established. Case-study methodology has long treated generalization as a design problem rather than an automatic consequence of sample size Gerring 2007. Relational inquiry adds that transport depends on whether the relations supporting the original claim remain sufficiently similar in the target setting.

Transfer can occur across populations, organizations, jurisdictions, cultures, historical periods, spatial regions, technological infrastructures, or scales. Similarity in observed variables can be insufficient when institutional rules, network structure, legal status, language, historical trajectory, or access conditions differ. External validation therefore requires an account of which relational conditions are expected to remain relevant across settings.

A mechanism can travel while its manifestation changes. For example, gatekeeping can occur through formal licensing in one setting and informal brokerage in another. Conversely, similar manifestations can arise through different mechanisms. External validity is therefore strengthened by distinguishing the transferable relational function or mechanism from the local representation through which it becomes visible.

Definition 7.290 (Relational transfer profile). A *relational transfer profile* records the source and target configurations, focal relational mechanism or property, relevant similarities and differences, boundary and scale correspondence, measurement comparability, institutional and historical conditions, expected transfer limits, and evidence obtained in the target setting.

The transfer profile supports graded generalization. A claim can travel strongly across organizations within one institutional regime, moderately across related jurisdictions, and weakly across historically different systems. Such graded external validity is often more informative than a single declaration of generalizability.

AI-assisted research increases both the opportunities and risks of external validation. Large language models and automated retrieval can rapidly surface apparent analogies across domains. Embeddings and similarity measures can identify cases that appear close in a shared representation. These tools can enlarge the encounter surface for comparison, while similarity in representation remains distinct from relational equivalence. Transfer still requires validation of the substantive conditions on which the original inference depended.

7.29.9 Limits of Validation

Validation reduces uncertainty relative to specified alternatives, tests, and scopes. It rarely removes the need for revision. This limitation is especially important for relational inquiry because evidence access, boundaries, scale, historical conditions, representations, and institutional settings can change after a claim has been evaluated.

One limit is open-ended alternatives. Researchers can test prominent competing interpretations without exhausting the space of possible explanations. Another is evidence dependence: additional records, newly accessible archives, changed platforms, improved measurement, or later observations can reorganize the evidential field. A third is reflexivity: publication of a relational claim can alter behavior, classifications, institutional responses, or future observability. A fourth is generativity: Chapter 8 will examine cases in which relations contribute to future structures whose develop-

ment cannot be fully validated from the present configuration alone.

Validation also has costs. Expanding samples, collecting independent sources, replicating across settings, reconstructing historical categories, or testing alternative representations consumes time, money, attention, and access. The research problem is therefore one of proportionate validation. More consequential claims, broader transfer claims, and stronger causal or normative conclusions generally warrant more demanding validation than narrow descriptive claims with limited downstream use.

Definition 7.291 (Validation remainder). A *validation remainder* is the set of materially relevant uncertainties, alternative explanations, untested domains, representation dependencies, missing evidence, or transfer conditions that remain after the validation procedures undertaken for a relational claim.

Preserving the validation remainder supports epistemic humility and future re-epistemization. It allows later researchers to distinguish what the original study tested from what it left open. The remainder can also guide replication, additional data collection, or targeted methodological development.

Counterevidence deserves a visible place in this record. A claim that survives several supportive tests can still require revision when high-quality evidence conflicts with its central mechanism or scope. Section 163 treated failure and negative results as resources for proportionate revision. Validation should therefore preserve the possibility that later counterevidence changes the balance of warrant.

Contingent encounter and aesthetic judgment retain a role at this stage. A result can appear unexpectedly elegant, unstable, patterned, or anomalous; a small contradictory case can disrupt an apparently well-validated account; a representation can reveal a structure that previous validation procedures did not anticipate. Such salience can motivate renewed testing while remaining distinct from validation itself. In AI-assisted research, where many robustness checks and alternative models can be generated cheaply, the scarcity increasingly lies in deciding which tests are substantively discriminating and which merely repeat the same assumptions in another technical form.

Proposition 7.292 (Relational validation warrant). A *relational claim gains warrant through validation to the extent that tests bear on the claim's intended construct, historical conditions, relational structure, boundary, scale, representation, methodological pathway, and transfer domain, while materially relevant counterevidence and validation remainders remain visible*.

Proposition 7.292 frames validation as structured exposure to relevant alternatives and failure conditions. The objective is calibrated credibility rather than rhetorical closure. Once a relational claim has been validated to a level proportionate to its intended use, the research process still faces ethical obligations concerning consent, privacy, third-party exposure, representation, classification, and data governance. Section 196 therefore turns from epistemic validation to the ethics of relational inquiry.

7.30 Ethics of Relational Inquiry

The preceding sections developed methods for specifying relational objects, reconstructing configurations, combining heterogeneous evidence, measuring relations, analyzing missingness, triangulating evidence, and validating relational claims. The role of the present section is to examine the ethical conditions under which those

methodological capacities may be exercised responsibly. Its objective is to move from an ethics centered primarily on isolated research participants toward an ethics attentive to relations, third parties, institutions, classifications, infrastructures, and downstream uses of research representations. The discussion proceeds through consent, privacy, relational privacy, third-party exposure, vulnerable relations, representational harm, classification harm, data governance, and researcher responsibility. The method is relational and scope-sensitive: established human-subject principles remain important, while the analysis asks what additional ethical problems appear when data and claims concern relations among persons, organizations, communities, and institutions.

Research ethics has long emphasized respect for persons, beneficence, justice, informed consent, risk–benefit assessment, and equitable selection of participants. The Belmont Report remains a prominent articulation of these principles in human-subject research National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research 1979. Relational inquiry retains these commitments while introducing a recurrent complication: information supplied by one participant can reveal, classify, or alter the visibility of another person or group that did not directly participate in the research. A network edge, family relation, organizational tie, legal status, interview narrative, correspondence archive, geolocation trace, or relational inference may therefore distribute ethical consequences beyond the individual from whom the evidence was obtained.

Definition 7.293 (Relational ethics profile). A *relational ethics profile* records the research object, participating and non-participating affected positions, consent conditions, informational flows, relational privacy risks, vulnerable relations, possible representational and classification harms, data-governance arrangements, anticipated downstream uses, mitigation procedures, and the allocation of research responsibility across the inquiry lifecycle.

Definition 7.293 places ethics within research design from the outset and extends it beyond final-stage compliance review. Ethical assessment can influence which relations are collected, which identifiers are retained, which representations are published, how uncertainty is communicated, and which forms of reproducibility are appropriate. It can also affect whether a technically informative analysis is worth performing when the foreseeable exposure or misuse risk exceeds the epistemic gain.

Table 7.29 summarizes the ethical dimensions developed below.

The table emphasizes that relational ethics concerns both research procedure and the representations produced by research. A relation can become ethically consequential through collection, inference, publication, classification, or later institutional reuse. These stages may involve different affected parties and therefore different safeguards.

7.30.1 Consent

Consent in relational inquiry concerns participation in research and the foreseeable relational scope of the evidence contributed. The Belmont tradition treats informed consent through information, comprehension, and voluntariness National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research 1979. Relational inquiry adds a scope problem: a participant may knowingly contribute information about personal experience while the resulting dataset also per-

Table 7.29: Ethical dimensions of relational inquiry

Dimension	Primary ethical object	Characteristic risk	Methodological response
Consent	Participation and use of contributed evidence	Scope expansion beyond what participants understood	Layered consent and scope review
Privacy	Information about identifiable positions	Inappropriate collection, linkage, disclosure, or reuse	Context-sensitive information-flow assessment
Relational privacy	Information contained in ties and configurations	Exposure of one position through another's data	Relation-level disclosure analysis
Third-party exposure	Non-participating affected positions	Inference about people or groups outside the consent process	Third-party risk mapping and minimization
Vulnerable relations	Relations with asymmetric exit, dependence, or exposure	Coercion, retaliation, amplified dependency, or unsafe disclosure	Relation-sensitive safeguards and access controls
Representational harm	Published accounts, models, narratives, and visualizations	Stigmatization, distortion, decontextualization, or identity reduction	Context preservation, uncertainty, and contestability
Classification harm	Categories, labels, scores, and inferred types	Misclassification, reification, exclusion, or institutional reuse	Classification provenance and downstream-use review
Data governance	Custody, access, retention, linkage, and reuse	Secondary exposure or use beyond justified scope	Stewardship, role-based access, retention and reuse rules
Researcher responsibility	Decisions across the research lifecycle	Diffused accountability under collaborative or AI-assisted inquiry	Traceable decision authority and revision obligations

mits inference about colleagues, relatives, organizations, communities, or interaction partners.

A consent procedure should therefore describe the research operation at a level appropriate to the likely consequences of participation. For a conventional interview this may include recording, transcription, quotation, and archival retention. For relational research it can also include linkage, network reconstruction, inference about interaction partners, combination with administrative data, longitudinal reuse, or publication of structural patterns. The ethical significance of these possibilities depends on identifiability, sensitivity, context, research purpose, and downstream access.

Definition 7.294 (Relational consent scope). A *relational consent scope* specifies the forms of participation, evidence contribution, linkage, relational inference, reuse, dissemination, and foreseeable third-party implication that a participant is being asked to authorize within a defined research setting.

The definition limits consent to the participant's own authorization and identifies where additional ethical review is required for information concerning other people mentioned in the account. In network or household research, for example, one person's nomination of another can generate information about the nominated position without creating consent on that person's behalf.

Consent can also require temporal review. A dataset collected for one relational question can later support substantially different inferences when linked with new sources or analyzed with more capable models. A research team can therefore maintain a *consent-to-inference map* that records which analytical operations were reasonably within the original consent scope and which later operations introduce new ethical exposure. Re-consent, additional review, aggregation, de-identification, or a narrower research design may be appropriate when the inferential scope changes materially.

Voluntariness is itself relational. A formal option to decline can coexist with dependence on an employer, school, care provider, gatekeeper, research sponsor, or

community authority. Consent assessment should therefore examine whether the surrounding relation alters the practical cost of refusal. This becomes especially important where participation occurs inside hierarchical institutions or where participants reasonably believe that refusal could affect access, status, evaluation, or future opportunities.

7.30.2 Privacy

Privacy in relational inquiry concerns the appropriateness of information flows across research contexts. It includes secrecy and confidentiality in some settings, while extending beyond them. Nissenbaum's contextual-integrity framework analyzes privacy through social context, actors, information types, and transmission principles, thereby treating appropriate information flow as context-sensitive Nissenbaum 2010. This perspective is particularly useful for relational research because the ethical significance of the same datum can change when it moves between contexts or is linked with other information.

A public record, for example, may be legally accessible while large-scale aggregation, cross-dataset linkage, or inference about social relations creates a materially different informational flow. An organizational roster may be routine within an institution yet become sensitive when combined with communication logs and performance records. A location trace may appear mundane at one temporal resolution while repeated observations reveal patterns of association, residence, worship, health care, work, or political activity. Ethical analysis therefore benefits from examining transformations in informational meaning alongside the limited distinctions available from a public/private binary.

Definition 7.295 (Relational privacy context). A *relational privacy context* records the relevant actors, information types, relational inferences, original and proposed recipients, transmission conditions, institutional norms, temporal scope, and the values or legitimate purposes that structure an information flow.

The privacy context provides a bridge between data governance and substantive relational interpretation. It can reveal that a technically permissible transformation changes who can know what about whom, at what granularity, and for which purpose. It can also expose situations in which de-identification at the record level leaves a relational configuration readily recognizable to insiders.

Privacy risk should therefore be assessed after plausible linkage and inference, not only at the moment of raw-data collection. This is especially relevant for small communities, rare institutional positions, distinctive relational configurations, or longitudinal records where identity can emerge from structure even after conventional identifiers are removed.

7.30.3 Relational Privacy

Relational privacy concerns information whose ethical significance resides partly in the connection among positions. A relation can be sensitive even when information about each endpoint is individually mundane. Co-membership, communication, kinship, financial exchange, professional collaboration, care, conflict, mobility, or repeated co-location can expose affiliations and dependencies that participants would reasonably treat differently from isolated attributes.

This creates a unit-of-protection problem. Conventional privacy procedures often focus on records associated with an identifiable individual. Relational data require attention to dyads, groups, configurations, and positions whose disclosure may affect several parties simultaneously. A published network can identify a broker, isolated participant, coalition, peripheral subgroup, or gatekeeping organization even when names are replaced by pseudonyms.

Definition 7.296 (Relational privacy unit). A *relational privacy unit* is the smallest relational object whose disclosure, linkage, or inference is ethically relevant to the research question, such as a dyad, group membership, higher-order relation, configuration, trajectory, or position within a field.

The privacy unit should be matched to the representation. Dyadic data may require edge protection; higher-order data may require protection of group membership; temporal data may require trajectory protection; field analysis may require care around identifiable positions even when individual attributes are suppressed. This approach also helps researchers evaluate whether aggregation genuinely reduces exposure or merely relocates it.

Relational privacy can create tensions with reproducibility. Full release of an edge list, event history, or linked archive may permit independent analysis while also enabling re-identification or disclosure of sensitive connections. Reproducibility can therefore be pursued through controlled-access data, synthetic representations, code release, disclosure-controlled aggregates, secure enclaves, preregistered transformations, or other governance arrangements that preserve methodological transparency without requiring unrestricted disclosure of sensitive relations.

7.30.4 Third-Party Exposure

Third-party exposure arises when research about participating positions produces information about people, groups, or institutions that did not directly enter the research process. Relational inquiry makes this problem especially visible because one participant's evidence often contains information about others. Interviews describe colleagues and family members; communication logs contain senders and recipients; organizational documents identify decision makers; mobility traces reveal co-presence; network nominations reveal uncontacted alters.

The ethical issue depends on the nature and consequence of the exposure. Mentioning a public institutional role can pose little additional risk in one study, while inferring a stigmatized affiliation, hidden dependency, or interpersonal conflict can create substantial risk in another. The appropriate unit of review is therefore the third-party claim, its evidential pathway, and its foreseeable consequence; the mere presence of another person in the data provides insufficient ethical differentiation.

Definition 7.297 (Third-party exposure map). A *third-party exposure map* records non-participating positions about which the research can generate identifiable or consequential information, the evidential pathway producing that information, its sensitivity, likelihood of recognition, plausible downstream recipients, and available risk-reduction measures.

The map is particularly useful for AI-assisted relational extraction. A model can identify names, co-occurrence patterns, likely affiliations, latent communities, or predicted ties from materials originally collected for a narrower purpose. The speed of inference can make third-party exposure easy to overlook because the affected posi-

tions did not directly participate in the research interaction. Ethical review should therefore include the inferential products of analysis, not only the raw inputs supplied by participants.

Third-party considerations also interact with publication. A richly described case can be scientifically valuable while allowing insiders to identify people or organizations from contextual clues. Researchers may need to alter detail, aggregate relations, delay disclosure, negotiate quotation, or retain sensitive findings in a controlled archive. Such decisions should preserve the integrity of the analysis as far as feasible while making the reason for non-disclosure traceable in the research record.

7.30.5 Vulnerable Relations

Vulnerability in relational inquiry can arise from the characteristics or circumstances of persons and from the structure of the relation in which they are embedded. The Belmont Report recognizes the need for additional protection where autonomy is limited or vulnerability affects the ethical justification of participation National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research 1979. A relational approach adds attention to dependence, exit costs, authority, resource asymmetry, secrecy, exposure, and the consequences of disclosure within a specific relation.

A participant can possess substantial decision-making capacity while remaining vulnerable within an employment, migration, care, debt, housing, educational, familial, or organizational relation. Disclosure may therefore carry asymmetric consequences. The researcher should examine who can sanction whom, who controls access to resources, who bears the cost of exposure, and whether research participation changes those relations.

Definition 7.298 (Relational vulnerability profile). A *relational vulnerability profile* records the relevant dependence, authority, exit conditions, resource asymmetries, exposure pathways, retaliation risks, confidentiality constraints, and protective capacities that shape a participant's or third party's vulnerability within the research setting.

The profile avoids treating vulnerability as a permanent identity label. Vulnerability can vary across relations and over time. The same person may hold substantial authority in one domain and face strong dependence in another. Ethical safeguards can therefore be calibrated to the relational pathway through which harm could occur.

Vulnerable relations also affect sampling and interpretation. Highly dependent or exposed participants may be less able to participate, less willing to speak openly, or more likely to use indirect language. Their underrepresentation can generate epistemic as well as ethical consequences. Protecting participants and improving relational validity can therefore align when safer research conditions enable previously suppressed evidence to become available.

7.30.6 Representational Harm

Representational harm concerns consequences produced by the way research describes, visualizes, models, quotes, or narrates people and relations. A representation can be empirically grounded while still compressing a person or group into one

salient relation, reproducing a stigmatizing narrative, erasing internal disagreement, or presenting a historically contingent classification as an enduring identity. These risks are especially relevant in relational research because diagrams and network visualizations can make structural positions appear definitive and intuitively self-explanatory.

Representational ethics therefore concerns both accuracy and consequence. An accurate statement can be misleading when detached from its boundary, scale, time, uncertainty, or institutional context. A centrality score can become a public label of influence; a cluster can become a presumed community; a legal classification can become an attributed identity; a historical relation can be narrated as continuous despite substantial transformation.

Definition 7.299 (Representational harm profile). A *representational harm profile* records the research representation, affected positions, salient simplifications, uncertainty, plausible misreadings, foreseeable institutional or public uses, contestability mechanisms, and available contextual safeguards.

The profile encourages researchers to ask how a representation may travel beyond the immediate scholarly argument. A figure designed to communicate one structural feature can be reproduced in media, policy documents, litigation, organizational evaluation, or automated decision systems with much weaker contextual qualification. The ethical burden therefore includes reasonable anticipation of high-consequence reinterpretation where such reuse is foreseeable.

Fricker's account of epistemic injustice provides one useful perspective on unequal credibility and unequal participation in meaning-making Fricker 2007. Relational research can compound these inequalities when participants with limited institutional voice are represented through categories or interpretations they have little opportunity to contest. Contestability, participant checking where appropriate, alternative interpretations, and careful disclosure of uncertainty can reduce this risk without converting participant agreement into the sole criterion of validity.

7.30.7 Classification Harm

Classification harm arises when research categories, inferred types, scores, clusters, or labels shape visibility and treatment in ways that exceed their evidential scope. Bowker and Star show how classifications and standards organize information infrastructures and social interaction Bowker and Star 1999. In relational inquiry, classification can also alter the relations under study by changing who is recognized, compared, prioritized, investigated, funded, sanctioned, or excluded.

The ethical problem becomes more consequential when classifications move from description into institutional action. A research-generated label such as "high risk," "peripheral," "uncooperative," "influential," "vulnerable," or "low trust" can acquire administrative force when incorporated into organizational or policy systems. A category originally designed for one analytical purpose can then be reinterpreted as a stable property of a person, community, or institution.

Definition 7.300 (Classification consequence profile). A *classification consequence profile* records the category or score, construction procedure, evidential scope, affected positions, uncertainty, decision contexts in which reuse is plausible, potential feedback effects, contestability, and procedures for revision or withdrawal.

Classification feedback deserves particular attention in generative relational research. Once a category enters an institutional process, actors may respond to it, resources may be redistributed, expectations may change, and future data may reflect the classification's effects. Later researchers can then mistake a classification-induced pattern for confirmation of the original category. Preserving the timing and institutional use of classifications helps distinguish descriptive evidence from consequences partly generated by the measurement or classification system itself.

AI-assisted classification intensifies this issue by lowering the cost of generating inferred categories at scale. Ethical review should therefore consider whether a model-generated classification is necessary to the research question, how its error and uncertainty are represented, and whether storing the classification creates downstream risks disproportionate to its epistemic contribution.

7.30.8 Data Governance

Data governance concerns the rules, responsibilities, and infrastructures through which relational evidence is collected, stored, linked, accessed, transformed, retained, shared, and deleted. Relational datasets can retain sensitivity after conventional identifiers are removed because structure, rare positions, temporal trajectories, and combinations of attributes can support re-identification. Governance should therefore address relational disclosure as well as record-level confidentiality.

A relational data-governance plan can specify stewardship roles, permitted analyses, linkage rules, access tiers, retention periods, disclosure review, version history, incident response, and conditions for secondary use. These provisions are especially important for collaborative research in which several institutions, contractors, or AI systems participate in data processing. Responsibility should remain traceable across transfers even when technical complexity distributes the work across several systems and institutions.

Definition 7.301 (Relational data-governance profile). *A relational data-governance profile* records data custodians, authorized roles, relational sensitivity, linkage permissions, transformation history, storage and access controls, retention and deletion rules, secondary-use conditions, disclosure procedures, and mechanisms for audit, correction, and incident response.

Privacy as contextual integrity is useful here because governance concerns the appropriateness, purpose, and recipients of information flows in addition to the quantity of information Nissenbaum 2010. A dataset can be secure against external access while still being used internally for a purpose inconsistent with the context in which the evidence was contributed. Governance therefore needs both technical security and purpose-sensitive rules.

Open and cumulative research, developed in Section 164, can coexist with controlled access. Reproducibility may be supported through code, schemas, synthetic data, secure access environments, transformation logs, or qualified replication agreements when unrestricted relational data release would create disproportionate exposure. Ethical openness concerns reconstructability and accountable access. Maximal public disclosure is one possible transparency mechanism among several, and it can be inappropriate for sensitive relational evidence.

7.30.9 Researcher Responsibility

Researcher responsibility integrates the preceding ethical dimensions across the life-cycle of inquiry. Responsibility includes choices about object specification, boundary, scale, recruitment, consent, representation, classification, model selection, data governance, publication, and revision. It also includes decisions about which technically feasible analyses deserve to be performed and which outputs should remain controlled because their foreseeable harms outweigh their contribution to the stated research purpose.

Relational inquiry can distribute agency across research teams, institutions, infrastructures, funders, data providers, software systems, and AI models. Distributed cognition does not eliminate the need for accountable decision authority. Section 160 developed this issue for AI-assisted research, and Section 161 extended it to heterogeneous research collectives. Ethical practice therefore benefits from identifying who authorizes consequential transformations, who reviews disclosure, who can correct an error, and who remains responsible for the published claim.

Definition 7.302 (Research responsibility chain). *A research responsibility chain records consequential decisions across the research lifecycle, the persons or institutions authorized to make them, the evidence and ethical considerations available at the time, downstream dependencies, review points, and procedures for correction or withdrawal when later information changes the ethical assessment.*

The responsibility chain also supports epistemic humility. Researchers can document why a decision appeared proportionate under the available evidence without implying that the decision is beyond later revision. New information about re-identification risk, participant expectations, institutional misuse, historical context, or model error can justify reopening an earlier ethical judgment.

Contingent encounter and aesthetic judgment have an ethical dimension as well. A surprising field encounter, archival trace, unexplained silence, unusual network pattern, or AI-generated association may make a new relation salient. Curiosity can appropriately motivate investigation, while salience alone does not establish ethical permission to pursue, expose, or publish the relation. The passage from encounter to research object therefore includes an ethical judgment about proportionality, vulnerability, privacy, and downstream consequence in addition to epistemic judgment about plausibility and significance.

Proposition 7.303 (Relational ethical adequacy). *A relational inquiry becomes ethically better grounded to the extent that its consent scope, informational flows, third-party implications, vulnerable relations, representational and classification consequences, data governance, and responsibility chain remain aligned with the evidential purpose and foreseeable consequences of the study, while material uncertainties and revision conditions remain visible.*

Proposition 7.303 is intentionally procedural and leaves substantive ethical judgment open to context-specific requirements. Ethical adequacy depends on substantive context, applicable law, institutional review requirements, community norms, and the evolving consequences of research technologies. The proposition therefore provides a structure for disciplined judgment whose application remains dependent on the specific research context.

The methodological consequence of this section is that ethics belongs inside relational inquiry. Object specification determines who becomes visible; boundaries de-

termine who is omitted; measurement and classification create representations that can travel; publication changes informational access; and AI increases the speed at which new relational inferences can be generated. Section 197 therefore turns next to reporting practices that make these analytical and ethical decisions explicit, reproducible where appropriate, and open to later reinterpretation.

7.31 Reporting Relational Inquiry

The preceding sections developed a relational methodology for specifying research objects, constructing boundaries and scales, identifying and characterizing relations, reconstructing configurations, combining heterogeneous evidence, quantifying uncertainty, validating claims, and governing ethical consequences. The role of the present section is to translate those methodological commitments into a reporting architecture that permits readers and later researchers to reconstruct how a relational claim was produced. Its objective is to make boundary, scale, representation, assumptions, uncertainty, alternative models, provenance, reproducibility, and reinterpretability visible in the research record. The discussion proceeds through these nine dimensions and treats reporting as an integral component of epistemic accountability across the research lifecycle. The method is claim-relative and ethically constrained: the degree of disclosure should be sufficient for assessment and cumulative inquiry while remaining proportionate to privacy, legal, security, stewardship, and third-party obligations developed in Section 7.30.

Relational claims are especially vulnerable to compression during reporting. A published graph can omit the decisions by which nodes and edges were constructed; a regression coefficient can hide the boundary, exposure mapping, dependence assumptions, or missingness process; an institutional description can present formal rules without the evidence concerning enacted practice; an archival interpretation can conceal the record-survival pathway on which it depends. Concise presentation is often necessary, yet compression becomes epistemically costly when it removes information required to understand what the claim means, where it applies, or how it might be challenged.

Definition 7.304 (Relational reporting profile). A *relational reporting profile* records the research object, boundary, scale, representation, material assumptions, uncertainty structure, alternative relational models, evidential and analytical provenance, reproducibility conditions, reinterpretability conditions, and relevant ethical or access constraints associated with a reported relational claim.

Definition 7.304 provides a reporting counterpart to the methodological profiles developed throughout this chapter. Its purpose is not to maximize documentation indiscriminately. The relevant standard is whether a reader can recover the inferential architecture of the claim and identify which changes in object specification, boundary, scale, representation, evidence, or assumptions could alter its interpretation.

Table 7.30 summarizes the dimensions developed below.

The dimensions in Table 7.30 are interdependent. Boundary and scale shape what enters the representation; representation and assumptions shape the inferential operation; uncertainty and alternative models delimit warrant; provenance supports reconstruction; reproducibility tests recoverability of the analytical procedure; reinterpretability preserves future epistemic option value when later researchers ask dif-

Table 7.30: Reporting dimensions for relational inquiry

Dimension	Reported object	Characteristic opacity	Reporting practice
Boundary	Inclusion, exclusion, permeability, and remainder	Apparent closure of the relational domain	State boundary rule, exclusions, and sensitivity
Scale	Analytical resolution and cross-scale bridge	Transfer across levels without justification	State focal scale and aggregation/decomposition logic
Representation	Graph, field, statistical, legal, historical, qualitative, or other form	Representation mistaken for the relation itself	State preserved and suppressed properties
Assumptions	Material inferential and operational commitments	Hidden conditions supporting the claim	Record assumption, role, evidence, and sensitivity
Uncertainty	Evidential, model, boundary, scale, temporal, and interpretive uncertainty	Precision interpreted too broadly	Disaggregate material uncertainty sources
Alternative models	Plausible competing relational specifications	One convenient model presented as uniquely implied	Report alternatives and discriminating evidence
Provenance	Source, custody, transformation, linkage, and analytical history	Claim detached from evidential trajectory	Preserve source-to-claim transformation chain
Reproducibility	Recoverability of analytical operations	Weak independent reconstruction	Provide code, specifications, environments, or controlled reconstruction routes
Reinterpretability	Capacity for later re-analysis under new concepts or questions	Published conclusion becomes the only surviving epistemic object	Preserve recoverable evidence, versions, context, and interpretive remainder

ferent questions of the same evidence.

7.31.1 Explicit Boundary

Boundary reporting states which positions, relations, institutions, places, time intervals, records, or interaction types are treated as internal to the focal analysis and which remain outside it. Section 7.4 developed boundary construction as a question-relative methodological operation. Reporting should therefore preserve the boundary rule itself and make clear that the extent of the resulting dataset or case corpus follows from that rule.

An explicit boundary statement can identify inclusion and exclusion criteria, permeability, external relations retained as contextual conditions, and the boundary remainder. In network inquiry this can include roster construction, relation-type inclusion, and treatment of external nodes. In archival inquiry it can include collections searched, restricted holdings, languages, date ranges, and finding systems. In institutional research it can distinguish formal membership from effective relational reach. In spatial inquiry it can record whether the domain follows administrative territory, travel-time accessibility, infrastructural connectivity, or another spatial criterion.

Boundary reporting also benefits from explaining why the chosen boundary is adequate for the claim. A study may intentionally restrict itself to one organization even when relevant relations extend beyond it. Such restriction can remain methodologically defensible when the claim is correspondingly local and external relations are preserved as potential remainders. Difficulty arises when the reported conclusion silently expands beyond the boundary that generated the evidence.

Definition 7.305 (Boundary reporting statement). A *boundary reporting statement* records the focal analytical domain, inclusion and exclusion criteria, permeability assumptions, materially relevant external relations, boundary remainders, and the sensitivity of the reported claim to plausible alternative boundaries.

Definition 7.305 makes boundary sensitivity reportable without requiring an exhaustive enumeration of everything outside the study. The objective is to preserve exclusions that could materially alter interpretation, transfer, or causal inference.

7.31.2 Explicit Scale

Scale reporting identifies the resolution at which entities, relations, configurations, and temporal processes are represented. Section 7.5 showed that scale selection can change which relational properties become visible. A report should therefore state whether the analysis operates primarily at individual, dyadic, organizational, community, institutional, field, regional, transnational, or another substantively defined scale, together with the transformations used to move among scales.

This is especially important when aggregation creates new analytical objects. An organizational average does not preserve each interpersonal relation inside the organization; a regional accessibility surface does not preserve each person's mobility constraints; an institution-level network does not preserve the full set of within-institution ties. Conversely, decomposing an institution into individual observations can suppress authority, routine, memory, or legal competence that exists at a coarser level of organization.

A scale report should identify cross-scale bridges when the argument moves from one resolution to another. If an individual-level behavioral pattern is interpreted as an institutional effect, the evidential pathway connecting institutional organization to individual experience should be visible. If an organizational pattern is used to support a claim about a transnational field, the aggregation and transfer logic should be reported. Scale dependence can then become a substantive finding whose analytical consequences remain visible.

Definition 7.306 (Scale reporting statement). A *scale reporting statement* records the focal analytical resolution, aggregation and decomposition rules, cross-scale bridges, scale remainders, temporal resolution where relevant, and the observed sensitivity of the claim to plausible alternative scales.

Such reporting is particularly important for multiscale and fast-slow inquiry developed later in the book. It allows later researchers to distinguish a change in the phenomenon from a change produced by the resolution at which the phenomenon was represented.

7.31.3 Explicit Representation

Relational inquiry can represent the same research object through graphs, matrices, fields, statistical models, institutional maps, legal-position structures, historical narratives, spatial surfaces, higher-order structures, or qualitative configurations. Each representation preserves some properties more directly than others. Section 7.29 therefore treated representation robustness as one dimension of validation. Reporting should make the representational choice and its consequences explicit.

A graph report can state node and edge semantics, direction, weighting, temporal aggregation, and whether higher-order relations were projected into pairwise form. A statistical report can identify the observation structure, estimand, dependence model, and meaning assigned to latent variables or random effects. A field-based report can identify the relational coordinate and evidence supporting distributed

organization. A legal reconstruction can distinguish formal status, institutional interpretation, and enacted practice. A qualitative configuration can state how cases, relations, and interpretive categories were constructed from field materials.

Definition 7.307 (Representation disclosure). A *representation disclosure* records the formal or interpretive representation used for a relational claim, the properties it is intended to preserve, transformations applied to the underlying evidence, properties known to be suppressed or approximated, and the substantive bridge from representation to interpretation.

The representation disclosure supports ontological restraint. A latent coordinate, graph edge, field gradient, institutional category, or historical periodization can be analytically productive without being presented as exhaustive ontology. It also supports comparison among alternative representations because readers can identify whether two apparently different results arise from different evidence, different transformations, or different representational commitments.

7.31.4 Explicit Assumptions

Relational claims depend on assumptions that can arise at several stages of inquiry. Some concern measurement: a proxy is assumed to track a target property. Some concern missingness: unobserved relations are assumed to follow a specified mechanism. Some concern causality: exposure mappings, interference pathways, exclusion restrictions, or temporal ordering support an estimand. Others concern history, institutional identity, legal continuity, network boundaries, or cross-cultural comparability.

Reporting assumptions is therefore broader than listing the conditions of a statistical estimator. The relevant assumptions are those whose failure could materially alter the relational claim. A historical analysis might depend on the assumption that two archives record comparable institutional categories. A network analysis might depend on the assumption that a communication record provides an adequate indicator of a specified relation. An interview comparison might depend on sufficient comparability of elicitation conditions. A multiscale analysis might depend on a proposed bridge between organizational and institutional levels.

Definition 7.308 (Relational assumption register). A *relational assumption register* records the material assumptions supporting a claim, the stage of inquiry at which each assumption operates, its evidential or theoretical basis, plausible failure modes, available diagnostics or sensitivity analyses, and the consequences of failure for the reported conclusion.

The register can distinguish operational assumptions from theoretical assumptions and strong assumptions from approximations introduced for tractability. This distinction helps readers assess where additional evidence would most improve the claim. It also reduces a recurrent problem in AI-assisted analysis, where software can execute a technically valid procedure while leaving the substantive assumptions that justify its use weakly articulated.

7.31.5 Explicit Uncertainty

Uncertainty reporting should preserve the heterogeneous sources of uncertainty developed throughout this chapter. Sampling error, parameter uncertainty, mea-

surement error, missing relations, boundary uncertainty, scale uncertainty, temporal identity, interpretation, model specification, archival survival, representation choice, and ethical access restrictions can each affect a relational claim. Compressing these sources into a single confidence interval or verbal qualifier can conceal which part of the inference remains uncertain.

The relational uncertainty envelope introduced in Section 7.21 provides one model for reporting. It can be adapted to qualitative and historical inquiry by recording uncertainty about source interpretation, identity continuity, missing evidence, periodization, and competing explanations. Uncertainty can also be asymmetric: evidence may strongly support the existence of a relation while leaving its intensity, direction, or mechanism less secure.

Definition 7.309 (Relational uncertainty statement). A *relational uncertainty statement* separates materially relevant sources of uncertainty, indicates which components are quantified and which remain qualitative or interval-based, states how uncertainty affects the scope or strength of the claim, and preserves unresolved dependencies among uncertainty sources when they matter to interpretation.

Explicit uncertainty supports the epistemic humility principle adopted for this project. It permits precise claims where evidence is strong while keeping other dimensions provisional. It also helps distinguish substantive instability from weak observation. A relation can vary strongly through time and still be measured with relatively low uncertainty, while an apparently stable estimate can rest on substantial uncertainty about boundaries, missingness, or construct meaning.

7.31.6 Alternative Relational Models

Reporting a single relational model can give the impression that the evidence uniquely determines one representation or explanation. In many inquiries, several plausible specifications remain available. A social configuration can be represented as a network, a higher-order structure, an institutional arrangement, or a field; a temporal trajectory can admit several periodizations; an observed association can be consistent with influence, selection, shared environment, or measurement structure; a legal relation can have several plausible interpretations under contested doctrine or institutional practice.

Alternative-model reporting does not require presenting an unlimited set of possibilities. It requires preserving alternatives that are substantively plausible and materially consequential for the claim. These alternatives can be compared through fit, predictive performance, historical evidence, triangulation, sensitivity analysis, interpretive coherence, mechanism evidence, or another criterion appropriate to the method.

Definition 7.310 (Alternative relational model record). An *alternative relational model record* documents substantively plausible competing specifications, the evidence each preserves or explains, their principal assumptions, discriminating evidence, differences in downstream conclusions, and the reasons for retaining, revising, or setting aside each model.

This record connects directly to the validation remainder developed in Section 7.29. A preferred model can be reported clearly while unresolved alternatives remain visible. Model abundance under AI-assisted research makes this discipline increasingly consequential because generating additional specifications is becoming inexpensive

while the evidential task of distinguishing among them remains demanding.

7.31.7 Provenance

Provenance connects a published relational claim to the evidence and transformations through which it was produced. Documentary provenance in Section 7.10, archival provenance in Section 7.11, reflexive field-note chains in Section 7.12, and research audit trails in Chapter 6 each addressed parts of this problem. Reporting relational inquiry requires these local provenance practices to be connected to the final analytical output.

A provenance chain can include source production, custody, collection, sampling, transcription, translation, cleaning, linkage, entity resolution, coding, aggregation, model fitting, visualization, interpretation, and revision. For AI-assisted work it can additionally record model-assisted extraction, summarization, classification, translation, coding suggestions, or synthetic transformations where these operations materially affect the reported claim. Provenance does not require preservation of sensitive content in an unrestricted repository. It requires sufficient recoverability of the transformations that matter to assessment, subject to ethical and legal constraints.

Definition 7.311 (Relational claim provenance chain). A *relational claim provenance chain* records the evidential sources, custody or access conditions, material transformations, linkage and coding operations, analytical procedures, version history, interpretive decisions, and responsible actors through which a relational claim moved from manifestation to reported conclusion.

The FAIR principles emphasize findability, accessibility, interoperability, and reusability while treating rich metadata and provenance as important conditions for later reuse Wilkinson et al. 2016. For relational inquiry, provenance additionally helps later researchers distinguish changes in source material from changes in object specification, representation, or interpretation. This distinction is essential when research is re-epistemized under later methods or concepts.

7.31.8 Reproducibility

Reproducibility concerns whether the analytical operations supporting a reported result can be reconstructed with sufficient fidelity to evaluate the result. Open-research initiatives emphasize transparent methods, materials, data practices, and replication as institutional supports for cumulative inquiry Nosek et al. 2015; Open Science Collaboration 2015. Relational inquiry retains these goals while requiring attention to data sensitivity, changing relational systems, proprietary infrastructures, and historically unique evidence.

Reproducibility can therefore take several forms. Computational work can preserve code, software versions, random seeds, model specifications, preprocessing rules, and dependency environments. Qualitative research can preserve coding procedures, sampling logic, interview protocols, interpretive memos, and traceable evidence excerpts where disclosure is appropriate. Archival and historical research can document collections, finding aids, search strategies, record identifiers, exclusions, and interpretive transformations. Sensitive relational datasets can support reconstruction through secure environments, controlled access, synthetic examples, disclosure-limited extracts, or qualified replication arrangements.

Definition 7.312 (Relational reproducibility package). A *relational reproducibility package* contains the materials and access instructions required to reconstruct the material analytical operations supporting a relational claim, including specifications, transformation rules, code or procedural descriptions, version information, and ethically appropriate routes to the underlying evidence.

Datasheet-style documentation provides one useful precedent for making dataset motivation, composition, collection process, uses, and limitations visible Geburu et al. 2021. The relational reproducibility package extends this logic from datasets to the complete evidence-to-claim pathway. Its adequacy is claim-relative: a descriptive graph, historical interpretation, causal estimate, and legal-institutional reconstruction require different forms of reconstruction.

Reproducibility also has temporal limits. Platforms change, APIs close, institutions reorganize, archives are reclassified, and software dependencies disappear. Reporting should therefore distinguish reproducibility of an analytical operation from literal recreation of the historical research environment. Preservation of versions, snapshots, schemas, documentation, and provenance can retain substantial reconstructability even when the original environment is not recoverable exactly.

7.31.9 Reinterpretability

Reinterpretability concerns the capacity of later researchers to revisit evidence under different concepts, methods, questions, or historical knowledge. Chapter 6 treated preservation and re-epistemization as conditions of cumulative research. Relational reporting should therefore preserve more than the shortest route needed to reproduce the author's preferred conclusion. It should retain enough of the evidential and interpretive structure for later inquiry to ask questions that were not anticipated when the study was conducted.

Reinterpretability is distinct from reproducibility. Reproducibility asks whether a reported analytical pathway can be reconstructed. Reinterpretability asks whether the preserved research record permits a different warranted pathway to be explored. A code repository can support reproducibility while offering little reinterpretability if the underlying categories, exclusions, source context, and discarded alternatives are unavailable. Conversely, a richly documented historical archive can support reinterpretation even when the exact computational environment of the original study is no longer recoverable.

Definition 7.313 (Reinterpretability profile). A *reinterpretability profile* records which evidential materials, contextual information, versions, alternative codings, rejected or unresolved interpretations, negative results, boundary and scale variants, and provenance records remain available for later inquiry, together with the ethical, legal, technical, and stewardship conditions governing their access.

Reinterpretability has particular importance in the AI era. Future systems may be able to inspect corpora, images, records, simulations, and relational structures in ways unavailable to the original researchers. Preserving only a polished conclusion can foreclose these later possibilities. Preserving evidence without adequate context can create a different problem by enabling decontextualized reinterpretation. The relevant objective is therefore contextualized recoverability.

This point also reconnects reporting to contingent encounter. A future researcher may encounter a minor anomaly, discarded category, unexplained residual, archival

fragment, or alternative boundary that had little significance under the original research question. Aesthetic judgment can make that preserved remainder salient under a new intellectual context. Reinterpretability allows subsequent epistemic inquiry to determine whether the encounter supports a new relation, mechanism, or historical reconstruction. In this sense, reporting and preservation help construct the encounter surface available to future research communities.

Proposition 7.314 (Relational reporting adequacy). *A reported relational claim becomes more reconstructable and cumulatively useful to the extent that its boundary, scale, representation, material assumptions, uncertainty, plausible alternatives, provenance, reproducibility conditions, and reinterpretability conditions remain explicit enough for readers to assess the inferential pathway, while ethical and access constraints remain visible.*

Proposition 7.314 treats reporting as part of methodology. It does not imply that each project should publish the same materials or disclose sensitive relational evidence. The reporting burden depends on claim type, consequence, data sensitivity, available infrastructure, and the forms of reconstruction that are ethically and legally appropriate. Epistemic humility therefore appears in reporting through calibrated claim scope, visible uncertainty, preserved alternatives, and recoverable provenance while permitting clear statement of well-supported findings.

Sections 167–197 have developed methods for identifying, characterizing, reconstructing, measuring, comparing, validating, ethically governing, and reporting relations. These achievements establish that a relation exists or has specified properties with a degree of warrant. A further methodological problem remains: the existence of a relation does not by itself establish what that relation generates. Section 198 therefore turns from relational identification toward consequences, mechanisms, trajectories, structural transformation, and the methodological threshold at which relational inquiry becomes generative relational inquiry.

7.32 Generative Attribution Threshold of Relational Inquiry

The preceding sections developed the methodology required to specify, identify, reconstruct, characterize, compare, measure, validate, and report relations. The role of this closing section is narrower than a methodology of generation. It identifies the evidential boundary at which a relational finding becomes an input to a stronger generative inquiry. Its objective is to prevent the existence, persistence, or configuration of a relation from being treated as sufficient evidence for what that relation later produces. Mechanisms, trajectories, structural transformation, transformations of generative rules, and the methods used to investigate them belong to Chapter 8.

Relational inquiry can establish consequential foundations for later generative work. It can warrant the identity of relata, the existence and type of a relation, its direction or reciprocity where relevant, its temporal interval, its persistence, its boundary and scale, its position within a wider configuration, and the provenance and uncertainty of the evidence supporting those claims. These findings constrain later attribution because a generative claim cannot be more precise about its relational source than the evidence supporting that source permits.

Table 7.31 summarizes the boundary.

Table 7.31: Claim boundary between relational inquiry and generative attribution

Claim level	What relational inquiry can establish	Additional burden beyond Chapter 7
Relation existence and characterization	Identity, type, direction, persistence, boundary, scale, configuration, provenance, and uncertainty of the relation	None when the intended claim remains relational
Relational consequence	Evidence that the relation is associated with or contributes to a specified difference under an explicit inferential bridge	Stronger temporal, comparative, causal, or interpretive support when contribution is claimed
Generative attribution	A sufficiently specified relational source that can enter a hypothesis about later capacities, constraints, configurations, or possibilities	Evidence concerning temporal ordering, mechanism or pathway, conditions, alternatives, scale, and the object being generated
Stronger generative claims	Relational inputs and uncertainty that constrain later analysis	Chapter 8 methodology for mechanisms, trajectories, structural transformation, rule change, multiscale dynamics, robustness, and reporting

7.32.1 Relational Findings as Inputs to Generative Inquiry

A relational finding should travel into generative inquiry with its evidential profile intact. The later analysis should be able to recover how the relation was identified, what manifestations support it, which semantic interpretation is being used, what boundary and scale were selected, which alternatives remain plausible, and where uncertainty enters. This requirement prevents downstream generative language from silently strengthening an upstream relational claim.

The same discipline applies to representation. A contractual relation, institutional role, observed interaction, network edge, statistical dependence, field position, or higher-order relation can each be methodologically useful, yet they do not become equivalent because they concern the same actors or setting. Chapter 8 can build generative hypotheses on these objects only after the relation being carried forward is stated at the level actually supported by Chapter 7 evidence.

Proposition 7.315 (Relational-input preservation). *A relational finding is suitable for entry into generative inquiry when its object specification, evidential provenance, boundary, scale, temporal scope, representation, and material uncertainty remain recoverable after the research question is reformulated in generative terms.*

7.32.2 Consequence Claims and the Attribution Boundary

The first increase in burden appears when a study moves beyond the existence of a relation and claims that the relation contributes to a specified difference. A relation can be well established while remaining irrelevant to the outcome under study. A consequence claim therefore requires an explicit bridge between the relation and the difference being attributed to it. Depending on the question, that bridge can be historical, comparative, causal, interpretive, institutional, or formal.

This boundary is important because evidence of sequence or association can be suggestive without establishing a generative mechanism. A relation may precede an outcome because both arise from another condition. A policy relation may alter an immediate administrative result while leaving later capacities unchanged. A network tie can predict diffusion while the relevant generative process operates through an omitted institutional structure. Chapter 7 therefore permits consequence claims only at the strength supported by their inferential bridge and leaves the stronger recon-

struction of generation to Chapter 8.

Definition 7.316 (Generative attribution threshold). The *generative attribution threshold* is the point at which a research claim requires evidence concerning how a specified relation or configuration contributes to later capacities, constraints, structures, trajectories, or reachable possibilities, beyond evidence sufficient to establish the relation or a local consequence alone.

Crossing this threshold changes the methodological problem. The inquiry must specify the object of generation, relevant temporal horizon, candidate pathway or mechanism, conditions under which the contribution is expected, relevant alternatives, and the scale at which the claim is intended to hold. Chapter 7 identifies these as additional burdens without developing their methods.

7.32.3 Handoff Record for Generative Inquiry

A disciplined handoff into Chapter 8 can be represented by a compact record rather than by a preliminary generative methodology. The record should identify the established relational finding, the candidate downstream difference that motivates further inquiry, the evidential gap between the two, the temporal and scale requirements likely to matter, and the principal alternative interpretations that remain open.

Definition 7.317 (Generative-inquiry handoff record). A *generative-inquiry handoff record* contains the relational object carried forward from Chapter 7, its evidential and uncertainty profile, the candidate generated object or downstream difference, the additional attributional questions opened by that candidate, and the unresolved alternatives that Chapter 8 methodology must examine.

The handoff record also preserves the distinction between discovery and warrant. Contingent encounter, aesthetic judgment, AI-assisted search, or cross-domain analogy can make a possible generative pathway salient. Such salience can justify further inquiry without becoming evidence that the pathway operated. The record can therefore include candidate mechanisms or trajectories as research prompts while marking them as unestablished.

Chapter 8 begins from this threshold. It develops the methods needed to formulate generative research questions, reconstruct mechanisms and trajectories, evaluate sequence and counterfactuals, investigate co-generation, delay, propagation, feedback, branching, path dependence, criticality, structural transformation, capacity and constraint generation, option-space change, transformations of generative rules, multi-scale processes, formal and computational representations, intervention, attribution, robustness, and reporting. Chapter 7 closes before those tasks begin. Its contribution is to ensure that generative inquiry receives relational objects whose evidential meaning remains explicit and whose limitations are not erased by the stronger vocabulary of generation.

References

Abbott, Andrew (2001). *Time Matters: On Theory and Method*. Chicago: University of Chicago Press.

- Angrist, Joshua D. and Jörn-Steffen Pischke (2009). *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton, NJ: Princeton University Press. DOI: [10.2307/j.ctvcn4j72](https://doi.org/10.2307/j.ctvcn4j72).
- Anselin, Luc (1988). *Spatial Econometrics: Methods and Models*. Vol. 4. Studies in Operational Regional Science. Dordrecht: Springer. DOI: [10.1007/978-94-015-7799-1](https://doi.org/10.1007/978-94-015-7799-1).
- Aronow, Peter M. and Cyrus Samii (2017). “Estimating Average Causal Effects Under General Interference, with Application to a Social Network Experiment”. In: *The Annals of Applied Statistics* 11.4, pp. 1912–1947. DOI: [10.1214/16-AOAS1005](https://doi.org/10.1214/16-AOAS1005).
- Bar-Yam, Yaneer (2004). “Multiscale Variety in Complex Systems”. In: *Complexity* 9.4, pp. 37–45. DOI: [10.1002/cplx.20014](https://doi.org/10.1002/cplx.20014).
- Battiston, Federico, Giulia Cencetti, Iacopo Iacopini, Vito Latora, Maxime Lucas, Alice Patania, Jean-Gabriel Young, and Giovanni Petri (2020). “Networks beyond Pairwise Interactions: Structure and Dynamics”. In: *Physics Reports* 874, pp. 1–92. DOI: [10.1016/j.physrep.2020.05.004](https://doi.org/10.1016/j.physrep.2020.05.004).
- Beach, Derek and Rasmus Brun Pedersen (2019). *Process-Tracing Methods: Foundations and Guidelines*. 2nd ed. Ann Arbor: University of Michigan Press. DOI: [10.3998/mpub.10072208](https://doi.org/10.3998/mpub.10072208).
- Bertrand, Marianne, Esther Duflo, and Sendhil Mullainathan (2004). “How Much Should We Trust Differences-in-Differences Estimates?” In: *The Quarterly Journal of Economics* 119.1, pp. 249–275. DOI: [10.1162/003355304772839588](https://doi.org/10.1162/003355304772839588).
- Bick, Christian, Elizabeth Gross, Heather A. Harrington, and Michael T. Schaub (2023). “What Are Higher-Order Networks?” In: *SIAM Review* 65.3, pp. 686–731. DOI: [10.1137/21M1414024](https://doi.org/10.1137/21M1414024).
- Bourdieu, Pierre (1977). *Outline of a Theory of Practice*. Trans. by Richard Nice. Cambridge: Cambridge University Press. DOI: [10.1017/CB09780511812507](https://doi.org/10.1017/CB09780511812507).
- Bourdieu, Pierre and Loïc J. D. Wacquant (1992). *An Invitation to Reflexive Sociology*. Chicago: University of Chicago Press.
- Bowker, Geoffrey C. and Susan Leigh Star (1999). *Sorting Things Out: Classification and Its Consequences*. Cambridge, MA: MIT Press. DOI: [10.7551/mitpress/6352.001.0001](https://doi.org/10.7551/mitpress/6352.001.0001).
- Brenner, Neil (2001). “The Limits to Scale? Methodological Reflections on Scalar Structuration”. In: *Progress in Human Geography* 25.4, pp. 591–614. DOI: [10.1191/030913201682688959](https://doi.org/10.1191/030913201682688959).
- Brinkmann, Svend and Steinar Kvale (2015). *InterViews: Learning the Craft of Qualitative Research Interviewing*. 3rd ed. Thousand Oaks, CA: SAGE Publications.
- Butts, Carter T. (2003). “Network Inference, Error, and Informant (In)accuracy: A Bayesian Approach”. In: *Social Networks* 25.2, pp. 103–140. DOI: [10.1016/S0378-8733\(02\)00038-2](https://doi.org/10.1016/S0378-8733(02)00038-2).
- Coalition for Content Provenance and Authenticity (2026). *Content Credentials: C2PA Technical Specification, Version 2.4*. URL: https://spec.c2pa.org/specifications/specifications/2.4/specs/C2PA_Specification.html (visited on 09/18/2026).
- Creswell, John W. and Vicki L. Plano Clark (2018). *Designing and Conducting Mixed Methods Research*. 3rd ed. Los Angeles: SAGE.
- Cronbach, Lee J. and Paul E. Meehl (1955). “Construct Validity in Psychological Tests”. In: *Psychological Bulletin* 52.4, pp. 281–302. DOI: [10.1037/h0040957](https://doi.org/10.1037/h0040957).
- Desrosières, Alain (1998). *The Politics of Large Numbers: A History of Statistical Reasoning*. Trans. by Camille Naish. Cambridge, MA: Harvard University Press.

- DeVellis, Robert F. and Carolyn T. Thorpe (2021). *Scale Development: Theory and Applications*. 5th ed. Thousand Oaks, CA: SAGE Publications.
- DiMaggio, Paul J. and Walter W. Powell (1983). “The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields”. In: *American Sociological Review* 48.2, pp. 147–160. doi: [10.2307/2095101](https://doi.org/10.2307/2095101).
- Emerson, Robert M., Rachel I. Fretz, and Linda L. Shaw (2011). *Writing Ethnographic Fieldnotes*. 2nd ed. Chicago: University of Chicago Press.
- Epstein, Joshua M. and Robert Axtell (1996). *Growing Artificial Societies: Social Science from the Bottom Up*. Cambridge, MA: MIT Press. ISBN: 9780262050531.
- Fairclough, Norman (2003). *Analysing Discourse: Textual Analysis for Social Research*. London: Routledge.
- Fligstein, Neil and Doug McAdam (2012). *A Theory of Fields*. New York: Oxford University Press. doi: [10.1093/acprof:oso/9780199859948.001.0001](https://doi.org/10.1093/acprof:oso/9780199859948.001.0001).
- Fortunato, Santo (2010). “Community Detection in Graphs”. In: *Physics Reports* 486.3–5, pp. 75–174. doi: [10.1016/j.physrep.2009.11.002](https://doi.org/10.1016/j.physrep.2009.11.002).
- Foucault, Michel (1977). *Language, Counter-Memory, Practice: Selected Essays and Interviews*. Ed. by Donald F. Bouchard. Ithaca, NY: Cornell University Press.
- Freeman, Linton C. (1978). “Centrality in Social Networks: Conceptual Clarification”. In: *Social Networks* 1.3, pp. 215–239. doi: [10.1016/0378-8733\(78\)90021-7](https://doi.org/10.1016/0378-8733(78)90021-7).
- Fricker, Miranda (2007). *Epistemic Injustice: Power and the Ethics of Knowing*. Oxford: Oxford University Press. doi: [10.1093/acprof:oso/9780198237907.001.0001](https://doi.org/10.1093/acprof:oso/9780198237907.001.0001).
- Gangl, Markus (2010). “Causal Inference in Sociological Research”. In: *Annual Review of Sociology* 36, pp. 21–47. doi: [10.1146/annurev.soc.012809.102702](https://doi.org/10.1146/annurev.soc.012809.102702).
- Gebru, Timnit, Jamie Morgenstern, Briana Vecchione, Jennifer Wortman Vaughan, Hanna Wallach, Hal Daumé III, and Kate Crawford (2021). “Datasheets for Datasets”. In: *Communications of the ACM* 64.12, pp. 86–92. doi: [10.1145/3458723](https://doi.org/10.1145/3458723).
- Geertz, Clifford (1973). *The Interpretation of Cultures: Selected Essays*. New York: Basic Books.
- Gelman, Andrew and Jennifer Hill (2007). *Data Analysis Using Regression and Multi-level/Hierarchical Models*. Cambridge: Cambridge University Press.
- Gerring, John (2007). *Case Study Research: Principles and Practices*. Cambridge: Cambridge University Press.
- Giere, Ronald N. (2004). “How Models Are Used to Represent Reality”. In: *Philosophy of Science* 71.5, pp. 742–752. doi: [10.1086/425063](https://doi.org/10.1086/425063).
- Granovetter, Mark (1985). “Economic Action and Social Structure: The Problem of Embeddedness”. In: *American Journal of Sociology* 91.3, pp. 481–510. doi: [10.1086/228311](https://doi.org/10.1086/228311).
- Groves, Robert M., Floyd J. Fowler, Mick P. Couper, James M. Lepkowski, Eleanor Singer, and Roger Tourangeau (2009). *Survey Methodology*. 2nd ed. Hoboken, NJ: Wiley.
- Hacking, Ian (2002). *Historical Ontology*. Cambridge, MA: Harvard University Press.
- Hall, Peter A. and Rosemary C. R. Taylor (1996). “Political Science and the Three New Institutionalisms”. In: *Political Studies* 44.5, pp. 936–957. doi: [10.1111/j.1467-9248.1996.tb00343.x](https://doi.org/10.1111/j.1467-9248.1996.tb00343.x).
- Hamilton, James D. (1994). *Time Series Analysis*. Princeton, NJ: Princeton University Press.
- Hammersley, Martyn and Paul Atkinson (2019). *Ethnography: Principles in Practice*. 4th ed. Abingdon, Oxon: Routledge.
- Hansen, Walter G. (1959). “How Accessibility Shapes Land Use”. In: *Journal of the American Institute of Planners* 25.2, pp. 73–76. doi: [10.1080/01944365908978307](https://doi.org/10.1080/01944365908978307).

- Hart, H. L. A. (2012). *The Concept of Law*. Ed. by Joseph Raz, Penelope A. Bulloch, and Leslie Green. 3rd ed. Oxford: Oxford University Press.
- Hoff, Peter D., Adrian E. Raftery, and Mark S. Handcock (2002). "Latent Space Approaches to Social Network Analysis". In: *Journal of the American Statistical Association* 97.460, pp. 1090–1098. DOI: [10.1198/016214502388618906](https://doi.org/10.1198/016214502388618906).
- Hohfeld, Wesley Newcomb (1919). *Fundamental Legal Conceptions as Applied in Judicial Reasoning, and Other Legal Essays*. Ed. by Walter Wheeler Cook. New Haven, CT: Yale University Press.
- Holme, Petter and Jari Saramäki (2012). "Temporal Networks". In: *Physics Reports* 519.3, pp. 97–125. DOI: [10.1016/j.physrep.2012.03.001](https://doi.org/10.1016/j.physrep.2012.03.001).
- Holstein, James A. and Jaber F. Gubrium (1995). *The Active Interview*. Thousand Oaks, CA: SAGE Publications.
- Hudgens, Michael G. and M. Elizabeth Halloran (2008). "Toward Causal Inference with Interference". In: *Journal of the American Statistical Association* 103.482, pp. 832–842. DOI: [10.1198/016214508000000292](https://doi.org/10.1198/016214508000000292).
- Hutchins, Edwin (1995). *Cognition in the Wild*. Cambridge, MA: MIT Press. ISBN: 9780262082310.
- Imbens, Guido W. and Thomas Lemieux (2008). "Regression Discontinuity Designs: A Guide to Practice". In: *Journal of Econometrics* 142.2, pp. 615–635. DOI: [10.1016/j.jeconom.2007.05.001](https://doi.org/10.1016/j.jeconom.2007.05.001).
- Imbens, Guido W. and Donald B. Rubin (2015). *Causal Inference for Statistics, Social, and Biomedical Sciences: An Introduction*. Cambridge: Cambridge University Press. DOI: [10.1017/CB09781139025751](https://doi.org/10.1017/CB09781139025751).
- Jick, Todd D. (1979). "Mixing Qualitative and Quantitative Methods: Triangulation in Action". In: *Administrative Science Quarterly* 24.4, pp. 602–611. DOI: [10.2307/2392366](https://doi.org/10.2307/2392366).
- King, Gary, Robert O. Keohane, and Sidney Verba (1994). *Designing Social Inquiry: Scientific Inference in Qualitative Research*. Princeton, NJ: Princeton University Press.
- Kivelä, Mikko, Alex Arenas, Marc Barthélemy, James P. Gleeson, Yamir Moreno, and Mason A. Porter (2014). "Multilayer Networks". In: *Journal of Complex Networks* 2.3, pp. 203–271. DOI: [10.1093/comnet/cnu016](https://doi.org/10.1093/comnet/cnu016).
- Koselleck, Reinhart (2004). *Futures Past: On the Semantics of Historical Time*. Trans. by Keith Tribe. New York: Columbia University Press.
- Kossinets, Gueorgi (2006). "Effects of Missing Data in Social Networks". In: *Social Networks* 28.3, pp. 247–268. DOI: [10.1016/j.socnet.2005.07.002](https://doi.org/10.1016/j.socnet.2005.07.002).
- Krackhardt, David (1988). "Predicting with Networks: Nonparametric Multiple Regression Analysis of Dyadic Data". In: *Social Networks* 10.4, pp. 359–381. DOI: [10.1016/0378-8733\(88\)90004-4](https://doi.org/10.1016/0378-8733(88)90004-4).
- Lijphart, Arend (1971). "Comparative Politics and the Comparative Method". In: *American Political Science Review* 65.3, pp. 682–693. DOI: [10.2307/1955513](https://doi.org/10.2307/1955513).
- Little, Roderick J. A. and Donald B. Rubin (2019). *Statistical Analysis with Missing Data*. 3rd ed. Wiley. DOI: [10.1002/9781119482260](https://doi.org/10.1002/9781119482260).
- Lohr, Sharon L. (2021). *Sampling: Design and Analysis*. 3rd ed. CRC Press.
- Longino, Helen E. (1990). *Science as Social Knowledge: Values and Objectivity in Scientific Inquiry*. Princeton, NJ: Princeton University Press.
- MacCormick, Neil (2005). *Rhetoric and the Rule of Law: A Theory of Legal Reasoning*. Oxford: Oxford University Press. DOI: [10.1093/acprof:oso/9780199571246.001.0001](https://doi.org/10.1093/acprof:oso/9780199571246.001.0001).

- Mahoney, James and Dietrich Rueschemeyer, eds. (2003). *Comparative Historical Analysis in the Social Sciences*. Cambridge: Cambridge University Press. DOI: [10.1017/CB09780511803963](https://doi.org/10.1017/CB09780511803963).
- Martin, John Levi (2003). "What Is Field Theory?" In: *American Journal of Sociology* 109.1, pp. 1–49. DOI: [10.1086/375201](https://doi.org/10.1086/375201).
- Massey, Doreen B. (1994). *Space, Place and Gender*. Cambridge: Polity.
- Mathison, Sandra (1988). "Why Triangulate?" In: *Educational Researcher* 17.2, pp. 13–17. DOI: [10.3102/0013189X017002013](https://doi.org/10.3102/0013189X017002013).
- McCullagh, P. and John A. Nelder (1989). *Generalized Linear Models*. 2nd ed. Chapman and Hall.
- Meredith, William (1993). "Measurement Invariance, Factor Analysis and Factorial Invariance". In: *Psychometrika* 58.4, pp. 525–543. DOI: [10.1007/BF02294825](https://doi.org/10.1007/BF02294825).
- Messick, Samuel (1995). "Validity of Psychological Assessment: Validation of Inferences from Persons' Responses and Performances as Scientific Inquiry into Score Meaning". In: *American Psychologist* 50.9, pp. 741–749. DOI: [10.1037/0003-066X.50.9.741](https://doi.org/10.1037/0003-066X.50.9.741).
- Moore, Sally Falk (1973). "Law and Social Change: The Semi-Autonomous Social Field as an Appropriate Subject of Study". In: *Law & Society Review* 7.4, pp. 719–746. DOI: [10.2307/3052967](https://doi.org/10.2307/3052967).
- National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research (Apr. 18, 1979). *The Belmont Report: Ethical Principles and Guidelines for the Protection of Human Subjects of Research*. U.S. Department of Health and Human Services. URL: <https://www.hhs.gov/ohrp/regulations-and-policy/belmont-report/read-the-belmont-report/index.html>.
- Nelson, Richard R. and Sidney G. Winter (1982). *An Evolutionary Theory of Economic Change*. Cambridge, MA: Harvard University Press. ISBN: 9780674272279.
- Newman, M. E. J. (2003). "The Structure and Function of Complex Networks". In: *SIAM Review* 45.2, pp. 167–256. DOI: [10.1137/S003614450342480](https://doi.org/10.1137/S003614450342480).
- Nissenbaum, Helen (2010). *Privacy in Context: Technology, Policy, and the Integrity of Social Life*. Stanford, CA: Stanford Law Books. ISBN: 9780804752374.
- North, Douglass C. (1990). *Institutions, Institutional Change and Economic Performance*. Cambridge: Cambridge University Press.
- Nosek, Brian A., George Alter, George C. Banks, et al. (2015). "Promoting an Open Research Culture". In: *Science* 348.6242, pp. 1422–1425. DOI: [10.1126/science.aab2374](https://doi.org/10.1126/science.aab2374).
- Ogburn, Elizabeth L. and Tyler J. VanderWeele (2014). "Causal Diagrams for Interference". In: *Statistical Science* 29.4, pp. 559–578. DOI: [10.1214/14-STS501](https://doi.org/10.1214/14-STS501).
- Open Science Collaboration (2015). "Estimating the Reproducibility of Psychological Science". In: *Science* 349.6251, aac4716. DOI: [10.1126/science.aac4716](https://doi.org/10.1126/science.aac4716).
- Opsahl, Tore, Filip Agneessens, and John Skvoretz (2010). "Node Centrality in Weighted Networks: Generalizing Degree and Shortest Paths". In: *Social Networks* 32.3, pp. 245–251. DOI: [10.1016/j.socnet.2010.03.006](https://doi.org/10.1016/j.socnet.2010.03.006).
- Ostrom, Elinor (1990). *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge: Cambridge University Press. DOI: [10.1017/CB09780511807763](https://doi.org/10.1017/CB09780511807763).
- (2009). "A General Framework for Analyzing Sustainability of Social-Ecological Systems". In: *Science* 325.5939, pp. 419–422. DOI: [10.1126/science.1172133](https://doi.org/10.1126/science.1172133).

- Peirce, Charles Sanders (1960). *Collected Papers of Charles Sanders Peirce, Volumes 3–4*. Ed. by Charles Hartshorne and Paul Weiss. Cambridge, MA: Belknap Press of Harvard University Press.
- Pierson, Paul (2000). “Increasing Returns, Path Dependence, and the Study of Politics”. In: *American Political Science Review* 94.2, pp. 251–267. DOI: [10.2307/2586011](https://doi.org/10.2307/2586011).
- Porter, Theodore M. (1995). *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life*. Princeton, NJ: Princeton University Press.
- Przeworski, Adam and Henry Teune (1970). *The Logic of Comparative Social Inquiry*. New York: Wiley-Interscience.
- Ragin, Charles C. (1987). *The Comparative Method: Moving Beyond Qualitative and Quantitative Strategies*. Berkeley: University of California Press.
- Rosenbaum, Paul R. and Donald B. Rubin (1983). “The Central Role of the Propensity Score in Observational Studies for Causal Effects”. In: *Biometrika* 70.1, pp. 41–55. DOI: [10.1093/biomet/70.1.41](https://doi.org/10.1093/biomet/70.1.41).
- Sack, Robert David (1986). *Human Territoriality: Its Theory and History*. Cambridge: Cambridge University Press.
- Sartori, Giovanni (1970). “Concept Misformation in Comparative Politics”. In: *American Political Science Review* 64.4, pp. 1033–1053. DOI: [10.2307/1958356](https://doi.org/10.2307/1958356).
- Schwartz, Joan M. and Terry Cook (2002). “Archives, Records, and Power: The Making of Modern Memory”. In: *Archival Science* 2.1–2, pp. 1–19. DOI: [10.1007/BF02435628](https://doi.org/10.1007/BF02435628).
- Scott, John (1990). *A Matter of Record: Documentary Sources in Social Research*. Cambridge: Polity Press.
- Searle, John R. (1995). *The Construction of Social Reality*. New York: Simon & Schuster.
- Sewell William H., Jr. (1996). “Historical Events as Transformations of Structures: Inventing Revolution at the Bastille”. In: *Theory and Society* 25.6, pp. 841–881. DOI: [10.1007/BF00159818](https://doi.org/10.1007/BF00159818).
- Shalizi, Cosma Rohilla and Andrew C. Thomas (2011). “Homophily and Contagion Are Generically Confounded in Observational Social Network Studies”. In: *Sociological Methods & Research* 40.2, pp. 211–239. DOI: [10.1177/0049124111404820](https://doi.org/10.1177/0049124111404820).
- Simmel, Georg (1906). “The Sociology of Secrecy and of Secret Societies”. In: *American Journal of Sociology* 11.4, pp. 441–498. DOI: [10.1086/211418](https://doi.org/10.1086/211418).
- (1971). *On Individuality and Social Forms: Selected Writings*. Ed. by Donald N. Levine. Chicago: University of Chicago Press.
- Simon, Herbert A. (1962). “The Architecture of Complexity”. In: *Proceedings of the American Philosophical Society* 106.6, pp. 467–482.
- Snijders, Tom A. B., Gerhard G. van de Bunt, and Christian E. G. Steglich (2010). “Introduction to Stochastic Actor-Based Models for Network Dynamics”. In: *Social Networks* 32.1, pp. 44–60. DOI: [10.1016/j.socnet.2009.02.004](https://doi.org/10.1016/j.socnet.2009.02.004).
- Stoler, Ann Laura (2009). *Along the Archival Grain: Epistemic Anxieties and Colonial Common Sense*. Princeton, NJ: Princeton University Press.
- Tobler, Waldo R. (1970). “A Computer Movie Simulating Urban Growth in the Detroit Region”. In: *Economic Geography* 46.sup1, pp. 234–240. DOI: [10.2307/143141](https://doi.org/10.2307/143141).
- Trouillot, Michel-Rolph (1995). *Silencing the Past: Power and the Production of History*. Boston: Beacon Press.
- Wasserman, Stanley and Katherine Faust (1994). *Social Network Analysis: Methods and Applications*. Cambridge: Cambridge University Press. DOI: [10.1017/CB09780511815478](https://doi.org/10.1017/CB09780511815478).

- Weiss, Robert S. (1994). *Learning from Strangers: The Art and Method of Qualitative Interview Studies*. New York: Free Press.
- Wellman, Barry (1983). “Network Analysis: Some Basic Principles”. In: *Sociological Theory* 1, pp. 155–200. DOI: [10.2307/202050](https://doi.org/10.2307/202050).
- White, Harrison C. (2008). *Identity and Control: How Social Formations Emerge*. 2nd ed. Princeton, NJ: Princeton University Press.
- White, Harrison C., Scott A. Boorman, and Ronald L. Breiger (1976). “Social Structure from Multiple Networks. I. Blockmodels of Roles and Positions”. In: *American Journal of Sociology* 81.4, pp. 730–780. DOI: [10.1086/226141](https://doi.org/10.1086/226141).
- Wilkinson, Mark D., Michel Dumontier, IJsbrand Jan Aalbersberg, et al. (2016). “The FAIR Guiding Principles for Scientific Data Management and Stewardship”. In: *Scientific Data* 3, p. 160018. DOI: [10.1038/sdata.2016.18](https://doi.org/10.1038/sdata.2016.18).
- Woodward, James (2003). *Making Things Happen: A Theory of Causal Explanation*. New York: Oxford University Press. ISBN: 9780195155273. DOI: [10.1093/0195155270.001.0001](https://doi.org/10.1093/0195155270.001.0001).
- Wooldridge, Jeffrey M. (2010). *Econometric Analysis of Cross Section and Panel Data*. 2nd ed. Cambridge, MA: MIT Press.
- World Bank (2021). *World Development Report 2021: Data for Better Lives*. Washington, DC: World Bank. ISBN: 9781464816000. DOI: [10.1596/978-1-4648-1600-0](https://doi.org/10.1596/978-1-4648-1600-0).